PROCEEDINGS

NINETY-SEVENTH ANNUAL MEETING

of the

UNITED STATES ANIMAL HEALTH ASSOCIATION

THE SAHARA HOTEL
LAS VEGAS, NEVADA

October 23–29, 1993
PROCEEDINGS

NINETY-SEVENTH ANNUAL MEETING

of the

UNITED STATES ANIMAL HEALTH ASSOCIATION

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THE SAHARA HOTEL
LAS VEGAS, NEVADA

October 23–29, 1993
This book is dedicated in memory to the members of USAHA who passed away in 1993

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Mr. Steve Wolcott, Paonia, CO
Dr. Peregrine Wolff, Apple Valley, MN
<table>
<thead>
<tr>
<th>Date</th>
<th>Place of Meeting</th>
<th>President</th>
<th>Secretary</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sept 27–28, 1897†</td>
<td>Fort Worth, TX</td>
<td>*Mr. C. P. Johnston, Springfield, IL</td>
<td>*Mr. D. O. Lively, Fort Worth, TX</td>
</tr>
<tr>
<td>2. Oct. 11–12, 1898</td>
<td>Omaha, NE</td>
<td>*Mr. C. P. Johnston, Springfield, IL</td>
<td>*Mr. Taylor Riddle, KS</td>
</tr>
<tr>
<td>3. Oct. 11–12, 1899†</td>
<td>Chicago, IL</td>
<td>*Mr. C. P. Johnston, Springfield, IL</td>
<td>*Mr. Mortimer Levering, Lafayette, IN</td>
</tr>
<tr>
<td>4. Oct. 2–3, 1900</td>
<td>Louisville, KY</td>
<td>*Mr. C. P. Johnson, Springfield, IL</td>
<td>*Dr. E. T. Eisenman, Louisville, KY</td>
</tr>
<tr>
<td>5. Oct. 8–9, 1901</td>
<td>Buffalo, NY</td>
<td>*Dr. E. P. Niles, VA</td>
<td>*Dr. E. T. Eisenman, Louisville, KY</td>
</tr>
<tr>
<td>6. Sept. 23–24, 1902</td>
<td>Wichita, KS</td>
<td>*Mr. W. H. Dunn, TN</td>
<td>*Mr. Wm. P. Smith, Monticello, IL</td>
</tr>
<tr>
<td>7. Sept. 22–23, 1903</td>
<td>Denver, CO</td>
<td>*Mr. W. E. Bolton, Woodward, OK</td>
<td>*Mr. Wm. P. Smith, Monticello, IL</td>
</tr>
<tr>
<td>8. Aug. 23–24, 1904</td>
<td>St. Louis, MO</td>
<td>*Dr. J. C. Norton, AZ</td>
<td>*Mr. Wm. P. Smith, Monticello, IL</td>
</tr>
<tr>
<td>9. Aug. 15–16, 1905</td>
<td>Guthrie, OK</td>
<td>*Mr. Wm. P. Smith, Monticello, IL</td>
<td>*Dr. S. H. Ward, St. Paul, MN</td>
</tr>
<tr>
<td>10. Aug. 15–16, 1906</td>
<td>Springfield, IL</td>
<td>*Mr. M. M. Hankins, Quanah, TX</td>
<td>*Dr. S. H. Ward, St. Paul, MN</td>
</tr>
<tr>
<td>11. Sept. 16–17, 1907</td>
<td>Richmond, VA</td>
<td>*Dr. F. L. Luckey, Columbia, MD</td>
<td>*Dr. S. H. Ward, St. Paul, MN</td>
</tr>
<tr>
<td>14. Dec. 5–7, 1910</td>
<td>Chicago, IL</td>
<td>*Dr. C. E. Cotton, St. Paul, MN</td>
<td>*Dr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>15. Dec. 5–6, 1911</td>
<td>Chicago, IL</td>
<td>*Dr. John F. Devine, Goshen, NY</td>
<td>*Mr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>16. Dec. 3–5, 1912</td>
<td>Chicago, IL</td>
<td>*Dr. Macyck P. Ravener, Madison, IL</td>
<td>*Mr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>17. Dec. 2–4, 1913</td>
<td>Chicago, IL</td>
<td>*Dr. Peter F. Bahnson, Atlanta, GA</td>
<td>*Mr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>18. Feb. 16–18, 1914</td>
<td>Chicago, IL</td>
<td>*Dr. S. H. Ward, St. Paul, MN</td>
<td>*Mr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>19. Dec. 2–3, 1915</td>
<td>Chicago, IL</td>
<td>*Dr. J. 1. Gibson, Des Moines, IA</td>
<td>*Mr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>20. Dec. 5–7, 1916</td>
<td>Chicago, IL</td>
<td>*Dr. O. E. Dyson, Springfield, IL</td>
<td>*Mr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>21. Dec. 3–5, 1917</td>
<td>Chicago, IL</td>
<td>*Dr. J. G. Willis, Albany, NY</td>
<td>*Mr. J. J. Ferguson, Chicago, IL</td>
</tr>
<tr>
<td>22. Dec. 2–4, 1918</td>
<td>Chicago, IL</td>
<td>*Dr. M. Jacob, Knoxville, TN</td>
<td>*Dr. S. H. Ward, St. Paul, MN</td>
</tr>
<tr>
<td>23. Dec. 1–3, 1919</td>
<td>Chicago, IL</td>
<td>*Dr. G. W. Dumphry, Lansang, MI</td>
<td>*Dr. S. H. Ward, St. Paul, MN</td>
</tr>
<tr>
<td>24. Nov. 29–Dec. 1, 1920</td>
<td>Chicago, IL</td>
<td>*Dr. S. F. Musselman, Frankfort, KY</td>
<td>*Dr. D. M. Campbell, Chicago, IL</td>
</tr>
<tr>
<td>25. Nov. 28–30, 1921</td>
<td>Chicago, IL</td>
<td>*Dr. W. F. Crewe, Bismarck, ND</td>
<td>*Dr. D. M. Campbell, Chicago, IL</td>
</tr>
<tr>
<td>26. Dec. 6–8, 1922</td>
<td>Chicago, IL</td>
<td>*Dr. T. E. M Munce, Harrisburg, PA</td>
<td>*Dr. Theo. Burnett, Columbus, OH</td>
</tr>
<tr>
<td>27. Dec. 5–7, 1923</td>
<td>Chicago, IL</td>
<td>*Dr. W. J. Butler, Helena, MT</td>
<td>*Dr. Theo. Burnett, Columbus, OH</td>
</tr>
<tr>
<td>28. Dec. 3–5, 1924</td>
<td>Chicago, IL</td>
<td>*Dr. J. G. Femeoughy, Richmond, VA</td>
<td>*Dr. O. E. Dyson, Kansas City, MO</td>
</tr>
<tr>
<td>29. Dec. 2–4, 1925</td>
<td>Chicago, IL</td>
<td>*Dr. J. H. McNeill, Trenton, NJ</td>
<td>*Dr. O. E. Dyson, Kansas City, MO</td>
</tr>
<tr>
<td>30. Dec. 1–3, 1926</td>
<td>Chicago, IL</td>
<td>*Dr. John R. Mohler, Washington, DC</td>
<td>*Dr. O. E. Dyson, Kansas City, MO</td>
</tr>
<tr>
<td>31. Nov. 30–Dec. 2, 1927</td>
<td>Chicago, IL</td>
<td>*Dr. L. Van Es, Lincoln, NE</td>
<td>*Dr. O. E. Dyson, Kansas City, MO</td>
</tr>
<tr>
<td>32. Dec. 5–7, 1928</td>
<td>Chicago, IL</td>
<td>*Dr. C. A. Cary, Auburn, AL</td>
<td>*Dr. O. E. Dyson, Kansas City, MO</td>
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<tr>
<td>33. Dec. 4–6, 1929</td>
<td>Chicago, IL</td>
<td>*Dr. Chas. O. Lamb, Denver, CO</td>
<td>*Dr. O. E. Dyson, Kansas City, MO</td>
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<tr>
<td>Date</td>
<td>Place of Meeting</td>
<td>President</td>
<td>Secretary</td>
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<tr>
<td>34. Dec. 3-5, 1930</td>
<td>Chicago, IL</td>
<td>*Dr. A. E. Wight, Washington, DC</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>35. Dec. 2-4, 1931</td>
<td>Chicago, IL</td>
<td>*Dr. J. W. Connaway, Columbia, MD</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>36. Nov. 30-Dec. 2, 1932</td>
<td>Chicago, IL</td>
<td>*Dr. Peter Malcolm, Des Moines, IA</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>37. Dec. 6-8, 1933</td>
<td>Chicago, IL</td>
<td>*E. T. Faulder, Albany, NY</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>38. Dec. 5-7, 1934</td>
<td>Chicago, IL</td>
<td>*Dr. T. E. Robinson, Providence, RI</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>39. Dec. 4-6, 1935</td>
<td>Chicago, IL</td>
<td>*Dr. Edward Records, Reno, NV</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>40. Dec. 2-4, 1936</td>
<td>Chicago, IL</td>
<td>*Dr. Walter Wisnicky, Madison, WI</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>41. Dec. 1-3, 1937</td>
<td>Chicago, IL</td>
<td>*Dr. R. W. Smith, Concord, NH</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>42. Nov. 30-Dec. 2, 1938</td>
<td>Chicago, IL</td>
<td>*Dr. E. Westmoreland, Frankfort, KY</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>43. Dec. 6-8, 1939</td>
<td>Chicago, IL</td>
<td>*Dr. J. L. Axby, Indianapolis, IN</td>
<td>*Dr. O. E. Dyson, Wichita, KS</td>
</tr>
<tr>
<td>44. Dec. 4-6, 1940</td>
<td>Chicago, IL</td>
<td>*Dr. H. D. Port, Cheyenne, WY</td>
<td>Dr. Mark Welsh, College Park, MD</td>
</tr>
<tr>
<td>45. Dec. 3-5, 1941</td>
<td>Chicago, IL</td>
<td>*Dr. E. A. Crossman, Boston, MA</td>
<td>Dr. Mark Welsh, College Park, MD</td>
</tr>
<tr>
<td>46. Dec. 2-4, 1942</td>
<td>Chicago, IL</td>
<td>*Dr. I. S. McAdory, Auburn, AL</td>
<td>Dr. Mark Welsh, College Park, MD</td>
</tr>
<tr>
<td>47. Dec. 1-3, 1943</td>
<td>Chicago, IL</td>
<td>Dr. W. H. Hendricks, Salt Lake City, UT</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>48. Dec. 6-8, 1944</td>
<td>Chicago, IL</td>
<td>Dr. J. M. Sutton, Atlanta, GA</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>49. Dec. 5-7, 1945</td>
<td>Chicago, IL</td>
<td>Dr. C. U. Duckworth, Sacramento, CA</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>50. Dec. 4-6, 1946</td>
<td>Chicago, IL</td>
<td>*Dr. William Moore, Raleigh, NC</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>51. Dec. 3-5, 1947</td>
<td>Chicago, IL</td>
<td>*Dr. Will J. Miller, Topeka, KS</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>53. Oct. 12-14, 1949</td>
<td>Columbus, OH</td>
<td>*Dr. T. O. Brandenburg, Bismarck, ND</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>54. Nov. 1-3, 1950</td>
<td>Phoenix, AZ</td>
<td>*Dr. C. P. Bishop, Harrisburg, PA</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>55. Nov. 14-16, 1951</td>
<td>Kansas City, KS</td>
<td>*Mr. F. E. Mollin, Denver, CO</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>57. Sept. 23-25, 1953</td>
<td>Atlantic City, NJ</td>
<td>*Dr. T. Childs, Ottawa, Canada</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>58. Nov. 10-12, 1954</td>
<td>Omaha, NE</td>
<td>*Dr. T. C. Green, Charleston, WV</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>59. Nov. 18-19, 1955</td>
<td>New Orleans, LA</td>
<td>Dr. H. E. Wilkins, Helena, MT</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>60. Nov. 28-30, 1956</td>
<td>Chicago, IL</td>
<td>Dr. A. L. Brueckner, Baltimore, MD</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>61. Nov. 13-15, 1957</td>
<td>St. Louis, MO</td>
<td>Dr. G. H. Good, Cheyenne, WY</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>62. Nov. 4-6, 1958</td>
<td>Miami Beach, FL</td>
<td>Dr. John G. Milligan, Montgomery, AL</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>63. Nov. 15-18, 1959</td>
<td>San Francisco, CA</td>
<td>Mr. F. G. Buzzell, Augusta, ME</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>64. Oct. 17-21, 1960</td>
<td>Charleston, WV</td>
<td>*Dr. J. R. Hay, Chicago, IL</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>65. Oct. 3-Nov. 3, 1961</td>
<td>Minneapolis, MN</td>
<td>Dr. A. P. Schneider, Belsey, ID</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
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<tr>
<td>Date</td>
<td>Place of Meeting</td>
<td>President</td>
<td>Secretary</td>
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<tr>
<td>67. Oct. 15–18, 1963</td>
<td>Albuquerque, NM</td>
<td>*Dr. T. J. Grennan, Jr., Providence, RI</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>70. Oct. 10–14, 1966</td>
<td>Buffalo, NY</td>
<td>Dr. C. L. Campbell, Tallahassee, FL</td>
<td>*Dr. R. A. Hendershott, Trenton, NJ</td>
</tr>
<tr>
<td>72. Oct. 6–11, 1968</td>
<td>New Orleans, LA</td>
<td>Dr. John F. Quinn, Lansin, MI</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>73. Oct. 12–19, 1969</td>
<td>Milwaukee, WI</td>
<td>*Dr. John L O'Hara, Reno, NV</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>75. Oct. 24–29, 1971</td>
<td>Oklahoma City, OK</td>
<td>*Dr. M. D. Mitchell, Pierre, SD</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>76. Nov. 5–10, 1972</td>
<td>Miami Beach, FL</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>77. Nov. 14–19, 1973</td>
<td>St. Louis, MO</td>
<td>*Dr. W. C. Tobin, Denver, CO</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>78. Nov. 13–18, 1974</td>
<td>Roanoke, VA</td>
<td>Mr. 0. H. Timm, Dixon, GA</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>79. Nov. 2–7, 1975</td>
<td>Portland, OR</td>
<td>*Dr. J. E. Andrews, GA</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>80. Nov. 7–12, 1976</td>
<td>Miami Beach, FL</td>
<td>*Dr. H. E. Goldstein, Columbus, OH</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>81. Oct. 16–21, 1977</td>
<td>Minneapolis, MN</td>
<td>*Dr. A. E. Janawicz, Montpelier, VT</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td><strong>82. Oct. 21–Nov. 3, 1978</strong></td>
<td>Buffalo, NY</td>
<td>Dr. L. E. Bartell, Sacramento, CA</td>
<td>*Dr. W. L. Bendix, Richmond, VA</td>
</tr>
<tr>
<td>83. Oct. 28–Nov. 2, 1979</td>
<td>San Diego, CA</td>
<td>Dr. T. F. Zwergart, Raleigh, NC</td>
<td>Dr. J. C. Shook, Hyattsville, MD</td>
</tr>
<tr>
<td>84. Nov. 2–7,1980</td>
<td>Louisville, KY</td>
<td>*Mr. B. W. Hawkins, Ontario, OR</td>
<td>Dr. J. C. Shook, Hyattsville, MD</td>
</tr>
<tr>
<td>85. Oct. 11–16, 1981</td>
<td>St. Louis, MO</td>
<td>*Dr. L. W. Hinchman, Indianopolis, IN</td>
<td>Dr. J. C. Shook, Hyattsville, MD</td>
</tr>
<tr>
<td>86. Nov. 7–12, 1982</td>
<td>Nashville, TN</td>
<td>Dr. G. B. Rea, Salem, OR</td>
<td>Dr. J. C. Shook, Hyattsville, MD</td>
</tr>
<tr>
<td>87. Oct. 16–21, 1983</td>
<td>Las Vegas, NV</td>
<td>Dr. J. R. Ragan, Nashville, TN</td>
<td>Dr. J. C. Shook, Annapolis, MD</td>
</tr>
<tr>
<td>88. Oct. 21–26, 1984</td>
<td>Ft. Worth, TX</td>
<td>Mr. J. O. Pearce, Jr., Okeechobee, FL</td>
<td>Dr. J. C. Shook, Annapolis, MD</td>
</tr>
<tr>
<td>89. Oct. 27–Nov 1, 1985</td>
<td>Milwaukee, WI</td>
<td>*Dr. David U. Walker, Montpelier, VT</td>
<td>Dr. J. C. Shook, Annapolis, MD</td>
</tr>
<tr>
<td>90. Oct. 19–24, 1986</td>
<td>Louisville, KY</td>
<td>Dr. N. W. Kruse, Lincoln, NE</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
<tr>
<td>91. Oct. 25–30, 1987</td>
<td>Salt Lake City, UT</td>
<td>Dr. J. F. Hudelson, Denver, CO</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
<tr>
<td>92. Oct. 16–21, 1988</td>
<td>Little Rock, AR</td>
<td>Dr. J. A. Cobb, Atlanta, GA</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
<tr>
<td>93. Oct. 28–Nov. 3, 1989</td>
<td>Las Vegas, NV</td>
<td>Mr. P. E. Bradshaw, Griggsville, IL</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
<tr>
<td>94. Oct. 6–12, 1990</td>
<td>Denver, CO</td>
<td>Dr. M. A. Van Buskirk, Harrisburg, PA</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
<tr>
<td>95. Oct. 26–Nov. 1 1991</td>
<td>San Diego, CA</td>
<td>Dr. P. L. Smith, Sacramento, CA</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
<tr>
<td>96. Oct. 31–Nov. 6 1992</td>
<td>Louisville, KY</td>
<td>Dr. J. Lee Alley, Montgomery, AL</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
<tr>
<td>97. Oct. 23–29, 1993</td>
<td>Las Vegas, NV</td>
<td>Dr. T. J. Hagerty, St. Paul, MN</td>
<td>Dr. J. C. Shook, Mechanicsburg, PA</td>
</tr>
</tbody>
</table>

+This was the last meeting of the Interstate Association of Livestock Sanitary Boards
INVOCATION

Max A. Van Buskirk, Jr., V.M.D.
Harrisburg, PA

O God of the Universe, we pray that You will preside over this 97th Annual meeting of the United States Animal Health Association and this 36th Annual Conference of the American Association of Veterinary Laboratory Diagnosticians;

We pray for understanding of Your plan for life on this earth and strength and courage to carry out Your will;

We pray for guidance and wisdom as we seek to protect and preserve animal life in Your Kingdom;

We thank you, God, for the opportunity to serve mankind here in these United States and throughout the world;

We pray that You remember and care for those USAHA and AAVLD members who have departed life on earth this past year:

Mrs. Dorothy Loan – wife of Dr. Raymond Loan, Chairman of the Biologics Committee, College Station, TX – June 28, 1993.

Almighty and everlasting God, we pray for these dear friends and for all who seek to serve in Your name.

Amen
RESPONSE TO WELCOME ADDRESS

H. Michael Chaddock, D.V.M.
Lansing, Michigan

Thank you, Senator Sue Lowden. On behalf of the members and guests of the American Association of Veterinary Laboratory Diagnosticians (AAVLD) and the United States Animal Health Association (USAHA), I thank you for your warm welcome to the State of Nevada and this exciting desert city, Las Vegas.

This city has become a mecca for many and a part of the itinerary of any well-traveled American. When you reach middle-age and haven't yet gambled at the Sahara Hotel or enjoyed a show at the Sahara Hotel, people are puzzled. Well, I assure you this is not my first time and probably won't be my last!

Next year, the annual meeting for USAHA will be held in Michigan and so on behalf of my fellow citizens, I invite you to visit the beautiful Great Lakes State. I encourage you to then stay a little longer to take in some of Michigan's breathtaking sights, meet its friendly people, and taste some of the best fresh produce grown in the nation.

I suspect many of you think of cars when you think of Michigan, or you may be reminded of the difficulties faced by our biggest city, Detroit. But when I think of Michigan, I see a state of energy and serenity, deep clear lakes, thimbleberry jam and tart cherry pies, children of Dutch descent learning to walk in wooden shoes for the annual parade, and minority students sitting in a Detroit classroom studying Japanese.

If there is any word that best describes Michigan, it is diversity ... in our people, our land, and in the food we grow and eat.

We have one of the largest Arab populations outside of the Middle East, a strong Polish representation in the city of Hamtramck where you can still line up on Fat Tuesday to buy the calorie-laden doughnut Paczki (punch key) of the old country, and a growing Hispanic population in Saginaw near some of the most fertile farmland in the nation.

With the largest freshwater sand dunes in the world and hundreds of miles of white sandy beaches, Michigan is now the eighth most popular travel destination in the United States. In the Upper Peninsula, you can enjoy a hike through the beautiful Porcupine Mountains, or row a boat along the shore of the largest freshwater lake in the world, Lake Superior. Or, if you want a quiet, gentle ride on a Sunday afternoon travel, to a country orchard and taste the tart sweetness of freshly pressed cider.

Michigan is second only to California in diversity of crops, bringing a sense of pride to farmers, school students, elected officials, and consumers who flock to farm markets every summer to buy a bounty of fresh produce. Our beans are served every day in the bean soup that appears on the menu in the U.S. Senate dining room. Black beans are exported to Mexico, blueberries to Belgium and Hong Kong, and the Japanese come visit us.
RESPONSE TO WELCOME ADDRESS

each fall to buy salmon eggs for the Japanese New Year celebration.

We also have a growing and critically acclaimed wine industry. Our climate is similar to that found in the grape-growing region of Germany, so many of our white wines have the delicate flavor of Rhine wines. Both the white and red wines have taken honors in international competition.

Grand Rapids will be the host city for the meeting next year and it's a perfect spot. Be assured that I, my staff, and the Michigan Department of Agriculture will do our best to make your stay enjoyable.
I would like to extend Eugene Branstool's sincere apologies; he had hoped to be here tonight. He and I both recognize USAHA's invaluable role in charting the course of U.S. agriculture during a time of great change. There's been a lot of talk over the past year or so about change. Some people say, "We need more change." Others say, "We need different change." And still others say, "On second thought, maybe change isn't such a hot idea." I guess I see change as a fact of life. It's like aging or junk mail, whether you want it or not, there it is. We simply do not live in the same world we grew up in. Many of us in this room remember life before personal computers, before Germany and Japan were our allies, before genetic engineering of corn and cows was even a gleam in a biologist's eye.

All the changes in our lives challenge us in some way. This is nothing new. Addressing Congress in the midst of the Civil War, Abraham Lincoln said, "The ways of the quieter past are inadequate in the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew and act anew." We have all seen how unsteady winds of change have swayed agriculture over the years. But luckily, the climate we face is not nearly as menacing as it was in Lincoln's day. Still, there are some clouds on the horizon that we need to keep an eye on.

We will be grappling with global markets on a whole new scale. We face the new consumer—more concerned about food safety and the environment. As the currents have shifted over time, we've even started speaking a different language. In agricultural circles we rarely used to hear terms like disease regionalization, Hazard Analysis Critical Control Point, environmental impact statement, and farm animal welfare. Now these terms are like weather vanes pointing in the direction of our future. In responding to these new trends, we cannot look so far ahead that we neglect the progress we're making today. Anyone looking too long at clouds in a cow pasture learns this lesson the hard way.

So before I talk about the challenge and promise of tomorrow, let's look at the progress we've made today. Our brucellosis program is older than most of us here, but in its younger days, livestock farmers faced some hard knocks. On many farms, cows lost calves and sows lost piglets while farmers lost herds and families lost hope. As late as 1957, brucellosis infected over 140,000 herds and perhaps over 100,000 people. We've come a long way since those darker days. Now 32 States are brucellosis-free and only about 300 herds are infected nationwide. Only a handful of Americans
days. Now 32 States are brucellosis–free and only about 300 herds are infected nationwide. Only a handful of Americans get infected with brucellosis annually, and most catch it overseas.

Through the USAHA's strong partnership, we've dispersed quite a few other clouds as well. In recent years, we've reduced the number of herds with tuberculosis to an average of about 12 a year, and we are taking on the TB program's thorniest problems, such as the El Paso Milkshed, imported Mexican steer, and unregulated herds of deer and elk. Although a relatively new effort, the pseudorabies eradication by the year 2000. We have also tackled the controversial Salmonella enteritidis problem, and we are currently revising our regulations with help from the industry. The SE program is a good example of how we can make significant progress in combatting a difficult disease situation when each partner does its best to understand the others' point of view. By looking at SE from a food safety perspective, USDA is helping both the industry and consumers as well.

And let's not forget the programs we've completed like hog cholera eradication in 1978. The program met its goals on time and under budget, making the United States one of only 16 countries around the world that's recognized as free of hog cholera.

We can pat ourselves on the back for building the best animal health system in the world and then roll up our sleeves because there's still much more to do. We must maintain our commitment to seeing through our current programs as we prepare to weather new challenges. And there are so many new challenges. The U.S. agricultural economy used to be virtually independent—but no more. Now more than ever, we are part of a larger international economy. But we are just beginning to realize potential markets even in places right next door like Mexico and Canada. In the past 4 years, we have tripled our red–meat exports and quadrupled our poultry exports there. We more than doubled dairy exports in 1 year alone. And all projections indicate a steady increase in demand for these products. There is an old Mexican proverb that says, "He who doesn't look ahead, stays behind." Let's keep looking ahead and keep moving forward in Mexico and around the world.

One way of increasing trade is through agreements like NAFTA and GATT. These agreements establish standards for trade restrictions, eliminating those that do not protect agricultural health or cannot be scientifically justified. Countries that sign on to NAFTA or GATT also commit to disease regionalization. Under regionalization, trading partners would recognize disease status by zones rather than national boundaries. Right now, if there is a disease outbreak anywhere in the United States, trade is often cut off for an entire industry from coast to coast.

There's no good reason why we can't export from areas outside of isolated disease outbreaks. We have the best animal health and disease quarantine system in the world. We just need to get the rest of the world to
XI

A CHANGING ENVIRONMENT

standards for regionalization that are based on hard science. That means using the latest methods of scientific risk assessment to determine acceptable levels of risk and identify reliable methods of reducing risk. With these standards in place, countries won't have to negotiate "catch-as-catch-can" entry requirements with their trading partners at the onset of each new disease outbreak. Universal standards would set a new watermark for animal health and fair trade policy around the world.

Efforts to establish international standards are already starting to pay off. Last summer, we met with Russian officials to open the Russian market to U.S. livestock. Massive price hikes and production problems in Russia make it a huge, untapped market for U.S. producers. Russian officials reviewed our risk assessment data and toured facilities like the Centers for Disease Control and our National Veterinary Services Laboratories. As a result, we allayed the Russian's animal health concerns and expanded the Russian market for U.S. cattle, swine, and pork.

Comparing the impacts of some recent outbreaks can show us how valuable regionalization can be. We estimate that the avian influenza outbreak in the 1980's cost the broiler industry $740 million in lost trade. The avian influenza outbreak in the Northeast this past year cost the industry over $1 million a month. We contained these outbreaks, but we did not have the international standards in place to recognize disease on a regional basis. As a result, many of our trading partners treated all U.S. producers as if they were infected. By contrast, the U.S. horse trade with the European Community and Canada is a $200 million industry that was hardly affected at all when a mysterious disease killed several race horses in New England last year. The difference was that the European Community and Canada reviewed our program to contain the disease and recognized it as biologically sound. In this way, horse shipments from outside the affected area continued in full force.

While trade under regionalization can increase U.S. exports, we also have to realize that it is a two-way street. Other countries need access to our markets as well. Under regionalization agreements, we should open our markets with confidence--confident in our ability to compete on a level playing field, and confident in our ability to protect the health of our agriculture. While more science-based import requirements will provide excellent protection, we at the USDA will not stop there. We will continue to improve our inspection efforts to prevent disease incursions, and we will continue to improve our containment and elimination of outbreaks when they occur.

On the domestic front, I'm sure you all are aware of the E. coli outbreak in the Northwest. We almost never hear about food poisoning deaths in this day and age. But we have just had tragic evidence that it can still happen. In fact, it happens to over 6,000 people every year. Less tragic but still upsetting is the Food and Drug Administration's estimate that 24 to
81 million cases of foodborne disease occur in the United States annually. That's at least 1 out of every 11 people. That means three or four dozen of us here tonight are likely to get sick from our food sometime within the next year. The researchers at some of our Nation's best agricultural colleges estimate that the cost related to medical treatment, lost productivity, and death from foodborne disease could total as much as $23 billion a year. That's $115 for every man, woman, and child in the United States. We need to do everything possible to bring down these numbers, and we've made a good start in the last few months in our Food Safety and Inspection Service and our Animal and Plant Health Inspection Service.

I've mentioned just some of the changes coming over the horizon, and now I'd like to close with an observation about our attitudes toward change. To the fearful, change is threatening because it means that things may get worse. To the hopeful, it is encouraging because things may get better. To the confident, it is inspiring because it provides a challenge to make things better. We have no reason to lack confidence in our abilities to rise to our challenges and make a secure future for U.S. agriculture. Helmut Schmidt, former Chancellor of West Germany, said, "Whoever wants to reach a distant goal must take many small steps." It could be a long way to prosperity in this new age of agriculture. And there could be some rough weather ahead. But I've got my galoshes on, and you're all welcome to share my umbrella. Let's get there together.
REMARKS OF THE PRESIDENT

THOMAS J. HAGERTY
ST. PAUL, MINNESOTA

Let me extend to each and everyone a warm welcome to the 97th annual meeting of the United States Animal Health Association and the 36th annual meeting of the American Association of Laboratory Diagnosticians. Ella Blanton, Linda Ragland, Beverley Bahen, John Shook, and the officers and the committee chairs and myself are proud of the program that has been prepared for this annual meeting and are anxious to get the meeting underway.

I want you to know how impressed I am by the effort and commitment of all the people involved to see that the activities of the organization are carried out. This is a very important association and is very effective in fulfilling its mandates.

We have a number of ongoing projects such as our involvement in the tuberculosis program, the tuberculosis working group, the continuation of the brucellosis and pseudorabies programs, the strategic plan for the organization, and the feed safety project, to name only a few.

One of the first concerns the officers had to work on this year was to upgrade our computer systems. The organization has had marked growth in members and activities over the past several years and our existing equipment and programs had become inadequate. We now have in place new equipment and software which is excellent in its capability to serve our needs now and in the foreseeable future.

The Governmental Relations Committee met on March 1-3, 1993 in Washington, DC with representatives of USDA, APHIS, VS, CSRS, FSIS, and ARS as well as FDA and representatives of the livestock industry. This was a very productive meeting and is an example of the ability that the association has to interact with many people and organizations who influence the way we fulfill our missions.

The committee has an opportunity while in Washington to participate in a livestock industry meeting on "Regionalization" sponsored by USDA and attended by representatives of industry organizations, the European Economic Community, four additional countries, veterinary colleges and Federal agencies.

I want to thank Drs. Lonnie King, Billy Johnson, and Don Luchsinger and their staffs for providing us with this opportunity. We also appreciate their work in arranging the governmental affairs meeting.

We have had conversations with the officers of the AAVLD exploring the possibility of a closer working relationship on office activities. With our excellent office facilities in Richmond and our capable staff and new computers there may be a way to incorporate some of the functions of both offices into one working arrangement.

We will continue to work on the strategic plan developed under Dr.
REMARKS OF THE PRESIDENT

Alley's leadership. This is very important as we look to the future of the organization.

I want to thank Lee Alley for his advice and willingness to take any assignment I gave him. He has participated in a number of activities in which our involvement was very important.

I cannot thank Ella Blanton, John Shook, Linda Ragland and Beverley Bahen enough for their excellent work on behalf of the organization and their help to me. They made my year as your President a very enjoyable one. Serving as President has been exciting, gratifying, and enlightening for me. I appreciate very much the opportunity that this has been for me.

I want to thank my wife, Shirley, for her understanding, help and moral support through this busy year.

I want to thank my secretary, Marian Comford, for all the work she has done for me. Her's was a big job and an important one as well.

I offer the best of luck to Joe Finley your incoming President. I know that Joe will be able to step right in with a smooth and orderly transition.

As you know, our Executive Director Ella Blanton will retire on December 31, 1993. Ella has served the organization since 1967. She has seen it grow over the years to 1300 members with 35 committees. Ella, you have served us well. You've been a faithful and dedicated Executive Director and I cannot tell you how much I, and all of us appreciate all you have done for the USAHA. Good luck and best wishes to you and your husband Bob, and all your family who are here with you tonight. Let me present you with this gift as a token of our appreciation. It is the logo of the USAHA encompassing a diamond that we had made as a charm for your bracelet. And, Ella, we are going to have a party for you right here right now. Here comes the cake.

Thank all of you for attending. Please stay and visit with Ella.

Dr. Hagerty presenting to Ella the USAHA Logo charm.
Mr. J. B. Finley, President-Elect, USAHA, presents a plaque to outgoing President, Dr. T. J. Hagerty for his contributions and outstanding leadership in 1993.
REMARKS OF THE PRESIDENT OF AAVLD

Dr. J. J. England
Baton Rouge, Louisiana

It has been both a pleasure and an honor to serve the AAVLD as President for 1993. We have had an extremely productive year: The Accreditation Committee had one of its busiest years with 10 site visits and, as a consequence, our accredited laboratory role now includes 32 laboratories; membership is 4 short of 800; the Journal of Veterinary Diagnostic Investigation has more manuscripts than ever being submitted for review and has been recognized internationally as a quality scientific publication; and quality control/quality assurance became the buzzword of the 1993 annual meeting.

The AAVLD Executive Board is working with the Executive board of the USAHA to define the future direction of the office functions of the Associations at this time of USAHA office personnel change. I also extend by thank you and good luck to Ella on her forthcoming retirement. I remain committed to the Mission of the AAVLD and to the continued alliance of the AAVLD and the USAHA.
NATIONAL ASSEMBLY AWARD

Dr. Daryl Thorpe, President of the National Assembly of Chief Livestock Officials, presented the fifth National Assembly Award to Dr. Calvin W. S. Lum.

Dr. Lum's current position is Administrator, Division of Animal Industry, State Veterinarian and Chief Livestock Health Official for the State of Hawaii.

Dr. Lum graduated from Iowa State University in 1966 with a Doctor of Veterinary Medicine degree. He returned to Hawaii where he was in a general veterinary practice until 1980. Since that time he has been active in all phases of regulatory veterinary medicine in Hawaii and in national groups. He is a past president of the Western States Livestock Health Association and Western Region of the USAHA. Dr. Lum has served on various committees of the USAHA.

Dr. Lum has been veterinary consultant to many groups and has been active in the International Zoo Veterinary group. He has been involved in the Association of Rabies Free States and countries.

Dr. Lum's contributions to the industry, veterinary associations, community, state and the nation are more numerous than I have time to cover.

The National Assembly is proud to honor this member of their association and I present this plaque to Dr. Calvin W. S. Lum of Hawaii.
Dr. D. K. Thorpe, President of the National Assembly of Chief Livestock Health Officials, present the fifth National Assembly A w r d to Dr. Calvin W. S. Lum, Hawaii State Department of Agriculture, Division of Animal Industry. The award is given to an active regulatory official or an industry representative for outstanding service in animal health regulatory programs.
PRESENTATION OF THE APHIS ADMINISTRATOR'S AWARD FOR USAHA

Remarks by Dr. Lonnie King, Acting APHIS Administrator, before the joint general session of the U.S. Animal Health Association and the American Association of Veterinary Laboratory Diagnosticians in Las Vegas, Nevada, October 25, 1993.

Good evening. It's nice to see so many smiling faces tonight. I'm here to once again present the APHIS Animal Health Award, more commonly known as the "Administrator's Award."

Let me begin by briefly recounting a little history of this award, which dates back to 1968. It was first presented by Dr. Frank Mulhern to Mr. Herman Aaberg, an individual who was very active in the hog cholera eradication program, at the annual meeting of the Livestock Conservation Institute. Beginning in the mid-1970's, an "Animal Health Award" has been presented each year by the APHIS Administrator in conjunction with the annual USAHA convention.

Our honoree tonight was born in southwestern Virginia on -- well, we don't have the exact date, but suffice it to say, it was long enough ago to be eligible to retire, which is one of the criteria for this award.

The second -- and most important -- criteria for the award is that the individual must have provided leadership in advancing animal health programs, programs that have made America's livestock and poultry populations the healthiest and most productive in the world.

Last year I mentioned that it was important to note that each year this award and the work of the U.S. Animal Health Association has taken on greater significance. That statement is even more true today. The interconnection of global markets, not to mention those closer to home, becomes increasingly complex, as do the new science and technology that guide us in developing the regulations that allow freer trade with greater safety.

The ongoing discussions of NAFTA and its wide coverage in the media only serve to point up the importance of trade. APHIS and its disease control and eradication programs developed in cooperation with the States play a key role in facilitating trade and protecting American agriculture, improving production, and helping to expand export markets for healthy agricultural products. We will continue our dialogue with Mexico and Canada on these issues through the various forums that deal with animal and plant health issues.

I should note here that APHIS is satisfied that the provisions in NAFTA will advance U.S. export interests as well as preserve our ability to maintain import standards and requirements that are essential to protect the health of our agriculture. We have always tried to promote transparent, scientifically based regulations. The NAFTA agreement commits the United States, Mexico, and Canada to such principles.
PRESENTATION OF THE APHIS AWARD

But, now to the matter at hand — our award tonight. Though we can point with pride to our accomplishments, many challenges remain before us. And, if we are to meet these challenges, it will be due in great part to the tireless work of individuals like the one who we honor here tonight.

Anyone who has had anything at all to do with organizations or animal health programs, knows full well these programs and organizations don't run by themselves. It takes hard work, dedicated work, to make things happen. The person we honor tonight has all of those qualifications.

Some of us work in the limelight, others behind the scenes. The work of both is vital to the success of an organization and its programs. Tonight's honoree is in the latter category, although the work accomplished is obvious to all of us.

I don't believe our honoree knows about this award. At least, that's my hope. So perhaps we can play a little game to see if, together, we can discover who this year's recipient is.

So . . . Would all those in the audience whose middle name begins with an "R" please raise their hands. Thank you — just keep them up. Now, would all whose last name begins with a "B" keep their hands up. Good.

Finally, would all those whose first name is "Ella" — please stand . . . and come forward.

If you haven't guessed by now, this year APHIS is presenting its Animal Health Award to Mrs. Ella R. Blanton, long-time employee of the U.S. Animal Health Association and, since 1987, its Executive Director.

Let me tell you just a little bit about Ella and her accomplishments. Married to the same lucky fellow for 46 years, Ella and her husband Robert raised four sons. Her history with USAHA doesn't date quite that far back.

It was in 1967, December to be exact, that Dr. William Bendix, former Virginia State Veterinarian who held a number of offices and was very active in this association, asked Ella, who was then working for a radio station in Richmond, if she was interested in a part-time job as a secretary.

We can all be very thankful that she said "yes" and became the first office person for USAHA. In contrast to our good fortune, Ella had to put up with Bill Bendix for ten years — and with John Shook since then.

Seriously, it would be hard to measure what Ella has done for our organization. Her cheerful spirit, her willingness to help, her ability to get the job done, have — at one time or another — helped each of us.

How can I say it better than this: If you want something done, call Ella. If you have a problem, call Ella. If something needs to be fixed, find Ella. If a crisis occurs, shout for Ella.

And soon — almost effortlessly, it seems, from your perspective — the job is done, the problem is solved, the broken part is fixed, and the crisis evaporates.
PRESENTATION OF THE APHIS AWARD

Earlier, I mentioned the successes of our organization and the things we have accomplished -- diseases eradicated, plagues conquered, healthy animals producing abundant food for our tables. So let me close by saying that if we fly high on those triumphs, we must remember that it was Ella -- and others like her -- who were the wind beneath our wings.

Ella, it's with great pleasure and pride that I present you with this certificate, which reads:

"Animal Health Award. Mrs. Ella R. Blanton. In recognition of your many years of meritorious service and your support of major national disease eradication programs that have contributed significantly to the health of the livestock and poultry industries of this country." It is signed by myself and Secretary Espy.

Dr. Lonnie J. King presenting Mrs. Ella R. Blanton with the APHIS Administrator's Award.

"Ella" with APHIS Administrator's Award and roses presented to her Dr. J. J. England, President of AAVLD.
AN URGENT NEED—DEVELOP THE POTENTIAL OF STATE PUBLIC VETERINARY MEDICINE: A PRESCRIPTION

Sidney R. Nusbaum, D.V.M., Boynton Beach, FL 33437

Note: State veterinarian, (SV), is used in this paper for the chief livestock officer and the organization he/she directs. State public veterinary medicine, SPVM, is used to encompass the entire matter of the state and animal health. The term should be considered a replacement for "state regulatory medicine" which no longer is adequate to describe the activities of the SV.

Introduction:

This paper is an attempt to condense an extensive and lengthy review. Because of the need to condense, information to support many of the arguments and conclusions have had to be omitted.

The conclusion of the review was that SPVM is in rapidly declining health, and probably will become terminal or go into a vegetative state if early, drastic therapy is not initiated.

The review was based on observations, experiences and factual information from a variety of sources over an extended period. The observations and conclusions are of necessity generaly because of the range of structures, practices and organizational environment of the fifty livestock offices. For every observation and conclusion there is an exception, but the trends and patterns overall are consistent.

Objective scientifically designed and planned surveys and studies would be preferable to personal observations. But no such studies exist nor can they be expected to be performed in the near future. Their lack helps prove the case. No one has been monitoring, much less treating, the health of SPVM. And now it is too late— in the absence of immediate action SPVM's wasting disease will continue. If it is persists, it will be as an ineffective cripple.

SPVM is not a parochial matter of concern for veterinarians alone. It has direct and indirect effects on far more than the profession. If SPVM's decline continues changes will be far reaching and extensive... the health of the country's herds and flocks will be endangered; industry will be less profitable and under some conditions unsustainable. Carried to its most draconian, but not impossible outcome, it would not be unreasonable to suggest increased food prices, lower levels of human nutrition, loss of export markets and economic disturbances which extend well beyond the livestock industries.

Observations:

SPVM is the descendant of state regulatory veterinary medicine, a system over a hundred years old originally designed to limit losses from specific animal diseases. Later the charge was broadened to include
epizootic infections. From its inception, it was recognized that the leader of animal health efforts should be a veterinarian, an animal health scientist familiar with the needs and problems of animal owners.

The successes of regulatory veterinary medicine are monumental. During the last decade, however, the monuments of the past are more obvious and significant than the deeds of the present. Now the role and prestige of SVs and SPVM are atrophying. Its dimensions and in some cases its quality, are shrinking at the same time when there is an obvious need for expansion. Our collective failure to recognize and fill the expansion needs are the core problem.

Signs of the times– at least one, and possibly two states do not have veterinarians acting as chief livestock officers. One of the largest of the animal raising states was targeted, just a year or two ago, to have a non-veterinarian serve as SV. At least as important maybe more, other states are effectively limiting the role of the SV and all livestock health planning and service through philosophical, organizational, and budgetary limitations.

A large number of factors preceded, and contributed to the wasting disease:

Success, in eliminating or almost eliminating major diseases made it appear that there was no more to be done;

Professional neglect and disinterest– organized veterinary medicine and veterinary colleges neglected or were disinterested (it is no accident that a survey of 1991 veterinary graduates did not list one who entered state service);

Industry disinterest, opposition and lack of understanding of the SV's role. Except for a few notable exceptions industries have provided minimal support for constructive change; narrow self interest and even pressure tactics to achieve short term, but expensive, gains have marked SV–industry relations.

Freedom from exotic disease has led to complacency; few realize the need, and the costs, of being prepared for devastating disease.

Reductions in federal contributions of money, labor and laboratory service.

Federal policies of centralization and disengagement have had profound damaging effects.

Peripheral items, the public's removal from the farm and animals; basic societal changes and special interest groups. The effects of the outside factors were multiplied by the action of state governments and the SV's themselves:

Stagnation– because we could not or would not change. Few SV's developed programs to meet expanding needs of disease control and planning, epidemiology, of societal and
NUSBAUM

professional and industry changes, and of the way government is
doing its business.

Concentration not only in the manner and the style of
yesteryear, but also the focus... concentration on a few major
disease programs, movement of livestock and sale inspection. Not
uncommonly even in these the form and content are performed by
rote and dictated by habit.

Political policy or industry pressures dictating actions rather
than science are not uncommon.

The combination of self imposed and outside factors has been
debilitating. (Interestingly enough, the size of the state and the SV
organization do not seem to be correlated with the quality of programs.)

In any review of disease, once the etiology is identified, the question
arises as to what should be done. We, veterinarians and livestock owners
are often faced with a need to weigh the cost of treatment against the value
of the ultimate product. In the case of SPVM is the investment worthwhile?
Would it be better to let the patient be permitted to become moribund and
slip away? We're not the only ones interested the question is being pushed
by those seeking to cut government budgets. What justification is there for
investing restorative actions? Who and how will they gain?

DISCUSSION

According to my less than sophisticated estimates, state
veterinarians control over 160 million dollars each year. This money is
directly invested in the protection and improvement of animal health and
increased profits. It pays for field and administrative programs and the
operations of more than 65 laboratories which identify disease and perform
basic research. It finances programs of information gathering, and provides
some support to colleges, extension services and practicing veterinarians.
The support for practitioners is particularly important in those areas which
might not have veterinary services otherwise. As part of the process it
ensures a cadre of essential dedicated veterinary specialists in the field and
laboratory.

The money is a good public investment and it is unlikely that this
money if placed in other departments would focus on the maintenance of
animal health. This despite any criticisms or shortcomings of programs
certainly is one justification for continuance.

A rarely considered fact is that the SV is the unelected voice of
veterinary medicine and industry. When there are cases of interest,—
whether it be an epizootic or animal plague, a two headed kitten, an animal
boycott or a residue scare, the media seeks the SV. He/she becomes the
spokesperson and symbol. We need good and knowledgeable and
sympathetic spokespersons.
AN URGENT NEED

The SV is the essential link in the identification and control of exotic disease. Except for those infections identified at import stations, exotic disease will be first be seen by the clinician who will channel the suspicion to the SV. The quality and speed of the SV's response is crucial in determining whether the infection will be limited or devastating.

Interstate health programs are the domain of the SV. These were started as logical and integral methods to identify infection and prevent the spread of disease. While essential, many have become rote, expensive burdens on industry and government alike. Modified programs could maintain protection from spread of infection while reducing costs and adding, without additional investment, effective disease survey and study information.

There are other activities that should be the logical province of the SV. Failure to develop them will result in dividing them between a variety of agencies ill equipped to fulfill them or doing them less adequately than the SV could. Many could be accomplished without significant new funds; all would be directed to the betterment of animal and human health and the maintenance of animal industries as viable entities. An incomplete list will suggest some:

* On-going programs of epidemiologic support to all veterinary practitioners and their clients.
* Knowledgeable involvement and support in toxicologic matters; ongoing residue programs.
* Active interest and participation in food safety programs and epizootiology.
* Ongoing in-house and cooperative programs of staff development.
* Regular involvement of field and laboratory staff in planning and response preparations.
* Extension and outreach programs to industry and professions. The development of expertise and participation in matters of animal welfare and so-called "animal rights".
* An understanding of, and intimate involvement in, the state budget process.

And pivotal, and potentially most important, the development of rapport and interaction between the executive departments and legislators. Without such rapport and interaction the SV becomes isolated in the state hierarchy, a bureaucrat with restricted visibility, limited opportunity and minimal effectiveness. The SV should be a person recognized and consulted within the people that shape our government and laws.

The last requires that the SV through his or her knowledge, expertise, political style, integrity and controlled aggressiveness gain the respect, and become sources of information and an adviser to legislators who write the laws. Similarly, the SV must develop relationships with the executive branch. Networking with other state and federal administrators
provide the opportunity for expansive and constructive cooperation in the writing and enforcement of regulations, on subjects as diverse as taxation, use and disposal of chemicals, food standards and myriad other matters of concern to animal industry and the veterinary profession. In short, the SV must become an effective, far reaching instrument of representation.

If there is a decision that the patient is worth saving then here is the prescription:

Rx
Industry, organized veterinary medicine and individual scientists, and colleges will work together to produce modern programs to achieve outstanding state public veterinary medicine. The process will include:

1. Development of a model for SV's. It will not be acceptable in the future that the choice of the SV be a casual political decision. SV's must be trained, specialized administrators of public scientific programs. The incumbent must be a scientist with special strengths in epidemiology; ideally the training would include significant involvement in the laboratory. In addition to meet the needs of modern government the SV of the future should be trained in public administration.

   Interestingly enough at least a few state civil service agencies already have job descriptions that approximate the model. For a number of reasons the agencies ignore the requirements. This model is essential. The environment and culture of the day demands that a person have the requisite knowledge and skills to satisfy not only the legal demands of government service but to effectively organize and use resources of budget, personnel, equipment and communications .... the tools of management. The results of a program led by the most skilled, dedicated health scientist, without management training may be successful; if he or she has this extra vital quality in his or her armamentarium greater success is probable.

2. Persuade the veterinary colleges of the importance of SPVM and secure their assistance in working with schools of management to provide training. Immediately, this can be a matter of an extension program for SV's in place. For students now in school it can done through dual track or companion programs. The recommendation of the Pew report that veterinary colleges develop special areas of expertise should reinforce arguments to the school. Programs based on existing models are not adequate for the future. It should not be difficult to make this point to the colleges, the inclusion of management training will provide the colleges themselves with new strengths and the basis for new resources for teaching and research.

3. After we have been convinced of the need, and after we have produced a model for the SV of the future and secured a commitment from the colleges to provide management training we must lobby and convince governors and legislators of the necessity of full-time, well trained, well
AN URGENT NEED

compensated SV's, protected from the ultimate political pressure, —dismissal for political reasons. This effort will secure not only recognition of the position but of the contribution, and the importance of the veterinary profession and the animal industries. Governments are viewed as refractory to change. This is not accurate. State government is responsive to logic and local needs if expressed clearly and to the right people. Governors and legislators are proof of the saying that "All politics is local". Effective presentations can be profitable.

This effort will require the AVMA, state veterinary societies, livestock and poultry organizations, and associated organizations, to embrace the idea and organize programs to convince government leaders. The importance of animal health speaks for itself; in the livestock raising states in the contribution to the state economy, and to everyone, in the health of the public. Witness the outcries about E.coli, salmonella and chemical contaminants. The benefits of a well organized, responsive SV program should be convincing to any politician concerned with the welfare of the state. As a first step the American Veterinary Medical Association's Council on Public Health and Regulatory Medicine has approved such a plan and has forwarded it to the Executive Board.

4. Finally, having convinced the various state leadership of the need for quality leadership and adequate staffs we must, on a continuing basis insist upon and promote competent leadership in the SV position, and support growth of the program.

None of this will be easy. Neither the profession nor the industries we serve have undertaken such a task before. It's importance may remain unclear, or even suspect to some, particularly to industry which may believe it has more immediate and obvious demands. The fact of the matter is that there will be no industry without animals and animals and profits will become increasingly threatened by present practices of husbandry, movement of animals, multiple sources of feed, a less than understanding public and some governmental organizations. New form of protection and assistance is required.

If we fill the prescription it may be one of the most important things most of us will accomplish in our efforts to maintain healthy industries and animals. If we collectively fail, then none will have the right to complain about a desolate future.
Resolution No. 1
Source: Committee on Transmissible Disease of Poultry and Other Avian Species.
Subject Matter: Reactivation of the USAHA SE Task Force

Resolved that USAHA reactivate the USAHA SE Task Force and appoint new Chairs.

Resolution No. 2
Source: Committee on Infectious Diseases of Cattle, Bison and Llama
Subject Matter: Importation Quarantine for Llamas and Alpacas

Resolved that APHIS Docket No. 92–107–1, Llamas and Alpacas, should be withdrawn or rejected so that high-security quarantine at the Harry S. Truman Animal Import Center with sentinel animals and all appropriate testing shall continue to be required for llamas and alpacas imported from Chile.

That the Argentine FMD study should be reviewed by an independent committee of experts for peer review before any further action is taken with respect to the llama and alpaca regulations.

The llama and alpaca regulations should be subject to review based on changing conditions and further research.

Resolution No. 3
Source: Committee on Salmonella
Resolved that USAHA request USDA-APHIS to direct funds from the pre-harvest food safety budget to NVSL that is sufficient to at least cover the 1992 level of submission for salmonella serotyping for diagnostic purposes.

Resolution No. 4
Source: Committee on Infectious Diseases Cattle, Bison and Llama
Subject Matter: Resolution for Brucella Testing Studies in Llamas and Alpacas

Resolved that the USAHA supports the concept of validation of brucellosis laboratory tests for use in lamas and alpacas and encourages USDA-APHIS to support research in this area.

Resolution No. 5
Source: Committee on Transmissible Diseases of Swine
Subject Matter: Global Disease Surveillance, A Requirement for Free Trade

Resolved that USAHA immediately initiate discussions with the USDA, Congress and international animal health organizations to develop and implement a system of global animal disease surveillance and a mechanism to mediate differences on a scientific basis to nullify present and avoid future non tariff trade barriers.

Resolution No. 6
Source: Committee on Rabies
Subject Matter: Federal Funding of Animal Damage Control Rabies Control Programs

Resolved that the United States Animal Health Association support enhanced funding by USDA for ADC rabies control programs in fiscal year 1996.

Resolution No. 7
Source: Committee on Leptospirosis
Subject Matter: Decrease in Services at the National Leptospirosis Reference Center

Resolved that sufficient funding be provided to allow the USDA to once again provide leptospiral culture from clinical specimens, identification of cultures, and to continue to provide, and improve upon, all diagnostic reagents.

Resolution No. 8
Source: Committee on Infectious Diseases of Horses
Subject Matter: Importation of Horses from Mexico
Resolved that USAHA support the position of the American Horse Council relative to the importation of Horses from Mexico.

Resolution No. 9
Source: Committee on Public Health and Environmental Quality and Committee on Tuberculosis
Subject Matter: Risk of Spread of Tuberculosis from Nonhuman Primates

Resolved that USAHA urges human and animal health agencies including but not limited to the U.S Department of Agriculture and the U.S. Department of Health and Human Services, to consider establishing a population based surveillance system consisting of a central point where data can be collated and reviewed regarding Intradermal Skin Test results (+ & -), disposition of test positive animals, and necropsy and ancillary test results for tuberculosis in nonhuman primates in the UNITED STATES.

Resolution No. 10
Source: Committee on Environmental Residues
Subject Matter: Allowable Selenium Level in Feed

Resolved that USAHA urgently requests that FDA reconsider reinstatement of the 1987 Amendment permitting .3 ppm selenium supplementation in animal feeds.

Resolution No. 11
Source: Committee on Johne's Disease
Subject Matter: Certification Program for Paratuberculosis

Resolved that the United States Animal Health Association encourages USDA/APHIS to endorse the voluntary model certification paratuberculosis program developed by the Task Force for the development of a National Paratuberculosis Certification Program. (Copy of that model program available).

Resolution No. 12
Source: Committee on Animal Disease Surveillance and Animal Health Information Systems
Subject Matter: AAVLD Representative on AVMA Informatics Committee

Resolved that USAHA request the AVMA Executive Board to appoint an AAVLD representative to the AVMA Informatics Committee.

Resolution No. 13
Source: Committee on Aquaculture
Subject Matter: Funding and Performance Criteria for Pivotal Studies for Approval of Critical Aquaculture Drugs
Resolved that USAHA supports Congressional appropriation and allocation of funds for pivotal studies required to obtain FDA approval of critical aquaculture drugs, and urges the United States Department of Agriculture and/or the United States Fish and Wildlife Service, to establish procedures to ensure maximum effective use of the monies to be used in the approval of aquaculture therapeutic and disease control compounds.

Resolution No. 14
Source: Committee on Sheep and Goats
Subject Matter: Validation and Standardization of Diagnostic Tests of Sheep and Goats

Resolved that the USAHA request the AAVLD to consider the validation and standardization of diagnostic tests that are currently being used for the diagnosis of ram epididymitis, CAE, OPP and Johnes disease.

Resolution No. 15
Source: Committee on Johne’s Disease
Subject Matter: Accreditation of Laboratories for Paratuberculosis Testing

Resolved that USAHA request USDA/APHIS/VS/NVSL to assume responsibility for accrediting laboratories to run official diagnostic tests for the national paratuberculosis certification program and that agency should run a check test for those laboratories on a regular basis (annually).

Resolution No. 16
Source: Committee on Brucellosis
Subject Matter: Funding for Calfhood Vaccination

Resolved that USDA–APHIS maintain adequate funding for official calfhood vaccination in those areas of the U.S. where vaccination is an integral part of the brucellosis program.

Resolution No. 17
Source: Committee on Brucellosis
Subject Matter: Brucellosis in the Greater Yellowstone Area

Resolved that USAHA supports the Tri-State Interagency Brucellosis Committee goal, mission and objectives. We urge U.S.D.A. (APHIS/VS and Forest Service) and U.S. Department of the Interior (Fish and Wildlife Service, National Park Service and Bureau of Land Management) to join with the states of Wyoming, Montana and Idaho in that committee to actively pursue control and eradication of Brucellosis from the Greater Yellowstone Area.
Resolution No. 18
Source: Committee on Brucellosis
Subject Matter: Swine Brucellosis Eradication

Resolved USAHA requests APHIS to immediately amend the swine brucellosis UM&R to require mandatory whole-herd depopulation of all infected and exposed animals, such animals to be purchased with public funds at market prices. Further that APHIS explore options for disposal of carcasses of such infected/exposed animals in anticipation of being unable to salvage them.

Resolution No. 19
Source: Committee on Food Safety
Subject Matter: Food Safety

Resolved that the U. S. Animal Health Association support a national program which assures a safe, nutritious supply of foods of animal origin, this program should encompass:
* On farm production of health animals
* Examination of individual animals at time of slaughter
* Scientific based inspection principles
* The assessment of human health risks
* The control of disease causing organisms and chemicals

Resolution No. 20
Source: Committee on Professional Oversight
Subject Matter: State Public Veterinary Medicine

Resolved that the United States Animal Health Association sponsor a study group of industry and organized veterinary medicine to:
1. Develop a model for state public veterinary medicine.
2. Work with colleges of veterinary medicine to develop extension and graduate programs of public administration for veterinarians, and
3. Communicate to state legislative and executive departments the need to develop state public veterinary medicine as an essential and civil service protected activity.

Resolution No. 21
Source: Committee on Transmissible Diseases of Poultry and Other Avian Species
Subject Matter: NVSL Personnel Support for Avian Mycoplasma Testing

Resolved that the United States Animal Health Association support efforts by USDA–APHIS–NVSL to provide the additional personnel required in this effort to improve the quality of avian mycoplasma serologic testing.
Resolution No. 22
Source: Committee on Transmissible Diseases of Poultry and Other Avian Species
Subject Matter: Biosecurity Educational Materials for Small Flocks

Resolved that USDA–APHIS–VS, USDA–ES, and state regulatory officials and Cooperative Extension specialists and agents, should closely consult and collaborate in the development and distribution of a variety of effective short–and long–term biosecurity educational materials for owners of flocks of poultry and other avian species. This initiative should also make good use of contributions available from many knowledgeable owners of small flocks of poultry and other avian species.

Resolution No. 23
Source: Committee on Transmissible Diseases of Poultry and Other Avian Species
Subject Matter: Avian Mycoplasma Testing Procedures

Resolved the United States Animal Health Association requests USDA–APHIS–NVSL and USDA–APHIS–NPIP to distribute and make available clear and concise laboratory procedures applicable to quality assurance in avian mycoplasma testing.

Resolution No. 24
Source: Committee on Biologics
Subject Matter: Resolution on Definition of "Animal Biological Product"

Resolved that the USAHA supports the definition of "Animal Biological Product" as contained in the citizen's petition presented to USDA by AH1 and urges USDA to adopt the same. (Copy of citizen's petition available).

Resolution No. 25
Source: Committee on Tuberculosis
Subject Matter: Indemnity for Cervidae

Resolved the United States Animal Health Association supports the efforts of the cervidae industry and the USDA to pass Federal legislation establishing a voluntary indemnification insurance program for Tuberculosis in cervidae.

Resolution No. 26
Source: Committee on Tuberculosis
Subject Matter: Continuation and Direction for the TB Working Group

Resolved that USAHA recommends that industry, government and research institutions continue the TB Working Group for one year to:
1. Coordinate and enable dedicated bovine tuberculosis research laboratories and research institutions with goals and objectives set over five years and shared minimum funding of $4 million per year. The following are not intended to be all inclusive but illustrative of the kind of effort required:
   a. Improved field diagnostics for individual animals,
   b. Validation of existing or modified test protocols in new species of concern
   c. Further basic knowledge of the disease process,
   d. Improved laboratory techniques to identify and fingerprint Mycobacterium isolates.

2. Monitor and facilitate implementation of policy initiatives recommended at USAHA. These include but are not limited to the UM&R establishing a national TB eradication program for Cervidae and other UM&R changes. Monitor industry progress to obtain statutory authority for a companion voluntary, insurance based indemnification program for Cervids.

3. Monitor and recommend action to reduce infection in the dairy herds in the Texas–New Mexico milk shed.

4. Encourage and solicit industry participation by representative(s) from non–traditional species of potential concern to the national eradication of TB in cattle, swine and cervids.

5. Make recommendations after release of the National Research Council report on bovine tuberculosis as to the implementation and integration into the national eradication program.

Resolution No. 27
Source: Committee on Tuberculosis
Subject Matter: Indemnity for "Diagnostic Suspects"

Resolved that USAHA recommends to USDA/APHIS/VS that federal indemnity be paid for diagnostic suspects under the following formula: Federal indemnity for a reactor less the salvage value of the diagnostic suspect.

Resolution No. 28
Source: Committee on Tuberculosis
Subject Matter: Importation of Cattle from Mexico

The U.S. Animal Health Association recommends USDA implement regulations that prohibits the entry of Holstein or Holstein cross steers from Mexico and allows entry of only beef steers and spayed heifers under one of the following conditions:
1. Without tests if from accredited free herds certified by SARH as having met the equivalent of U.S. free herd status.
2. Beef steers and spayed heifers from States that have implemented the official National Mexican tuberculosis eradication program found to be equivalent for testing, eradication and trace back to a Modified Accredited
U.S. tuberculosis State by the Joint U.S./Mexican TB Committee. Entry will be permitted if the entire lot test negative at a ranch of origin under the supervision of SARH or at a designated testing pen under the fulltime supervision of SARH. Equivalency shall be based on scientific data and information. All testing must be monitored and determined equivalent by representatives of the Joint Committee.

3. Beef steers and spayed heifers consigned to entry more than 60 days from last test or without test will be tested at the border with negative lots released and positive lots rejected (Positive on CFT subject to CCT).

4. Beef steers and spayed heifers tested within 60 days of entry or not qualified under Number 2 above, will be consigned to a quarantined feedlot or quarantined pasture in the U.S. or to a designated qualified holding area or pasture for retest after 60 days. Negative lots will be released for unrestricted movement—positive animals slaughtered—balance of lot will be consigned to quarantined feedlot or quarantined pasture.

5. The above program is subject to continuous review under the auspices of the Joint U.S./Mexican TB Committee. The Committee will be assigned Co-coordinators, one representing each country. The Co-coordinators will be responsible for monitoring all tuberculosis testing, traceback, and eradication activities based on standards established by the Joint Committee. Major focus and effort will be to assist Mexico and its States to fully implement a tuberculosis eradication program equivalent to a Modified Accredited Tuberculosis State as described under the U.S. Uniform Methods and Rules.

Resolution No. 29
Source: Committee on Tuberculosis
Subject Matter: Recognition of Ancillary Test and Authority of Tuberculosis Epidemiologists

Resolved that the U.S. Animal Health Association recommends that USDA provide the authority to designated Tuberculosis epidemiologists to:

1. Determine the appropriate herds and applications for use of the Gamma Interferon Assay (R) in parallel with recognized tuberculin skin tests.

2. Classify Gamma Interferon Assay (R) positive animals as reactors. Animals classified as reactors by this method should be eligible for federal indemnification at current rates.

Resolution No. 30
Source: Committee on Tuberculosis
Subject Matter: Tuberculosis in El Paso Milk Shed

Resolved that the United States Animal Health Association recommends to the Secretary of Agriculture that funds be provided to depopulate all known infected herds involved in the El Paso Milk Shed.

The USAHA encourage the dairy industry of the United States to
support efforts of depopulation.

Resolution No. 31
Source: Committee on Foreign Animal Diseases and Committee on Epizootic Attack
Subject Matter: APHIS Foreign Animal Diseases Programs

Resolved that USAHA recommends to the Secretary of Agriculture and the U.S. livestock and poultry industries that APHIS program officials station and maintain Veterinary attaches in certain critical overseas field positions as well as new countries that may become important to the U.S. through new trade initiatives, or where important disease information can be obtained by field work and observation.

Resolution No. 32
Source: Committee on Aquaculture
Subject Matter: Health Inspection and Certification, Import Requirements Export Protocols

Resolved that USAHA strongly supports the industry and urges USDA-APHIS-Veterinary Services to 1) initiate a certification and inspection program that will meet all the requirements concerning international certification and inspection of aquaculture products, 2) implement import requirements to protect against introductions of serious pathogenic agents, and 3) obtain export protocols for aquatic species and negotiate aquatic health export protocols with foreign countries to facilitate export certification and test requirements should be available upon request to all interested parties.

Resolution No. 33
Source: Committee on Wildlife Diseases
Subject Matter: Control of Duck Plague

Resolved that the U.S. Animal Health Association supports actions taken by conservation agencies to minimize the spread of this potentially devastating disease to free-ranging waterfowl populations by euthanasia of exposed waterfowl, carcass removal, environmental disinfection, and methods that reduce the attraction of the site for wild waterfowl.

Resolution No. 34
Source: Committee on Bluetongue and Bovine Retrovirus
Subject Matter: Molecular Epidemiology of Bluetongue Virus

Resolved that the U.S. Animal Health Association recommend that U.S.D.A. support further studies to determine the biologic and economic significance of recent findings that nucleic acid of bluetongue virus can be detected in the
blood of naturally infected cattle for up to 5 months after infection by PCR, whereas virus cannot be isolated from blood by 2 to 3 months after infection.

Resolution No. 35
Source: Committee on Bluetongue and Bovine Retrovirus
Subject Matter: Standards for Certification of Cattle Herds as Bovine Leukosis Virus Free

Resolved USAHA requests that USDA, APHIS provide national recognition for herds that achieve BLV free status utilizing as a guideline the protocol approved by the USAHA Bluetongue and Bovine Retrovirus Committee entitled Standards for Certification Of Cattle Herds As Bovine Leukosis Virus Free.

Resolution No. 36
Source: Committee on Bluetongue and Bovine Retrovirus
Subject Matter: Reducing Bluetongue Testing for International Trade with Canada

Resolved that USAHA supports the elimination of unwarranted bluetongue testing requirements for international trade with Canada as currently proposed by the Canadian Cattlemen's Association.
REPORT OF THE COMMITTEE ON AQUACULTURE

Chairman: Dr. Robert C. Goetz, Keo, AR
Vice Chairman: Dr. Thomas D. Goodrich, Bellevue, WA

J.A. Brock, HI; J.W. Bryan, SC; C.S. Card, PA; D. Galbreath, MD; J.B. Gratzek, GA; T.K. Hennessy, FL; D.L. Hunter, ID; M.R. Johnson, MS; W.E. Ketter, MD; C. L’Ecuyer, CAN; J.C. Leong, OR; J.B. Malone, AR; C.J. Mare’, AZ; R.E. Martin, VA; L. McGovern, WVA; R.B. Miller, MD; A.W. Montgomery, DC; V.F. Nettles, GA; R.J. Odenweller, KY; C. Palmer, CA; H.G. Purchase, MS; J.J. Rash, MO; F.Y. Rogers, MS; H.L. Rubin, FL; J.P. Sanders, Jr., FL; J.C. Sawyer, CA; R.A. Schultz, IA; G.L. Seawright, NM; S. Shin, NY; J.S. Walker, MD

Thursday, October 28, 1993, 8:30 – 5:30 pm, 97th annual meeting
Las Vegas, Nevada.

Meeting opened by Dr. Robert Goetz. A list of those attending, their committee membership status, and wishes regarding future membership status was circulated. Dr. Goetz’s introductory comments addressed the role of the veterinarian in the future of aquaculture. The goals of the previous meeting were reviewed and progress noted. The format adopted at the previous meeting was followed.

REPORTS

Brief reports were given by various Committee members and attendees. Dr. Althaea Langston reported that APHIS this year began export certification of live fish, eggs, embryos and gametes not for immediate human consumption. For exports to the European Community, APHIS, FDA, FWS, and NMFS each may provide certification, depending on type of product, intended use, and sometimes, the originating location of the animal.

Dr. Langston also reported on the Fish and Wildlife Service and establishment of the new National Biological Survey, on activities of the Joint Subcommittee on Agriculture, and on formation of the AAVLD aquaculture committee.

Dr. Mark Dulin reported on European Community policies and procedures regarding intracommunity trade and imports from “third countries.”

Dr. Alfred Montgomery reported on FDA’s 1992 testing of aquaculture products for pesticide; no above tolerance residues were found; residues from two compounds for which tolerances have been established were detected. Testing of 100 imported and 50 domestic shrimp samples revealed chloramphenicol residues in 3 samples from Thailand and 2 samples from China. Oxalinic acid was detected in samples from domestic salmon. A priority for FDA this year is development of tests for detection of selected compounds.

Dr. Bud Virts, Maryland State Veterinarian, reported that Maryland
had successfully exported shipments of fish to the UK and to Russia using the new capabilities of the Maryland State diagnostic laboratory, accredited veterinarians, and the office of the State Veterinarians and APHIS AVIC. In 1988 an aquaculture bill was passed in Maryland giving authority to the Maryland Department of Agriculture over farmed fish and aquaculture products. Additionally, this year 10 net pen sites are being permitted in tributaries of the Chesapeake Bay. An active state aquaculture committee meets in Maryland every 2 months.

PRESENTATIONS, FDA

Dr. Tom Bell gave a presentation on aquaculture drugs extralabel use, and INAD procedures. In the past 5 years approximately 400 aquaculture INADs have been granted; 100 are now pending, and more applications are expected. INADs are being used extensively by the aquaculture industry to provide access to therapeutic agents. At present the industry is participating intensively in INAD studies to determine the efficacy of additional aquaculture drugs.

Dr. Bob Goetz commented that from the perspective of the aquaculture industry, reports and presentations showed positive movement had occurred in at least six areas: APHIS entry into export certification, FDA's customization of aquaculture INAD applications, and inspection of imported as well as domestic seafood, AVMA's interest in aquaculture and establishment of the AVMA Aquaculture Committee, the establishment of the AAVLD's Aquaculture Committee, and Maryland's fish certification program and the total integration of the University of Maryland's fish diagnostic microbiology laboratory into the state veterinary diagnostic laboratory. The States of California and Washington are also in the process of establishing fish diagnostic facilities with their diagnostic laboratory systems.

Dr. Bob Goetz briefly discussed the Aquaculture bill sponsored by Senator Akaka of Hawaii, currently in Congress. This bill would establish the USDA as the head federal agency for aquaculture and establish aquacultured animals, plants, and products as agricultural livestock, crops, and agricultural commodities.

NEW ISSUES

Dr. Goetz returned to the subject of veterinarians and aquaculture. The need for both veterinarians and fish pathologists and biologists in health management of fish was emphasized by several in attendance. Dr. Graham Purchase discussed veterinary education in aquaculture and presented information by institution of the number of veterinary faculty in aquaculture, the number of veterinary students receiving coursework in aquaculture, and which colleges of veterinary medicine offer such courses. Nationwide for the 1991-1992 school year there were 52.95 faculty positions, 24/31 schools offering courses, and 911/2479 veterinary students taking aquaculture
AQUACULTURE

courses.

Dr. Bert Mitchell (FDA, CVM, Surveillance and Compliance) announced the availability of an FDA compliance guide "proper drug use and residue avoidance by non-veterinarians." He discussed the accountability of licensed and non-licensed administrators of drugs, and the fact that licensed professionals are subject to professional oversight in their use of drugs, including penalties up to license revocation for infractions, where no such system exists for non-licensed persons.

Dr. Langston announced that the Joint Subcommittee on Aquaculture's Quality Assurance Task Force produced a guide to Aquaculture drugs, chemicals and biologics, which is available from FDA and USDA. Another more detailed loose-leaf format publication is in the early prepublication review process now, and should be available in a few months.

Four proposed resolutions were discussed; two amended resolutions were passed by vote of the Committee.

The meeting was adjourned at 5:55 pm.
The meeting, October 27, 1993, was attended by 24 committee members and 14 guests. The mission of the committee was reviewed and applications for committee membership were invited. Committee members were urged to communicate to the chairman interests in special topics and specific presentations for the general assembly.

Dr. David Espeseth, Veterinary Biologics, reported on staff activities during the past year. Two new establishment licenses were issued and eight establishment licenses were terminated. There is currently a total of 116 licensees. As regards product licenses, 131 were issued and 67 were terminated, leaving a current total of 2090. Fifty-two import permits for research and 8 permits for transhipment were issued. Thirteen biotechnology product field trials were authorized. Dr. Espeseth presented charts showing the growth of licenses and licensees over the past several years. The process by which BBEP develops formal risk assessments for licensing biological products was discussed.

Dr. Donald C. Randall, Veterinary Biologics Field Operations, announced that the Veterinary Biologics Public Meeting which was canceled last August has been rescheduled for April 12-13, 1994. It will be held in Ames, Iowa. Consumer complaints (107), investigations initiated (28),
regulatory actions (42) and inspections (119) were approximately the same as in previous years. In collaboration with the National Animal Health Monitoring System (NAHMS) biological product use has been investigated, concentrating on rabies and bovine products.

Dr. Laurie Leach outlined Animal Health Institute (AHI) concerns over the economic impact of the APHIS reference requalification proposal. She restated AHI's opposition to user fees. Additionally, Dr. Leach reported on legislative and regulatory initiatives in two states, New Jersey and Michigan, which would have a negative impact on the sale and use of veterinary biologics.

Dr. Leach discussed AHI's proposed definition of an "Animal Biological Product." This definition has been presented to USDA and FDA in the form of a Citizen's Petition. The text of the petition is as follows:

"The term "animal biological product" means any virus, serum, toxin or analogous product represented as an animal biological product intended for use in the diagnosis, prevention, treatment and cure of disease in animals, including any vaccine, bacterin, toxoid, whole blood, plasma, serum, antiserum, antitoxin, other blood components involved in passive or active immunization, allergen, diagnostic component, or analogous product, whether any of these products is of natural or synthetic origin, or result from synthesizing or altering antigen or antibody components or similar technologies.

(1) A virus product is interpreted to be not only a product containing the infective agent known as a virus, but also a product containing live or killed microorganisms and the antigenic or immunizing components of microorganisms.

(2) A serum product is whole blood or any product derived from whole blood or any combination of whole blood components.

(3) A toxin product is a component or product of an organism (excluding substances that are selectively toxic to microorganisms, e.g., antibiotics) which is poisonous to other living organisms and which stimulates antibodies to itself when administered at sublethal doses.

(4) A product is analogous to a vaccine, bacterin, toxoid, whole blood, plasma, serum, antiserum, antitoxin, other blood components involved in passive or active immunization, allergen, or diagnostic components, and includes, but is not limited to viruses, bacteria, rickettsia, fungi, mycoplasma and parasites, if it is intended to have a similar effect in the stimulation, enhancement, supplementation, or modulation of immunity of animals or in the detection or measurement of antigens, antibodies, nucleic acids or immunity of animals."

Dr. Gary L. Cowman, National Cattlemen's Association, reported that injection site lesions in the top sirloin cuts have been reduced from 22% in 1990 to 10.9% in 1993. Necessary trim per lesion site has also been
REPORT OF THE COMMITTEE ON BIOLOGICS

reduced from almost three-fourths of a pound in 1990 to less than one-quarter pound in 1993.

Recommendations:

1. The committee recommended that USAHA send a letter to the National Cattlemen's Association complimenting them on their success in reducing the number and severity of injection site lesions in the top sirloin cuts of beef and offering USAHA's continuing support and help.

2. The committee recommended that continuing efforts be made to avoid future scheduling conflicts with the Biotechnology Committee.

Resolution:

The committee passed a resolution recommending that USAHA support the definition of "Animal Biological Product" as contained in the citizens petition presented to USDA by AHI.
REPORT OF THE COMMITTEE ON ENVIRONMENTAL RESIDUES

Chairman: Dr. Carl H. Graham, Shawnee Mission, KS
Vice Chairman: Dr. H. M. Stahr, Ogden, IA

J. Adams, VA; W.B. Buck, IL; H.H. Casper, ND; D.R. Cassidy, IA; C.Y. Erbel, NC; L.W. Godwin, FL; J.P. Honstead, MD; W.T. Hubbert, MD; W.E. Ketter, MD; L.F. Kubena, TX; D.C. Lazenby, VA; G. Meerdink, IL; G.H. Nelson, MN; G.D. Osweiler, IA; J.C. Reagor, TX; J.F. Robens, MD; F. Ross, IA; L.G. Sullivan, MI; M.A. Thomas, TX; W. Thomas, ME; J. Webb, FL

The first event was a presentation by Dr. Lew Williams, EPA, Las Vegas. Dr. Williams discussed risk assessment and decision making.

Next, a discussion of the FDA pending action to reduce the allowable level of Selenium in feed to 0.1 ppm was held. A resolution was developed and will be presented.

The status of test kits was discussed by P. F. Ross, APHIS/USDA. There are six B. lactam test kits approved for use by FDA and certified by the AOAC Research Institute. Two Aflatoxin kits have been submitted to the AOAC Research Institute for certification.

A report on Vomitoxin contamination of small grains was made. 50% of small grain is contaminated with Vomitoxin according to the estimates of committee members.

FDA has presented guidelines of 1 ppm Vomitoxin in swine feed and 5 ppm in bovine feed for no significant effect levels.

A report on mycotoxins was given by H. M. Stahr. The Mycotoxin Committee (AAVLD) established a guideline of 1 ppm Zearalenone in feed for no significant effect level in feed. The Fumonisin B levels established last year were not changed. No other Mycotoxin guidelines were established this year. Others will be considered next year.

Preharvest survey of corn for Mycotoxin in Iowa will be undertaken this year. APHIS may also do an on-farm survey of 2000 farms across the country this year.

Dr. Richard Ellis described the FSIS program for residue control. The emphasis will be on microbial contamination again. There will be a concentrated effort to produce new faster methods, work with APHIS/USDA for preharvest control (on farm), add inspectors, establish baseline surveys, use risk assessment to establish guidelines for Microbial contamination, use HACCP techniques throughout the production food processes.

There will be reorganization within FSIS to improve regulatory efforts and to make new initiatives a policy.

The chemical residue program will be expanded (more analysis will be done) and three new chemicals added to those screened for and some which have not been found may be dropped from those analyzed presently (cf Carbadox).
REPORT OF THE COMMITTEE

Discussion was held on the need to establish guidelines to advise agricultural interests what is actionable levels (cf Pb residues) in dairy products and food producing tissues and what should be done with contaminated agricultural residues.
Respectfully submitted: H. Stahr for Carl Graham
Robert Firth, California Pellet Mill, gave an overview of pelleting. It is important to reach a temperature of 190 degrees Fahrenheit and a moisture level of 15-17% in the mash in order to obtain good pellet quality. These conditions will also effectively destroy salmonella and other non sporeforming microbes if maintained for 1-2 minutes. The required time, temperature and moisture conditions can be achieved by passing the feed through a steam-jacketed conditioner before pelleting. Newer methods for producing pellets involve extruders and expanders, these machines operate at higher temperatures and pressures and produce hard, durable pellets; they require a higher energy input than regular pelleting machines.

A discussion of sampling plans was presented by Dr. A. P. Rainosek of the U.S. Department of Commerce. Sampling plans for Salmonella recommended by the International Commission on Microbiological Specifications for Foods (ICMSF) and the National Research Council (NRC) and, in part, adopted by the Food and Drug Administration (FDA) was presented. These "zero tolerance" sampling plans were examined for their ability to detect Salmonella as the degree of Salmonella contamination varies in a product lot. In particular, the concept of a "zero tolerance" sampling plan is a statistically defined term and does not mean that the sampled product is Salmonella free. This distinction was illustrated during the presentation.

General Guidelines for HACCP Programs was given by Daniel G. McChesney, Ph.D. FDA is focusing on a HACCP approach because it addresses the root causes of food safety; problems in production, storage, transportation, etc., is preventative, and is applicable to both human food and animal feed. For a voluntary or mandatory HACCP program to increase the margin of safety in our food supply will require that each manufacturer tailor a HACCP plan to the particular manufacturing site.
The minimum elements of a HACCP program for the feed industry should include the following.

1. Every processor should have a written HACCP plan that is specific for each manufacturing site and product manufactured at the site.
2. The HACCP plan should identify the safety hazard or hazards that must be controlled for each product at the plan.
3. Identify the critical control for each of the identified hazards and include these in the written HACCP plan.
4. Identify the critical limits that must be met at each of the critical control points and include these in the written HACCP plan.
5. Identify procedures that will be used to control and monitor each of the critical control points to ensure compliance with the critical limits and the person(s) responsible for monitoring the critical control point.
6. Establish a record keeping system that will document the monitoring of critical control points and contains the actual values obtained during monitoring. In addition to these records, records relating to product codes and dates should be maintained.
7. Establish a training program.

The minimum elements for a HACCP program that are outlined are incomplete. USAHA, industry, and academia can help complete the details.

Best Management Programs for Poultry was discussed by Dr. Ben Pomeroy. This was one of the outstanding achievements of the USAHA Committee on Salmonella.

In 1990 a small committee began to develop a specific integrated salmonella risk reduction program for the United States table egg industry (Mallinson, Opitz, Halvorson, Bryant and others from the Salmonella Committee). Once a draft was developed, it was circulated to a diverse group including extension veterinarians, industry representatives of poultry breeders, industry veterinarians, research workers, and state and Federal regulatory people. The Subcommittee on Education and Information met once to finalize the draft which was then presented to the USAHA Committee on Salmonella and was approved at its 1991 meeting. The report was then published in the Proceedings of the 95th Annual Meeting of the USAHA, pp 465–500, 1991. Reprints of this document have been widely circulated in the poultry industry, "Salmonella Risk Reduction - Integrated Guidelines for Table Egg Producers." Subcommittees were formed in 1991 to draft "Best Management Practices for Salmonella Risk Reduction in Broilers and Turkeys". The developers of the drafts (Holder and Halvorson) circulated the documents to the subcommittees before a joint meeting held at the 1992 USAHA meeting. The drafts were reviewed, suggestions and changes were made. The corrected draft for broilers was circulated to the broiler industry veterinarians and the Production Committee of the National Broiler Council. The draft for turkeys was submitted to the National Turkey Federal Turkey Health Committee and turkey industry veterinarians. The revised drafts were
then submitted to the members of the Salmonella Committee. The final drafts were again reviewed by the subcommittees (Broiler and Turkey) and will be acted on at the USAHA meeting on October 25, 1993. The full committee will consider the drafts for final approval.

The documents will then become part of the Report of the Committee on Salmonella and be reviewed by the Executive Committee of the USAHA. They will then be published in the Proceedings of the 97th Annual Meeting of the USAHA.

Dr. Stan Bailey of ARS reviewed the two procedures AOAC uses to approve test kits. The traditional approach involves collaborative research and is time consuming. In a different approach, companies which have developed test kits can contact AOAC Research Institute to have their claims verified. The second approach can be completed in 4 months and results in an AOAC recognized method. It is not known how well a recognized method will be accepted by courts. The traditional approach results in AOAC approved methods but takes 2–3 years to complete.

Dr. Robert Brewer, FSIS, reported on a field experiment in Puerto Rico which involved treatment of feed with a mixture of formic acid and propionic acid. The feed was also heated to 190 degrees Fahrenheit during pelleting. The birds that received the acid–treated feed had the same prevalence of carcass contamination with Salmonella (4%) and the same prevalence of cecal infection (46%) as the control birds.

A review of the research investigating the activity of chemical feed activities for reducing microbiological feed contamination was presented by Dr. Amy L. Waldroup, University of Arkansas.

Low levels of organic acids are added to animal feed for various purposes. Acids can increase the storage life of feed, and may improve digestibility. Organic acids may improve performance and feed conversion by altering intestinal microflora. Propionic, formic, lactic, citric, and ascorbic acid do not adversely affect bird performance and studies suggest that some acids can positively influence feed utilization. Utilizing butyric and lactic acid as feed supplements, researchers found that cecal colonization of broilers by Salmonella typhimurium was significantly reduced at 14 and 21 days of age. A commercial product containing formic and propionic acid is being marketed as an effective treatment for controlling Salmonella in the feed with the additional claim of preventing recontamination.

Several investigators have found that feeding fumaric acid to young pigs or broilers improves performance and reduces levels of Enterococci and anaerobic sporulating organisms in the cecae and small intestine. Part of the response to fumaric acid supplementation was related to improved nutrient digestion due to reduction in the pH of the digestive tract, thereby reducing levels of undesirable microorganisms and increasing pepsin activation. In another study, addition of buffered propionic acid (BPA) to broiler rations significantly reduced total coliforms in the duodenum and
ileum. The buffered acid product did not adversely affect body weight, feed efficiency or percentage abdominal fat, but altered the pH of intestinal contents. Addition of citric acid to broiler rations did not improve digestibility of dry matter or nitrogen.

Researchers have suggested that the antimicrobial activity of lactic acid is the result of decreased pH in addition to specific antimicrobial effects of the undissociated molecule. Following dissociation of short-chain organic acids, the undissociated acid molecules enter cells and dissociate into anions and protons which cause the pH of the cytoplasm to decrease, thus inhibiting synthesis of several macromolecules including cell wall components, DNA, lipid, protein, and RNA. Apparently destruction is not by lysis or perturbation of the cell membrane as was previously thought.

Very few of the above-mentioned studies have evaluated the effects of feeding organic acids on the microbiological quality of processed carcasses. In fact, very few studies which have proposed means to control colonization of the intestinal tract of poultry have evaluated the effects of such treatments on processed carcasses. Thus, the objective of the following series of studies was to evaluate the effects of feeding various organic acids to broilers on live performance, Salmonella colonization of the cecae and Salmonella contamination of prechill carcasses.

In three trials lactic acid (LA) (0.25 to 2.00%) or fumaric acid (FA) (0.5 to 2.00%), and in two trials a formic/propionic acid blend (FP) (.125 to 1.00%) or citric acid (CA) (.25 to 2.00%) was fed to birds that were inoculated via the drinking water with 10 to 10 cfu/mL on days 2, 7, and 14. At 42 days birds were processed and the cecae and prechill carcasses were evaluated for incidence and levels of NAL–SAL. LA, FA, and CA had no adverse effects on body weight, feed utilization, feed intake, or mortality. The FP blend significantly decreased body weight and feed consumption, but did not alter feed conversion or mortality. Neither LA nor FA affected cecal pH; however, pH was altered when the FP blend or CA was fed. None of the acids affected cecal weight or percentage. None of the acids consistently reduced levels of NAL–SAL in the cecae or on the prechill carcasses.

Recent work by others suggests that dietary propionic acid is metabolized in the foregut (crop, gizzard, proventriculus), and does not reach the intestine or cecae. Propionic, acetic, and butyric acids are also metabolized in the foregut of the bird. Thus, feeding organic acids to broilers does not appear to be a reliable method to control salmonellae colonization. However, if the pH of the crop were significantly reduced when pathogens were ingested by the bird perhaps the organisms would not reach the cecae or would be stressed to a point where they would be unable to colonize. Results from these studies and others also suggest that reductions in cecal colonization by pathogens such as Salmonella do not necessarily result in processed carcasses that are contaminated to a lesser degree.
Guidelines for testing feed additives was presented by Dr. Henry Ekperigin. CVM is considering the following ideas for evaluating the ability of antimicrobial feed additives to achieve their intended effect of controlling salmonella in feeds.

1. Most food additives will be considered for approval only if they are intended for use in maintaining feeds free of salmonella for a minimum of 14 days despite repeated exposure of the feeds to the microbe during the period.

2. Experiments should be conducted in two main stages consisting of laboratory and field trials. These trials should be well planned and documented as protocols and, conducted in ways that will enhance confidence in the integrity of data obtained.

3. Laboratory trials should conform to a uniform testing standard and consist of a dose determination study and two studies to determine the ability of the minimum effective dose of the additive to maintain feeds free of salmonella. Components of that standard include simulating natural contamination of feed with a mixture of four serotypes or more of salmonella including *S. typhimurium*, *S. montevideo*, *S. senftenberg*, and *S. enteritidis*. The initial concentration of salmonella in experimental feeds should be 10 cfu/g. One of the two studies to determine "ability to maintain free" should be conducted by an independent researcher.

4. The dose of feed additive determined in the dose titration study to be an appropriate effective dose should be further evaluated in the field to determine if the additive could be safely used to achieve its intended technical effect(s). Such conditions of use would include those associated with preparation, storage and consumption of the treated feeds. The trials should be conducted in at least three geographically different locations and during two different seasons of the year including the summer. Additional trials could be conducted during one or both of the other two seasons of the year if so desired by the sponsor.

A paper entitled Salmonella in Animal Protein Feed Supplements was presented by Dr. Don Franco, Director of Scientific Services for the Animal Protein Producers Industry (APPI).

A review of the epidemiology, reservoirs, transmission, serotypic significance and public health relevance is highlighted to examine the complexity of the genus Salmonella, as we plan programs for safe feed, healthy livestock and healthy people. The clinical spectrum in poultry/livestock and humans plays a significant role in the control endeavors. And, the ecology, behavior, and relevance of serotypes, including the critical consideration of widespread asymptomatic carriage of the organism by livestock and poultry heightens the equation for prevention and control. The interrelationship of the use of animal proteins as feed supplements in complete or balanced rations, the husbandry and the environmental impact is examined as we communally form alliances and a coalition for continued...
planned strategies for Salmonella control.

TRANSPORTATION SUBCOMMITTEE

The report was given by Lee Boyd. A mail survey to many of the ingredient manufacturers did not elicit a strong reply. The committee then selected a particular facet of transportation where additional effort would most likely pay the largest dividend. The following points were established.

1. Feed ingredients and mixed feeds are assumed for our purposes to be salmonella negative when offered for loading.

2. Transportation must be considered a potential source of contamination, though the potential is unknown at this time.

3. The majority of ingredients and mixed feeds are moved by truck. (It was recognized there may be some exceptions, such as grain moving by rail to the Southeast.)

4. Trucks can be dedicated, (owned or leased) for hire, or customer controlled. The majority of vehicles used for ingredients are not company owned or leased. Those for mixed feed are most likely company owned.

5. Dedicated trucks used only for one purpose should not be a major problem source due to control and limited exposure.

6. For Hire trucks apparently are the major potential as a contamination source due to previous exposure and less control problems due to lack of knowledge or meaningful control, with the greatest potential associated with for hire trucks.

Some possible solutions are as follows.

1. Education programs – Alert ingredient suppliers and feed manufacturers to the need to address the potential of transportation as a problem source. An appropriate brochure will also be most helpful and should be considered.

2. Recommend that all hired trucking be advised of the need to supply physically clean trucks for loading, and that trucks should be capable of maintaining the integrity of their loads – i.e., sound roofs and tarps. Inspect trucks for suitability before loading.

3. Advise customers of this same need regarding trucks offered for loading. If proper equipment is not offered, advise customer of this fact and secure a signed disclaimer.

4. With respect to 2 and 3 above, develop the following:
   (a) Information that can be used to alert the trucking industry to the potential of trucks as a source of salmonella contamination.
   (b) A sample truck inspection form that can be used to develop individual company forms to be used to both alert trucking firms and to check trucks for suitability.
   (c) Secure a list of appropriate/acceptable substances that can be used as sanitizing agents as a follow up to physical cleanliness.
FEED SAFETY

The report of the Feed/Feed Ingredient Subcommittee was presented by Dr. Frank Jones, North Carolina State University. The committee is working with all phases of the Feed Industry and the American Feed Industry Association (AFIA) to develop a model HACCP plan for control of *Salmonella* in feed mills. The plan development steps will include:

1. Identification of hazards,
2. Identification of critical control points (CCP's),
3. Identification of critical limits,
4. Identification of monitoring procedures,
5. Establishment of corrective action,
6. Establishment of recordkeeping systems, and
7. Verification of the program.

The presentation outlined the feed manufacturing process and identified possible CCP's in the following areas of the feed mill: ingredient purchasing, ingredient receiving and storage, batching and mixing, pelleting, finished feed storage and farm feed delivery and storage. The possible CCP's identified will be evaluated by the AFIA microbiology committee and true CCP's will be incorporated into a model HACCP plan. This model plan will provide feed manufacturers with a basis for development of individual HACCP plans for each manufacturing facility.

Dr. Beth Lautner, National Pork Producer's Association, presented the quality assurance program that is under development. The program is HACCP based and includes feed safety as one of several factors that impact on pork quality.

The report from the Microbiology Subcommittee was presented by Dr. Stan Bailey, Agricultural Research Service (ARS).

The microbiology subcommittee has met four times over the last two years. In discussions with FDA and industry the committee has decided that two sampling plans need to be developed. One for a USAHA baseline study which could be used to monitor progress over time. Under this plan companies would voluntarily pull samples according to the USAHA protocol, analyze them and supply the data to someone identified by USAHA to accumulate, compile and analyze the data. This baseline would then be updated every year to monitor industry progress in reducing salmonellae. Industry would know what the USAHA sampling plan would be so that they could determine the frequency of sampling that would satisfy them and allow them to establish internal baselines which would be beneficial in knowing where they will fit in the USAHA baseline and to monitor internal progress in reducing salmonellae levels. A second sampling plan for routine monitoring by regulatory agencies will be developed by USAHA with specific numbers of sample units to be evaluated dependent on the results of the baseline survey. This routine monitoring plan could voluntarily be incorporated into individual plant sampling plans to predict what the regulatory agency would find if they sampled the plant.

Tentatively, the baseline sampling plan will be the same as the FDA Category II sampling plan with the number of subsamples $n = 30$. Samples should be composited by taking 5 composites of 25 g from each of 6
subsamples. The routine monitoring plan will be dependent on the degree of prevalence for the different feed or ingredient types established in the baseline sampling plan.

The subcommittee is well pleased with its progress to date. The work of the committee is not finished however. In terms of the baseline survey for example, several issues need resolution prior to its execution. These issues relate to data acquisition, management and reporting; determining specific feed and ingredient styles to be surveyed; determining a suitable method to relate data to acceptable GMP performance; determining if direct quantification is possible; etc. It is anticipated that these issues can be resolved by the end of next year so that a report can be put forth to the full committee. In order to accomplish this objective, however, at least one meeting of the subcommittee augmented by conference calls will be necessary.
The Government Relations Committee met on March 1 and 2, 1993 in the United States Department of Agriculture Building in Washington, DC, with representatives of the United States Department of Agriculture and the Food and Drug Administration Center for Veterinary Medicine. It also met with representatives of the Allied Industries at the National Cattlemen's Association Office, 1301 Pennsylvania Avenue, Washington, DC.

It was a pleasure to have Acting Assistant Secretary of Agriculture Kenneth Clayton and Acting Administrator, Lonnie King of APHIS at the meetings and to hear of their interest in programs we feel important to USAHA.

The efforts of Dr. Billy Johnson and Dr. Don Luchsinger were greatly appreciated. They organized the program and made it one of the most open, frank and friendly meetings enjoyed between APHIS and USAHA.

**USDA-APHIS-VS**

Dr. Lonnie King and Dr. Billy Johnson extended a hearty welcome to the Government Relations Committee.

**CATTLE DISEASE SURVEILLANCE STAFF**

Dr. Granville Frye complimented the rapid progress being made on TB, and Mexican – U.S. relations. He defined and discussed the four elements of the USAHA TB committee resolutions which were: (1) strategic plan with Mexico (2) standards of importation (3) pilot studies for gamma-interferon and other tests (4) blood test options for rapid screening. The next step will be to establish a review committee for the oversight process.

TB problems in the El Paso milk shed will be approached by following these 7 goals: (1) declare it an endemic area (2) establish a full time TB epidemiologist in the area (Dr. Westover) (3) adopt herd plans using special testing and follow up surveillance (4) create slaughter surveillance for each herd (5) cooperate with Mexico and their area dairy herds (6) amend the CFR to provide indemnity (this has been done) (7) area testing.

TB in cervidae – final recommendations and guidelines are being prepared and will be sent out by March 14, 1993. However, the UM&R will not be published until final test results are obtained from Canada on the BTB
Environmental Protection Agency (EPA) is questioning our use of backtag cement. Several problems exist which are: (1) fireproof storage (2) it is a hazardous material (3) safer disposal (4) oversight needs to be increased. Other possible backtag options are being discussed. Oregon is the newest state to achieve Brucellosis free status.

IMPORT–EXPORT STAFF
Dr. Bob Kahrs stated that user fees are in place as a result of the 1990 farm bill. The intent is to completely recover the entire cost of import–export, including administrative fees.

Dr. Kahrs talked about Brucellosis vaccination as it relates to the export business. A growing number of countries will not accept Brucellosis vaccinated cattle. However, USDA's position is that any change in brucellosis vaccination requirements must come from the states.

Dr. Sam Richeson discussed the new requirements for importation of cervids from Canada. Cervid concerns are Elaphostrongylus cervi, and TB; also Brucella suis in Canadian caribou.

Dr. Bob Whiting said that spayed heifers from Mexico will be allowed into the U.S. if: (1) M-branded on left jaw (2) spay branded on right jaw (3) metal ID tag (4) supervised by the USDA veterinarian in Mexico (5) spayed by certified Mexican veterinarians.

Dr. Whiting stated that the "IN–Bond" Cattle Program allows steers and heifers from Mexico to enter the U.S. for feeding only, but must return to Mexico for slaughter.

EMERGENCY PROGRAMS – FAD
Dr. Chris Groocock discussed the status of avian influenza in the U.S. and its potential for its reversion to pathogenicity. An APHIS panel meeting on "Humane Methods for Euthanasia of Pet Birds" emphasized that the use of fire extinguishers as a source of CO2 was completely unacceptable.

SWINE DISEASES
Dr. Lenard reported on the progress that is being made on the eradication of pseudorabies and brucellosis in swine in the U.S. A risk analysis study is being done on garbage feeding of swine.

TRADE SUPPORT TEAM
Recognizing the importance of future trade agreements with Canada, Mexico, and the European community, APHIS showed tremendous foresight in establishing the need for a specialized support staff dealing strictly with trade issues. The formation of such a group alleviates members of veterinary services from becoming involved in non–technical issues needed
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to complete export agreements. By being relieved of non-technical issues, VS personnel can better devote their time to the critical issues of preventing the introduction of foreign disease agents and vectors.

Another major function of the team is to provide APHIS personnel with information needed to help them be better prepared and better informed as they enter specific trade negotiations.

APHIS UPDATE

The Government Relations Committee appreciated the frank discussions held with Dr. Billy Johnson on a wide range of current issues. We were particularly concerned with the announcement that there would be a 14% reduction in administrative costs extending over the next four years. The reason for concern focused on the fact that cooperative agreements are considered to be part of administrative costs.

Another area of concern which may have far reaching ramifications is the recent court decision against the U.S. Government concerning failure to complete an environmental assessment. This may prove to be a landmark decision that may impact, not only federal, but state animal health eradication programs.

We appreciated Dr. Johnson's discussion concerning regionalization. This important issue must be dealt with realistically using science and technology to its best advantage in assuring the continued safety of our animal populations from the introduction of foreign animal disease agents. This is a most important issue that must be addressed as we prepare to enter the era of The North American Free Trade Agreement (NAFTA) and The General Agreement on Tariff and Trade (GATT).

The Committee is pleased to hear that core funding is becoming a reality in the proposed fiscal 1994 budget. This concept has been supported in the past and the committee continues to believe this approach is critical for maintaining Veterinary Service's ability to respond to the possible introduction of foreign animal disease agents.

The Committee shares Dr. King's concern for the close proximity of a foreign animal disease vector in the form of the tropical bont tick. There is recent evidence that would indicate there is a change in migration patterns of the cattle egret that could bring this tick and its Heartwater disease agent to the United States. This is of particular concern because of the presence of a native tick species that is capable of supporting the life cycle of the Heartwater disease agent once it has been introduced.

The Committee urges Veterinary Services to pursue appropriate avenues that would lead to the elimination of this threat to the United State's livestock industry.
AGRICULTURAL RESEARCH SERVICE (ARS)

Dr. Dean Plowman, Administrator, Dr. Bob Oltjen and members of the staff reported on research activities presently being conducted at their biocontainment facilities.

They reported research is being conducted on a number of diseases including Foot-and-Mouth disease, E. coli 0157:H7, tuberculosis, brucellosis, avian influenza, tropical bont tick and neospora. Research efforts have been intensified in tuberculosis and E. coli 0157:H7, because of the growing concern by the industry and the consumer.

The six research facilities range from the Meat Animal Research Center (MARC) and the Arthropod–borne Animal Disease Research Laboratory (ABADRL) which have been constructed during the past five years to The Plum Island Animal Disease Center (PIADC) and National Animal Disease Center (NADC) which were constructed more than thirty years ago. Consequently the facilities are in various states of deterioration and in need of modernization and repair, estimates ranging up to $60–$80 million are needed over the next 8–10 years for PIADC and $100–$110 million for NADC. This compares to an estimated $500 million for construction of a replacement facility for Plum Island.

A task force has been established to determine the future of the PIADC—whether to move the facility to a more readily accessible location on the mainland, or the need to rebuild a facility at the present location, keeping biosecurity as the priority.

FOOD SAFETY INSPECTION SERVICE (FSIS)

Dr. Russell Cross, Administrator for FSIS and Dr. Ken McDougal from his staff reported to the Committee on the plans and goals for the modernization of the Federal Meat Inspection Program. The present program will be evaluated and upgraded but a new revolutionary approach will be initiated. The new programs will include science based inspection, risk assessment data, reduction of pathogens through rapid methods of detection, elimination of high risk plants and the establishment of a Comprehensive Pathogen Strategy Program. To reach the goal of a pathogen free product from the farm to the table will require support from the producer, the veterinary profession, federal and state regulatory and marketing agencies, the consumer education agencies and institutions, and cooperation between countries trading with the United States.

The Committee supports this concept and will cooperate and support the program in any way possible.

COOPERATIVE STATE RESEARCH SERVICE (CSRS)

Bill Carlson, DVM, CSRS Associate Administrator, introduced the staff who are key to the various research areas. Frank Flora, Program Director of Food Science and Technology, explained that CSRS is the
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primary link between the University (mainly land grant universities) and USDA. Dr. Rosemary Grady, National Research Initiative, explained the four main areas and the procedure used in awarding the research grants. The four areas are (1) Animal Systems (2) Nutrition, Food Safety and Health (3) Market Trends (4) Value Added Products. USAHA encourages continued cooperation which addresses future technology and economic viability in Agriculture.

FOOD AND DRUG ADMINISTRATION(FDA)

Gerald Guest, DVM, Director of Center for Veterinary Medicine, stressed the use of the HACCP concept within FDA. He discussed five major areas of involvement at present which are (1) Salmonella (2) Meat and Milk Residues (3) Aquaculture (4) Bovine Spongiform Encephalopathy(BSE) (5) Bovine Somatotropin(BST).

Dr. Guest emphasized that the key factors for the future of residue avoidance are identification, records, screening tests, and a monitor program. He said that FDA's emphasis in aquaculture is to study the pharmacokinetics of drugs in cold blooded animals. Currently only five drugs are approved for use in fish. Dr. Guest discussed Bovine Spongiform Encephalopathy(BSE); none has been found in the U.S.A. However, there is much concern because adult sheep heads are still being rendered in some plants for use in animal protein feeds. The Industry is revaluing the issue of whether this should be a voluntary program or not.

Prior to issuing approval for Bovine Somatotropin(BST) FDA will make a final analysis of the data regarding mastitis in BST treated cows and review labeling of the product. A public hearing on this issue will be held in March 1993. Dr. Guest stated that the Federal Drug Administration now approves the use of electronic implants in sheep in the scrapie program provided that Food Safety Inspection Services(FSIS) insures the removal of the transponders. Dr. Guest complimented USAHA's initiative to form the committee on feed safety, and the progress achieved on zero tolerance Salmonella in feed.

Dr. Guest addressed the issue of extra label use of animal drugs. He emphasized that with approval for extra label use of these drugs, there will be required identification of treated animals to the premises of origin.

ALLIED INDUSTRY

The Committee met with representatives of the Washington, D.C. based allied industries. The discussions were at times lively and many topics were covered in this meeting. TB in cattle and cervidae, reassessment of the need for calfhood vaccination and cost of surveillance as the brucellosis program phases out were discussed. Another major topic was the need for better meat inspection with emphasis on residues and quality assurance.
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The "M" brand for Mexico cattle, the screwworm program and its move from Mexico into Central America were noted as were the concept of regionalization of counties for movement of animal and animal products and the extra label use of medicines by veterinarians and livestock operators.
The USAHA Committee on Leptospirosis met on Tuesday, October 26, 1993, with 17 members and guests present.

Dr. Hailu Kinde, University of California–Davis, presented a report on a leptospira abortion storm in horses in southern California during the 1993 foaling season. There were 70 mares on the farm, 56 of which were pregnant. Of the 56 mares, nine aborted; two had delivered normal foals; two mares delivered sick or weak foals that died within days; and another mare gave birth to a sick foal which was treated and survived. All abortions occurred between March 3 and April 20, 1993 (a six–week period) at 9 to 10 months of gestation.

The abortion storm was preceded by heavy rain during the last part of January and the first part of February. This resulted in massive flooding over a large area which drained raw sewage on the ranch and in the stalls where the horses were housed. Water levels had peaked at 4–5 feet, immersing some of the mares to their hips.

Fetal tissues (liver, lung, spleen, kidney) and maternal serum from a mare were submitted to the California Veterinary Diagnostic Laboratory System. Leptospirosis was diagnosed by fluorescent antibody test (FAT) and/or microscopic agglutination test (MAT) and by demonstration of spirochetes in the tissue sections with the Warthin Starry Stain. The serovar was determined as *Leptospira interrogans* serovar *pomona* using a serovar specific FAT. Microscopic examination of the liver, kidney and spleen were unremarkable.

Fifteen serum samples from aborted and nonaborted mares were tested by MAT for leptospirosis. Maternal sera from nine aborted mares had titers between 25,600 and 204,800 against serovars *pomona* and *bratislavia*. However, a few also had detectable titers against serovars *grippotyphosa* and *icterohemorrhagiae*. Maternal sera from two mares with normal foals and another with a stillborn had negative or 1:100 titers against all serovars. The dam serum with a sick foal (which survived after treatment) and another one with a weak foal at birth (which died later) also had titers >3,200 for serovars *pomona* and *bratislava*.

Dr. Mike Donahue, Livestock Disease Diagnostic Center, University of Kentucky, presented a report on equine leptospiral abortions during the 1993 foaling season in central Kentucky. During the 1993 foaling season
REPORT OF THE COMMITTEE

(July 1, 1992–June 30, 1993) 732 equine abortion/neonate (up to 7 days of age) submissions were tested for leptospirosis using the fluorescent antibody test and microscopic agglutination test. Forty-three (5.9%) were diagnosed as leptospirosis. Mares from 38 different farms were involved. One farm had 3 mares that aborted, 3 farms 2 mares that aborted, and the other 34 farms 1 mare that aborted. The gestation age of the infected fetuses ranged from 6 months to term. Thirty-nine of the mares were Thoroughbreds, 3 (all from 1 farm) were Standardbreds, and 1 was a Quarterhorse. Thirty-three (77%) of the abortions occurred in November (16 cases), December (11 cases), or January (6 cases).

Leptospires were isolated from 22 (51%) of the 43 cases and sent to Dr. Carole A. Bolin, Agricultural Research Service, Ames, Iowa, for serovar identification. All the isolates were identified by restriction enzyme analysis as *Leptospira interrogans* serovar kennewicki. The MAT results on the fetal fluid and/or dam's serum of the 21 culture-negative cases were very similar to the results of the culture-positive cases, indicating that *kennewicki* might have also been involved in these abortions.

Concern was expressed by the committee that there are no Federally licensed leptospira vaccines approved for use in horses.

Mr. Wayne Roberts and Dr. Cathy Brown, University of Georgia Veterinary Diagnostic Laboratory, Athens, Georgia, provided the committee with a report on *Leptospira grippotyphosa* in dogs. During 1992, five cases of leptospirosis in dogs with acute renal failure were diagnosed. These dogs had similar clinical histories of progressive lethargy, anorexia, weight loss, polyuria, polydipsia, occasional vomiting, moderate azotemia, and mild leukocytosis. Each of the five dogs had a high level of circulating antibody to *Leptospira interrogans* serovar *grippotyphosa*, and this serovar was isolated from the urine of one dog. Two of the dogs died and the remaining three were successfully treated with penicillin. Despite efforts to encourage practicing veterinarians to submit samples from dogs presenting with acute renal failure, only one *L. grippotyphosa* case has been confirmed in 1993.

All five of the 1992 cases occurred during the months of September through December in three densely populated contiguous counties in north central Georgia (Atlanta area). Three of the dogs were German shepherds, one was a cockapoo, and one was a dachshund. Two of the German shepherds were pen mates. The cockapoo and dachshund were house dogs but had access to the back yard and wooded areas during walks.

Circulating antibody to *L. grippotyphosa* was demonstrated by the microscopic agglutination test in all five dogs. Three of the dogs had titers equal to or in excess of 1:12,800. Titers of 1:3,200 were noted in two of the dogs, and in one of these an acute serum collected one week earlier had a titer of only 1:400. Antibody to other serovars, specifically *pomona* and *bratislava*, was also detected in all five dogs. These "tracking" titers were quite high but at least six to eight fold lower than titers to *grippotyphosa*.
LEPTOSPIROSIS

Gross necropsy lesions were noted in one of the two dogs that died. Fluorescent antibody examination of kidney imprints revealed large numbers of characteristic leptospires and an appreciable amount of fragmented fluorescing objects thought to be leptospiral debris. The other dog that died was not necropsied.

Of these five cases of leptospirosis, one was confirmed by culture. Samples were unavailable for isolation attempts on three of the dogs; and in the one unsuccessful attempt, tissues had been refrigerated for three days prior to culture. The successful isolation was made from a 1:10 dilution of urine from one of the dogs with an antibody titer of >1:12,800. This was accomplished in EMJH semisolid medium. This isolate was identified serologically as *grippotyphosa* and confirmed as such at the NADC in Ames, Iowa. Further pathogenesis studies are planned.

Mr. Mark Wilson of the diagnostic section of the National Leptospirosis Reference Center (APHIS-NVSL) provided a report on the 1992–1993 activities of the section. A total of 1973 microscopic agglutination tests were performed during the period of October 1, 1992 to September 30, 1993. This is a decrease from the previous year's total of 3490 tests. Eighteen samples from four species (equine, bovine, canine, and porcine) were received for leptospiral isolation. No isolates were processed for Leptospira identification. Diagnostic reagents remain available from the diagnostic section of the National Leptospirosis Reference Center at the National Veterinary Services Laboratories (NVSL). Available reagents include live antigens and control antisera for microscopic agglutination testing, fluorescent multivalent Leptospira antibody conjugate, and concentrated flazo orange counterstain. Demand for these reagents is steady and unchanged.

Dr. Carole Bolin of the research section (ARS–NADC) of the National Leptospirosis Reference Center reported on the areas of research conducted during the year. Isolates of serovar *hardjo* from various parts of the world were assessed for pathogenicity in cattle. Three isolates from cattle in the U.S. and one strain each from Portugal, New Zealand, and Northern Ireland were tested. Each isolate was infectious for cattle and was detected in the urine of each challenged heifer. Differences in the immune response of cattle to the various strains were detected. Differences in the localization of *hardjo* in kidneys and the reproductive tract were also seen. These differences may explain in part the differences in the clinical signs and epidemiology of *hardjo* infections in different parts of the world.

Various antibiotics are being tested for treatment of Leptospirosis in domestic animals. These antibiotics are being preliminarily evaluated for treatment of serovar *pomona* in hamsters. Those which show promise in hamsters will be evaluated in pigs infected with *pomona* and cattle infected with *hardjo*.

Last year it was reported to the committee that the diagnostic
division of the National Leptospirosis Reference Center will no longer be providing serology other than for export or performing leptospiral isolations. This decrease in services provided by the Center was discussed at length and a resolution was unanimously adopted by the committee requesting that sufficient funding be provided to allow the USDA to once again provide leptospiral culture from clinical specimens, identification of cultures, and to continue to supply and improve upon all diagnostic reagents.
The committee met Wednesday, October 27, 1993, at 1:30 PM in the Sahara Hotel Room 5, Las Vegas, Nevada. There were 11 members and 25 guests present.

The First topic for discussion was, Preharvest Food Safety. Five different agencies' perspectives addressing this issue were presented.

1. Dr. Joe Annelli, USDA, APHIS, Swine Health Staff, National Swine Epidemiologist, reported the following to the committee:
   The United States Department of Agriculture (USDA), Animal Plant Health Inspections Service (APHIS), has accepted the leadership role in Preharvest Food Safety.

   Supplying the American public with safe food involves many participants and several stages that are linked together in a complex chain. Every link in this chain is vulnerable to disease-causing pathogens. The first link is the farmers/ranchers, who raise crops and livestock. Next come the transporters, who move these products to markets and then to slaughtering plants and processors. These links compose the preharvest area of the U.S. food chain. Animal identification plays a vital role in linking the animal from the consumer to the producer.

2. Dr. Robert Brewer, USDA, FSIS, Deputy Director, Slaughter Inspection Standards and Procedures Division, reported the following to the committee:
   The National Academy of Sciences 1985 report, "Meat and Poultry Inspection, The Scientific Basis of the Nations Program" made an excellent set of recommendations to modernize a system that would be scientific and meet needs of consumer public health and benefit producers.

   One recommendation was to establish an animal identification system that would allow animals to be traced from the producer to the consumer table.

   A system has to be initiated immediately with current technology.
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We can't wait for the ideal system to be developed before we mandate a livestock ID program. If a mandatory plan was started, it would accelerate technical developments and hasten improvements in ID devices.

Finally, the ID plan initially should in part be financed by USDA in much the same way as are the tuberculosis and brucellosis programs. These programs are supported as public health measures. A permanent traceable ID device unique to each animal used for food is ever bit as much a public health benefit as tuberculosis and brucellosis were at their inception.

The time has come for all agencies to close ranks and expedite universal adoption of permanent, unique ID for all potential food animals.

3. Dr. G. A Mitchell, Director, Office of Surveillance and Compliance, Food and Drug Administration (FDA)/Center for Veterinary Medicine, reported the following to the committee:

The FDA encourages producers, livestock dealers, and haulers to identify animals that are administered drugs. Electronic identification is one technique that holds great promise of assisting in proper identification of animals in certain classes.

The FDA Center for Veterinary Medicine (CVM) has determined that implantible electronic identification products are food additives under the Federal Food, Drug, and Cosmetic Act because there is a reasonable expectation of these products directly or indirectly becoming or otherwise affecting the characteristic of food. For instance, these products may reasonably be expected to become a component of rendered animal byproducts such as meat and bone meal.

Manufactures of implantible electronic identification products have contacted CVM seeking information on how to obtain a food additive position approval.

4. Dr. David Meeker, Vice President Research and Education, National Pork Producers Council (NPPC), reported the following to the committee:

The ability to identify the source of swine and traceback to their origin is critical for food safety, disease control, and product improvement.

A NPPC task force began work on swine identification (ID) in 1984 following a pork producer delegate resolution which called for its formation. In 1985, delegates approved ID standards. In 1986 the NPPC delegates moved to support mandatory identification of all slaughter hogs back to the last farm of ownership, with encouragement for sharing of health and carcass quality information with pork producers.

The push for mandatory ID came from several other NPPC task forces working independently on other issues. The first Pork Value Task Force requested mandatory swine identification because the success of their Pork Value program hinged on the flow of information on the composition and merit of market hogs or carcasses which can only be accomplished through identification and traceback. Successful efforts to prevent food-
borne illness such as trichinosis, require the ability to traceback to the herd of origin infected hogs and carcasses. Disease control programs such as the eradication of pseudorabies can only be effective with identification and traceback. The NPPC Quality Assurance Committee has taken the lead in developing a producer program to reduce sulfa residue violations. It is critical to the success of their efforts that violators can be identified and the problem corrected.

The USDA published their proposed rule for mandatory swine identification in the Federal Register on February 3, 1988. The proposal provided the legal mechanism to require that all hogs bought and sold into interstate commerce have identification consisting of a tattoo, eartag, backtag or some other suitable method and that records be kept on such transactions for two years.

Electronic ID shows great promise to be useful for better production records and management, as well as for slaughter ID and traceback. This method is still in the research stage and could be quickly implemented when costs become low enough to ensure payback.

The NPPC's ID Task Force examined the proposed rules and recommended minor changes to assure they serve the needs of the industry without unfair burden on any one segment. Mandatory swine identification rules are now in force and affect all slaughter hogs going to federally inspected slaughter plants, and breeding stock and feeder pigs in interstate commerce.

The NPPC continues to support swine identification for the long-term benefit of the pork industry.

5. Mr. Gary Wilson's, National Cattlemen's Association (NCA), Director, Animal Health/Inspection, Research and Food Policy, topic was the "The Status of Beef Cattle Traceback Systems." A summary of his report to the committee follows:

Results of the National Cattlemen's Association's Traceback Capabilities report indicate that current marketing systems allow 95% traceability of all fed cattle from packer to feedlot. Cattle purchased directly from the feedlot were 100% traceable. Results of the cull cow/bull segment of the study indicated a traceback rate of 77%. Identification was highest where cattle were double backtagged. In these cases, traceability was nearly 100%.

Mr. Wilson also reported that the NCA policy supports the establishment of traceback systems. The NCA does not support the establishment of a mandatory individual animal identification system. It is NCA's belief that cull cow traceability can be improved by utilizing existing backtagging procedures with a minimum amount of cost.

Five additional topics were addressed. The topics covered were:

1. Dr. James P. Davis', USDA, APHIS, Senior Staff Veterinarian, Cattle and Diseases Surveillance Staff, topics were: Backtag
REPORT OF THE COMMITTEE

Cement A Hazardous Waste Product and Official Swine Tattoos. A summary of his reports to the committee follows:

a. Backtag Cement A Hazardous Waste Product: The backtag cement used by the Animal and Plant Health Inspection Service (APHIS) in its animal identification program is considered a hazardous waste product in accordance with the Hazardous Waste Regulations 40 CFR 261, of the Environmental Protection Act (EPA) because of its high flammable rating. This backtag cement is supplied to livestock markets, stockyards and slaughter establishments for use in APHIS's Market Cattle Identification (MCI) and Market Swine Identification (MSI) programs. These programs have the markets maintain a supply of backtag cement and tags and apply the backtags necessary for animal identification. These backtags are used by the markets to record sales information on the animals sold in their market.

To reduce the use of backtag cement that is a hazardous waste product APHIS is requesting information on self-adhesive and non-hazardous glues that could be used in our MCI and MSI programs.

A backtag cement conference is scheduled for early December 1993, to give the adhesive industry an opportunity to help APHIS find new options for backtagging livestock.

There exists a need to evaluate new products in search for a better backtag cement.

b. Official Swine Tattoos: The use of official tattoos for sows and boars has provided the Animal and Plant Health Inspection Service (APHIS) with a method of swine identification that in the past met most of the needs for sow and boar identification. The approved tattoos for sows and boars were one of the primary means of identifying slaughter sows and boars, provided that the tattoo was retained on the carcass after slaughter. Because many of the sows are skinned at slaughter the official tattoo is lost and we are unable to identify the blood sample. The need for usable identification when collecting blood samples for pseudorabies and brucellosis has created a policy of not sampling animals that are not identified with an official backtag.

There exists a need to standardize the identification of slaughter sows and boars to provide uniformity in the collection of blood samples. Blood samples should be collected only from sows or boars identified with an official backtag. Slaughter sows and boars identified with tattoos should not be sampled.

We need to consider amending the present regulation 9 CFR, Part 78.33 (a)(3), the use of official tattoos for slaughter sows and boars. The amendment should require slaughter sows and boars to be backtagged when in interstate commerce. Official swine tattoos could still be used as a supplemental form of swine identification.

2. Dr. Ralph Knowles, (veterinary consultant) reported the following to the committee: Destron-Fearing (manufacturer) advises that,
LIVESTOCK IDENTIFICATION

the development of commercial applications for electronic ID (EID) of certain livestock is proceeding using external means of attachment. Application initially targeted are those where EID is used in conjunction with automation of data collection and retrieval in the barn or the corral. One of the first is, for records management in sow breeding, which is particularly "data intensive".

A combination handheld computer/scanner has been developed that allows the farmer or rancher to automatically record the identity of the animal, then record data about the animal by punching it into the handheld terminal. Data is then uploaded to the main records system on the PC or mainframe, and fresh batch data can be downloaded to the handheld unit as well, so records in the field are always up-to-date. This method replaces ID by tattoo or conventional eartag and writing down information by hand in the barn or corral for later keying into a main computer.

An "electronic eartag" has been developed for use with the computer/scanner. The eartag consists of a transponder embedded in a specially-developed eartag which attaches in the same way as a conventional eartag.

The advantages of automating data collection and identification as described include labor savings, avoidance of error, and availability of information in the barn or corral that is always organized and up-to-date.

Electronic I.D. Inc. (a distributor for Destron-Fearing) advises that they are on the threshold to launching a program under the authority of the Louisiana Livestock Sanitary Board; each horse sold through Louisiana Auction Markets or gathered for entertainment or athletic endeavors, is tested for equine infectious anemia and identified by one of the following methods: implanting an electronic ID transponder in the ligamentum nuchae or permanent individual ID such as a lip tattoo, freeze/hot iron brand. This is the first broad application of electronic identification of animals in an animal health control program in the United States.

Dr. James Lindstrom's, Assistant Executive Director, Texas Animal Health Commission, topics were Backtagging Cattle for Interstate Movement and Mexican Eartags for Cattle. A summary of his reports to the committee follows:

a. Backtagging of Cattle for Interstate Movement: The State of Texas backtagged in FY 1993 1.2 million test eligible cattle. Seven major Texas packing plants slaughtered 3/4 million eligible head or on average 62000 head per month. During March 1993 through September 1993, the State of Texas received from three states complaints about improperly placed backtags on cattle (they were not tagged a few inches from the midline, just behind the shoulder). They were in violation of 9 CFR 71.18 "(l) cattle, when moved in interstate commerce, are identified by a Department-approved backtag affixed a few inches from the midline and just behind the shoulder of the animal..." The source of the complaints were:
REPORT OF THE COMMITTEE


The State of Texas concluded that the problem could be resolved by the affected states by their implementing procedures such as: 1. Pulling backtag off prior to shackling the animal. 2. Providing elevated platform for removing backtag and collecting blood sample after shackling 3. Using "rake like" instrument to remove the backtag.

The suggestions were based on the small number of slaughter plants collecting blood samples for the State of Texas compared to the number of cattle being backtagged in Texas livestock markets. The State of Texas also suggested that 9 CFR 71.18 be reviewed for possible changes in tagging regulations.

b. Mexican eartags for Cattle: This issue has been partially addressed by the publication of a proposed change in the CFR (9 CFR Part 92, Docket #93-063-1) that requires Mexican cattle to be tagged with Mexican eartags to enter the United States.

Increased tracing of Mexican-origin diseased or exposed cattle would be aided by requiring identification to be recorded for Mexican cattle, anytime a certificate of veterinary inspection is required. Presently, steers and non-test-eligible cattle are generally not required to be individually identified on certificates of inspection. The collection of all man-made identification for tuberculosis tracebacks needs to be emphasized.

Also needed is the entering of identification onto a central data base that would be readily accessible on a national basis.

The committee acted to approve the following motion: The Livestock Identification Committee of the USAHA respectfully requests that the Administrator, USDA, APHIS, investigate the legal ramifications of making the retention of the official Mexican eartag on Mexican steers and spayed heifers be retained on the animal until its final destination at slaughter in the United States.

It is the committee's opinion that tuberculosis control and eradication can only be accomplished through identification sufficient to trace an infected animal to the herd of origin, whether it be in the United States or Mexico.

It seems reasonable to the committee that such an import requirement relating directly to an animal from a foreign country does not constitute a violation of "States'-Rights" nor fall under federal constraints of interstate commerce.

The committee acted to approve the following motion: That USDA consider eartags as the official form of identification for cull sows and boars (not market hogs) rather than backtags or tattoo. In the correct form, these eartags could be applied and used for record keeping on farms before serving as slaughter ID. Other forms of ID could be permitted if traceback could be accomplished. The meeting was adjourned at 5:00 PM.
The Committee met at 1:30 p.m. on Tuesday, October 26, 1993, in the Cleopatra Room at the Sahara Hotel in Las Vegas, NV; 16 committee members and 19 guests were in attendance.

The committee has maintained a continuing emphasis on providing a forum to identify and address issues concerning the availability and safe use of pharmaceutical products in animals. Continuing education at all levels regarding proper and effective use of pharmaceuticals has been encouraged as a means of achieving these goals. Invited speakers included: Dr. J. S. Gloyd, Associate Director for Scientific Activities, American Veterinary Medical Association; Dr. G. A. Mitchell, Director, Office of Surveillance and Compliance, Center for Veterinary Medicine(CVM); Ms. L.E. Chi, Associate General Counsel, Animal Health Institute(AHI); Dr. J. D. McKean, Extension Veterinarian, Iowa State University, College of Veterinary Medicine; and Dr. G.W. BeVier, Vice President, Premium Standard Farms.

Dr. Gloyd discussed the AVMA legislative initiative (HR 1423, S 340) to legalize extra-label use of pharmaceutical products that is currently being considered in Congress. HR 1423 has 250 House cosponsors and S 340 has 64 Senate cosponsors and the legislation is currently progressing through both houses.

Drs. Gloyd and Mitchell updated the Committee on the Compounding in Veterinary Medicine Symposium which took place September 9–11, 1993 in Crystal City, VA.; this Symposium was sponsored by the American College of Veterinary Clinical Pharmacology, American Veterinary Medical Association, Food and Drug Administration, Center for Veterinary Medicine, Society of Veterinary Hospital Pharmacists, and the United States Pharmacopeial Convention, Inc. The individual papers and Task Force summary of the Symposium will be published in an upcoming issue of the Journal of American Veterinary Medical Association. The salient points of the Symposium, as summarized by Dr. Gloyd were:

1. Compounding is a small but nonetheless essential and important aspect of the practice of veterinary medicine.
2. The potential for drug residues increases societal concerns when compounded medicaments are administered to food producing animals.
REPORT OF THE COMMITTEE

3. Veterinarians who compound medicaments need more information regarding drug interaction, pharmacologic incompatibilities and residue avoidance.

4. Veterinarians should not hesitate to request advice and services from veterinary pharmacists when compounding becomes a necessity for appropriate application of veterinary medicine.

5. Anesthesia and toxicologic antidotes are two areas where compounding becomes absolutely essential.

6. Many of the United States trading partners afford veterinarians the prerogative of compounding medicaments when necessary.

7. There are some unapproved chemicals that should be accessible to veterinarians and pharmacists for compounding suitable medications for animals without requiring an INAD prior to their acquisition.

Dr. Mitchell stated that following the publication of the Symposium results and Task Force recommendations and subsequent CVM review of these documents, a compliance guideline concerning veterinary drug compounding will be issued by the CVM.

Dr. Mitchell further presented information prepared by Dr. A.J. Beaulieu, Deputy Director, Office of New Animal Drug Evaluation (ONADE), CVM, concerning changes in the New Animal Drug Application (NADA) review process and the number of new animal drugs approved in fiscal year 1993.

It was stated that a number of concrete changes have been implemented at the CVM and others are in the process. Among these are efforts to learn more about the problems the animal pharmaceutical industry faces in its research and development effort, to work more closely with willing animal drug sponsors in the drug development process and to review individual studies and components of NADAs as the development process proceeds—even before an NADA is formally submitted to the Center.

Like all organizations, ONADE and its organizational components have many customers, both internal and external. While perhaps not the traditional view of a regulatory organization toward those it is charged to regulate, CVM believes that it is appropriate to consider the animal pharmaceutical industry (all of the potential NADA sponsors) as legitimate and major customers of CVM. NADA sponsors are, of course, also major suppliers to ONADE. They generate and package the information that constitutes the NADA which ONADE reviews. ONADE, working with advice of all concerned parties, has the task of setting appropriate standards for the NADA and ensuring that they are met. The common mission of these interdependent parties is to insure that safe and effective animal drugs reach the market place in a timely manner.

Among the issues which have come to the fore during this re-evaluation process at CVM is the need to insure the quality of the data upon which NADA sponsors and ONADE make decisions. The integrity of the whole approval process, including the organizational integrity of the parties
involved, depends finally upon the integrity of the information upon which approval decisions are made. ONADE has determined through various audit procedures that the animal pharmaceutical industry, or at least a significant portion thereof, needs to devote more effort toward improving the quality of the data submitted to ONADE for review. Standards for data collection, summary and submission (subject to revision based on involved party comment) have been established. It is likely that more specific standards regarding the overall quality of an NADA will be established, in the future. It is ONADE's intention to clearly place the primary burden for the quality of NADA submissions upon the NADA sponsor and to refuse to accept—rather than attempt to rework—those that fail to meet the quality standard. Trying to salvage poor quality NADAs involves an enormous amount of time and resources, often to no avail. Investing ONADE's limited time and resources in salvaging poor quality NADAs cheats sponsors that are supplying quality NADAs and delays the entry of safe and effective animal drugs to the market.

As already noted, ONADE is willing to work with sponsors throughout the development process to help assure that the right studies are conducted in the right way, but the ultimate responsibility to insure the integrity of the data and its presentation in the NADA submission is the sponsors.

At the same time that the ONADE is re-evaluating the NADA review process, it is developing policy statements and/or guidelines for public comment which provide for data packages supporting NADAs considerably different than the traditional by providing increased flexibility in establishing product safety and effectiveness. Additionally, CVM is reminding guideline recipients that guidelines are not regulations, they are benchmarks—one way of doing something that will be acceptable to the Center. Sponsors are encouraged to meet with ONADE before studies are conducted to reach agreement on alternative approaches to conducting the study in question.

One of the most significant guidelines under development relates to the flexible labeling of prescription antimicrobial drugs. While important in its own right, it will probably also serve as a model for similar guidelines relating to other classes of animal drug products. The initial formal step in developing the guideline will be the announcement of the availability of a "points to consider" document which describes the principles upon which a proposed guideline will be based. Final drafting of a proposed guideline will depend upon comments on the "points to consider" document. While all future Center guidance may not follow this same path, it is likely that significant guidance documents will do so. It is important in developing such standards that all involved parties have ample opportunity to participate. Establishing a consensus, if possible, on the principles underlying a document before moving on to the implementing language should improve the process significantly.

The principles of the flexible labeling guideline involve utilizing
pharmacokinetic data and in-vitro microbial inhibition data to establish theoretical dose for each disease/organism claimed on the label. This dose would subsequently be confirmed as effective in adequate and well-controlled field trials. Each of the field trial confirmed doses would appear on the label as a suggested dose for the associated disease claim. In addition, a dose range would appear on the label. The low end of the dose range would be the lowest suggested dose and the high end would be a dose determined to be safe for the target species. (For food animals, the high dose would also have to result in a practical withdrawal period.) The labeling for the product would bear pharmacokinetic data as well as microbial inhibition data related to any pathogenic organism associated with any disease claim on the label. (For food animals, labeling would also contain information correlating dose and withdrawal period.) Veterinarians could use, or prescribe the use of, the product within the dose range permitted on the label—guided by all of the information in the labeling—without fear of violating prohibitions against extra-label use.

Establishing the high end of a dose range by means of target animal safety data will likely involve revision of current target animal safety guidelines which are based on multiple of a fixed-dose approach to establishing product safety. It is likely that CVM will follow a process similar to that used for the flexible labeling guideline in revising the target animal safety guidelines.

With respect to both target animal safety and effectiveness, CVM anticipates that new guidance will stimulate considerably more flexibility than has traditionally been the case.

ONADE is in the process of codifying the basis for much of this increased scientific and administrative flexibility by revising its basic procedural regulations—specifically, 21 CFR 511 which provides for the use of Investigational New Animal Drugs and 21 CFR 514 which provides for the submission and review of New Animal Drug Applications. Revisions of the latter regulations have already been proposed and commented on. However, the center anticipates a reproposed revision of 514 and a proposed revision of 511 to be simultaneously published for comments, sometime in fiscal year 1994.

ONADE has just completed one of its most productive years in terms of significant approval actions. Thirty-eight approvals, including 1 new chemical entity, 7 Drug Efficacy Study Implementation (DESI) and 9 generic were published in the Federal Register during 1993. The Office hopes to maintain a similar level of productivity in fiscal year 1994, while at the same time laying the groundwork for significant improvement.

In May, 1993, AH1 and the CVM cosponsored a workshop on advertising and promotional labeling. The outcome of this workshop suggested the CVM sees the need for closely monitoring advertising to prevent the promotion of unapproved new drug claims; conversely, the
PHARMACEUTICALS

pharmaceutical industry feels that such activity exceeds the CVM's legitimate mandate. CVM's interpretation is that if the advertising of an OTC product establishes an unapproved use, the product becomes misbranded under Section 502(f)(1) and adulterated under Section 512(c)(1)(E) of the Federal Food, Drug and Cosmetic Act. CVM is writing a guideline to clarify the interpretation.

Ms. Chi stated AHl is looking forward to the issuance of the advertising guideline. It was hoped that the guideline would benefit from the frank presentation of the pharmaceutical industry's perspective as articulated in the workshop. Ms. Chi noted the CVM's inconsistencies regarding the link between advertising (a marketing issue) and the regulatory issues of safety and efficacy of an animal health product. She further noted the raising of this issue had provided considerable dispute (from a legal perspective) regarding whether regulatory responsibility (especially regarding OTC products) were within FDA's domain, as opposed to the FTC.

Dr. Mitchell referenced shuttle programs for coccidiostats and "derived benefits" from therapeutic agents as the CVM's major area of concern. Both advertising and brochures for examples are seen as an extension of the product's label. Dr. Mitchell stated that CVM is working on guidelines for acceptable advertising, and that these will be promulgated in 1994.

Dr. McKean emphasized in his presentation that advertising of veterinary pharmaceuticals is a major factor in activating proper drug usage. Advertisement and other promotional material must be accurate and truthful in content. Advertisements should explain the proper usage of an animal drug and the rationale for its selection. Economic considerations must be part of that educational process. The approved label dictates the approved conditions for use and represents supporting data for these label claims. Labels provide the legal limits for each new animal drug as approved by FDA. They do not provide the rationale for usage. This educational information transfer must be accomplished by the advertisement and promotional materials. The standard for acceptance of advertisements and promotional literature should be truthfulness and educational value. Dr. McKean cited the example that "it is not enough to know that a product is efficacious in reducing parasite burdens or treatment of disease". Additional information about the economic value of usage, appropriate applications within label claim and comparative values of competitive products enables producers and veterinarians to make more enlightened and intelligent judgements regarding selection and usage of animal drugs. Such information does not alter label claims, legality of usage, safety, or efficacy of the product. With respect to the above, Dr. McKean stated that such comparative data and economic evaluation must be credible and confirmable by field experiences for the manufacturer to receive benefits. "Puffery" of a drug which is counter to field experience will be discounted and the manu--
facturer and the drug in question will lose credibility as a result. Anecdotal information about product effectiveness for various usages moves rapidly through the producer/veterinarian community. This information dissemination occurs even in the absence of advertisements and promotions. Dr. McKean recognized that pharmaceutical manufacturers are the best source of information about their products, including unapproved uses. Pharmaceutical firm representatives are severely restricted in what they may say about such use. He encouraged the CVM to use discretion in allowing firms greater latitude in providing this information on request. He further stated that supportable, scientific–based information about how labeled usages can be integrated into production practices and the anticipated economic benefits to society does not require additional regulatory activity.

Dr. BeVier stated it is in the best interest of producers, veterinarians, pharmaceutical companies and governmental agencies that the flow of product information should not be impeded. Informed decisions about product purchases are made after careful consideration of all relevant facts (often including internally conducted trials) and that promotional material concerning secondary or derived benefits is useful information to the consumer. The buyer accepts that the product is safe and efficacious as approved by the FDA but the purchase is made on a cost/benefit basis. An additional concern was expressed that if derived benefit information obtained as a result of scientifically credible research is not available, small to medium sized producers will be put at an economic disadvantage as they would not have access to the same information available to large operators.

Following the above presentations, there was a question and answer session with comments from the audience and participants. The key point that developed during the discussion was the Committee's recognition of the fact that sponsors should be permitted to establish and use derived economic benefit information.
The Committee on Professional Oversight met at 1:30 p.m., October 28, 1993 with eight members in attendance.

Last year's report was reviewed. It appears that the changes in the use of Federal postage to support sample and communication delivery in cooperative programs are being accomplished with only limited damage to program results.

The presentation of Dr. Sid Nusbaum to the General Session regarding the role and status of State animal health officials (State Veterinarians) and the related broader agencies and programs was reviewed. The Committee concurs in principle with that report. A related resolution was forwarded to the Committee on Resolutions.

A proposal was presented to the Committee that USAHA study the feasibility of having tests and Certificates of Veterinary Inspection recognized for forty-five days rather than thirty days for purposes of interstate movement. It was noted that this would involve a change in the Code of Federal Regulations as well as statutes and/or rules in most states. A concern was noted that such changes would likely impact animals being prepared for export. The Committee requests that the President survey USDA, State animal health authorities, and appropriate industry parties to assess the impact of such changes.
REPORT OF THE COMMITTEE ON PUBLIC RELATIONS

Chairman: Dr. H. W. Towers, Dover, DE
Vice Chairman: Dr. John K. Atwell, Apex, NC

N. Black, MN; T.M. Cook, DC; T.J. Hagerty, MN; L.D. Mark, VA; R.H. McCapes, CA; J.C. Shook, PA; A.J. Stern, FL; M.C. Turner, TX; H.A. Virts, MD

The U.S.A.H.A. Committee on Public Relations met on Sunday afternoon October 24, 1993 in the Pharaoh's Board Room of the Sahara Casino Hotel. The chairman called the meeting to order with five committee members present. Mr. Neal Black, U.S.A.H.A.'s public relations person, reported that he had made two mailings during the year to his list of over three hundred agricultural publications throughout the United States. The first mailing announced the date and location of the meeting and also emphasized the committee structure of the organization, listing the committee names and their chairmen. The second contact was made at the beginning of September and included an invitation to press personnel, a press release describing the meeting and a media coverage request form where the contact persons could select the committee summaries or speech texts which they wished to have sent to them. Mr. Black reported that he had received requests for one hundred ninety one committee summaries and one hundred fifty general session presentations.

The committee was pleased to announce that a complimentary copy of last meeting's proceedings had been sent to each College of Veterinary Medicine in the United States. In September, a follow-up letter, brochure and program was sent to each college pointing out the diversity of our program and inviting anyone from their institution to attend this meeting. Along those same lines, the committee commends the Ad-Hoc Committee on the Interaction of U.S.A.H.A. with the Colleges of Veterinary Medicine and Veterinary Students for their thorough report and plans to address some of its recommendations in the future.

The committee was pleased to hear the details of the purchase of new computer equipment for the Richmond office. This has already enhanced the production of a timely and more informative newsletter as well as speeding up the completion of the proceedings.

Items to be addressed during the upcoming year include: soliciting the help of committee chairmen in submitting ideas for interesting newsletter articles and sending supplies of our organization's brochure to all state veterinarians to hand out to each accreditation applicant. The committee recommends that sometime in the future, when funds become available, a professional quality video be made depicting the scope and purpose of the organization. Copies of this video could then be sent to all Colleges of Veterinary Medicine, universities with animal and poultry science departments as well as to other interested parities.

The meeting was adjourned at 6:00 PM.
REPORT OF THE COMMITTEE ON SHEEP AND GOATS

Chairman: Mrs. Michele C. Turner, Water Valley, TX  
Vice Chairman: Dr. Michael M. Jochim, Wheat Ridge, CO

J.A. Acree, MD; R.K. Akkina, CA; A.A. Andersen, IA; M.H. Bairey, IA; M.S. Bulgin, ID; A. De La Concha, TX; N.E. East, CA; W.C. Foote, UT; J.E. Fox, GA; C.A. Gipson, FL; J.S. Glenn, CA; J.R. Gorham, WA; J.N. Huff, CO; L. Johnson, CO; W.E. Ketter, MD; C.V. Kimberling, CO; L.L. Logan–Henfrey, Kenya; C.J. Mare, AZ; M.R. Marshall, UT; B.I. Osburn, CA; C. Palmer, CA; R.K. Pelant, AR; R.A. Robinson, MN; P. Rodgers, CO; M.D. Salman, CO; C.M. Scanlan, TX; J.A. Schmitz, NE; A.W. Smith, OR; J.G. Songer, AZ; J.L. Stott, CA; W.L. Thomas, OH; P.H. Timm, CA; O.H. Timm, CA; P.R. Turner, TX; R.J. Velure, ND; H.W. Whitford, TX.

The Sheep and Goat Committee met at 1:30 P.M. Monday, October 25, 1993. There were 17 members and 38 guests for a total of 55 people in attendance.

The Committee met as requested by the President of USAHA to consider the business of the Committee and submit the following report:

Dr. Jim Alexander, Pan American Veterinary Laboratories, described the ELISA's offered by his laboratory for the detection of antibody to a number of diseases of sheep and goats. These include tests for Brucella ovis, Brucella melitensis, ovine progressive pneumonia, caprine arthritis encephalitis, paratuberculosis and caseous lymphadenitis. Results of a comparison between the ELISA offered by his laboratory and the standard ELISA for B. ovis ram epididymitis showed his test to be more sensitive and to provide greater accuracy in identifying infected animals at an earlier stage of the disease.

Dr. Glenn Songer, University of Arizona, reported on the evaluation of an ELISA for the diagnosis of caseous lymphadenitis in sheep and goats. The test uses a recombinant phospholipase D protein which has been expressed in E. coli and purified for use as an antigen in the ELISA. The toxic phospholipase D represents a major immunodominant antigen produced only by Corynebacterium pseudotuberculosis, among the pathogens of sheep. When used for routine diagnostic screening the test had a sensitivity and specificity of about 85%. Adjusting the cutoff optical density to a higher cutoff gave higher specificity, but lower sensitivity and visa versa. The test was also shown to have excellent reliability when samples were repeatedly tested on different ELISA plates and at different times with little variation in the results. Based upon these evaluations, Dr. Songer recommended the use of the ELISA to help eliminate caseous lymphadenitis from nonvaccinated, low prevalence flocks or herds, for use in screening animals before purchase and as a useful aid in the differential diagnosis of thin ewe or thin goat syndrome. Currently the testing is available only through Mann Equitest in Ontario, Canada.
Dr. Marie Bulgin, University of Idaho, discussed some of the areas of concern to sheep producers and veterinarians in Idaho. There is a need to have some important drugs cleared for use in sheep and for the use of higher levels of drugs to be allowed to be used in feedstuffs. These are related specifically to diseases caused by E. coli, salmonella, and coccidia. There is also a need for fertility drugs to be approved for use in the range sheep industry. Dr. Bulgin was concerned about the limited progress being made to certify the California produced BT vaccine for use in selected problem areas in Idaho.

Dr. John Glenn, University of California, reported on the concerns of the California Voluntary Scrapie Certification Board. The Board recommended that the National Oversight Committee consider the following changes: that flank tattoos, ear tattoos, or electronic identification devices be the official means of identification and that additional surveillance classes be added that address the risks and needs of western range operations. Another concern was the potential liability of board members because sensitive and confidential information may be discussed at the meetings. Unless some legal protection is afforded, many people who are vital to the success of the program are going to be reluctant to participate on the board. Lastly, there is concern over the proposed FDA ban on the inclusion of sheep and goat carcasses and offal from slaughter, in ruminant feed and the potential detrimental effect on participation in the Scrapie Voluntary program.

Dr. Daniel Harpster, USDA/APHIS, updated the committee on the status of the Federal/State Certification Program for Scrapie and the Limited Indemnity Program. The Indemnity Program was conducted from January 8, 1993, through July 7, 1993. Just over one million dollars in indemnity payments were made for 8,952 animals in 96 flocks. Seventy-nine flocks were totally depopulated. Partial depopulation, involving only high-risk animals, was carried out in 11 of the flocks. In the remaining six flocks, a single animal was purchased for diagnostic purposes. Seventy-nine of the flocks that were completely or partially depopulated were known to be infected or to be source flocks prior to the outset of the indemnity program. Approximately 180 flocks were known to be infected or to be source flocks when the program began. The National Veterinary Services Laboratories confirmed 139 cases of scrapie during fiscal year 1993 which included 110 newly identified flocks. It is estimated that a total of 35 to 40 flocks were in the Voluntary Scrapie Flock Certification Program as of September 30, 1993. Dr. Harpster also discussed the Scrapie Information System (SIS) which was introduced in the later part of 1993 with full utilization to take place during 1994. The system, which will maintain both flock status and individual animal records, was first made available as phase 1 which dealt only with the status of the flocks. After two training courses on the use of SIS, phase 2, which is the individual animal record component, will be installed in participating Veterinary Services' Area Offices. Access to the SIS
SHEEP AND GOATS

will initially be only through the National or Area Offices. Access through a nationwide "800" telephone line is being developed. With electronic identification not being readily available, and ear tattoos being difficult to read, the National Scrapie Oversight Committee recommended the use of flank tattoos as an official means of identification for the Program. Officially tattooed animals will not have to be reidentified when electronic identification becomes the official means of identification.

Sheep and Goat Committee Chairman Michele Turner read two resolutions passed by the USAHA in 1991 and 1992, requesting the importation of sheep genetics material and live animals into the U.S. After much confusion and discussion it was determined that two completely separate issues were being addressed:

1) A letter that announced an upcoming review of import regulations for germ plasm and also solicited input from interested parties, and
2) Drafts of Protocols developed by APHIS Staff for importing sheep or goat semen from countries recognized free of FMD, but are affected by Scrapie; Importation of frozen sheep or goat embryos from countries affected with Scrapie that are recognized free of foot-and-mouth disease; and the importation of live sheep and goats from foot-and-mouth disease free countries. These Protocols are to be developed cooperatively by APHIS and Industry.

Chairman Turner read the USAHA'S Sheep and Goat Committee response for the request for comments to the proposed changes in Part 98 of 9 CFR. This response pointed out that the USAHA had twice passed resolutions requesting that Protocols be established to permit the importation of these materials and live animals.

Dr. Roger Perkins, Staff Veterinarian, National Center for Import and Export, Vet. Services, USDA, stated that the proposal to change import regulations applied to all species. Also, that review of comments are underway – no decisions have been made – only bovine embryos are now being considered – much inhouse work is yet to be done.

After considerable discussion Dr. Perkins agreed to prepare a summary to clarify the issues related to differences in preparing the Protocols and changing existing Regulations. Dr. Robert Kahrs, Director, National Center for Import and Export, recommended that the committee work toward the development of these protocols, as there is no restriction on further discussion and input by the industry.

A Subcommittee will be established for the Development of Protocols for the Importation of Sheep and Goat Genetic Materials and Live Animals Into the United States. Dr. Perkins clarification statement and the draft protocols will be sent to every USAHA Sheep and Goat committee member for their information and response.

The committee passed 1 resolution requesting that the USAHA Sheep and Goat Committee, as well as the AAVLD, support the
standardization and validation of diagnostic tests for B. ovis, OPP, CAEV and Johnes disease. As there are multiple labs and different types of tests and antigens being used, the results are highly variable making it difficult to use these tests for disease control and/or eradication.

The committee tabled 1 resolution regarding concerns of the California Scrapie Certification Board, as the committee felt that these concerns should be addressed by the National Scrapie Oversight Committee which met immediately following the meeting of the Sheep and Goat Committee.
REPORT OF THE COMMITTEE
ON TRANSMISSIBLE DISEASES OF SWINE

Chairman: Dr. John P. Kluge, Ames, IA
Vice Chairman: Dr. David G. Thawley, North Oaks, MN

G.A. Anderson, KS; G.W. Beran, IA; L.G. Biehl, IL; N. Black, MN; P.E. Bradshaw, IL; J.R. Cole, GA; J.M. Cunningham, NE; P.B. Doby, IL; E.G. Duhamel, NE; G.A. Erickson, NC; W.R. Freese, MN; D. Galbreath, MD; A.M. Gallina, IL; R.D. Glock, CO; M. Hammer, NC; D.L. Harris, KY; G.W. Hausman, IA; H. Hill, IA; H.S. Joo, MN; W. Kadel, KY; C.L. Kanitz, IN; B. Lautner, IA; J.M. Lewis, MN; C. Massengill, MO; W.L. Mengeling, IA; R.D. Michaels, IA; F.J. Mulhern, MD; P.A. O'Berry, IA; C. Olson, IA; R.E. Omohundro, TX; C. Rogers, NE; L. Schlater, IA; R.A. Schultz, IA; G. Stevenson, IN; H.W. Towers, DE; W.G. Van Alstine, IN; M.W. Vorhies, KS; D.L. Weiss, MN; P.W. Widel, MO; W.B. Wren, KS; J.C. Wright, AL

1:30 PM, Monday October 25, 1993
Sahara Hotel, Las Vegas, Nevada

H. Hill, Iowa State University, presented an update on the current status of PRRS within the US. He noted that over the past three years the number of reproductive problems associated with PRRS has decreased dramatically. The number of respiratory cases has remained level and therefore represents a much larger percentage of the clinical cases. He noted that PRRS has become part of the respiratory disease complex of nursery/grower pigs. New information about the virus is that there are clear differences between the European and US strains of the virus. Differences have been demonstrated among US isolates and in general the US isolates are more pathogenic than the Lylestad virus. McGinley and Zimmerman from the US have demonstrated that the virus is highly infectious, more so than pseudorabies virus. Zimmerman has also reported the infection in waterfowl. Swensen from Iowa State University demonstrated PRRS virus in the semen of an experimentally infected boar. Benfield from South Dakota State University has reported transmission via undiluted semen.

S. Weber reported that USDA-APHIS Veterinary Services is participating with the swine industry in quantifying the risk of transmission of foreign animal diseases and/or public health diseases to swine through the feeding of uncooked garbage. The presentation focused on a brief background of the swine health protection program, the reasons why the risk assessment was requested, the approach to the risk assessment and the anticipated objectives. Members of the committee were solicited for their assistance in identifying and quantifying criteria which may be of importance in the risk assessment.

J. McKean, Iowa State University, presented his opinions on disease surveillance and the need to custom design surveillance to match the
disease and program. He noted that rapid changes within the swine industry have resulted in an increased focus on disease control by individual producers. The current interest in food safety and the increased availability of diagnostic tests have stimulated this trend. He stressed the difference between surveillance, (random examination of negative herds) and case finding (non-random examination of negative herds, example: trace back, down the road and circle testing). He drew a distinction between surveillance needed for diseases that spread rapidly between herds (inter-herd transmission) and those that do not (intra-herd transmission). He also noted that differences existed in the acceptance by producers of active (testing on random basis with a fixed percentage of non-infected herds tested annually) and passive (slaughter and first point testing) surveillance methods.

D. Thawley from the University of Minnesota presented a paper prepared by P. Davies describing a swine slaughter disease monitoring program, PIGMON. Since 1990 the programs has monitored over 1500 inspections involving nearly 50,000 pigs from over 840 herds. The program utilizes the monitoring of pigs at slaughter and monitors the following diseases: enzootic pneumonia, atrophic rhinitis, papular dermatitis, pericarditis, liver white spots, pleuritis, pleuropneumonia, ileitis and peritonitis. The program utilizes custom software to collate data and to generate reports. A centralized database is kept at the University of Minnesota. Validation of the program indicates its usefulness as a standardized monitoring device for measuring disease prevalence across the US swine industry. It provides a reliable index of lesion prevalence within the industry while concurrently serving as a means of monitoring quality control. Thawley noted that future development of the program will involve the merging of PIGMON data from herds with producer records and other data directed at the quality control of pork production.

J. Annelli, USDA-APHIS presented a paper on the international implications of new and emerging diseases on foreign trade. He used PRRS as an example of a new disease that has had significant trade implications. He described the current international distribution of the disease and over viewed current import restrictions due to PRRS. He noted that in many cases there is no logical association between disease occurrence and trade policy based on scientific information. He concluded that this is representative of trade issues related to emerging diseases.

A. Tank from the National Pork Producers Council discussed the subject of global surveillance. He described some of the rapid changes in the US industry and its emergence as a major exporter of pig meat. In the face of escalating interest worldwide of animal health and food safety issues, he noted an increased use of animal health and food safety issues as non tariff trade barriers. He alarmed the audience by describing the widespread use of non tariff trade barriers which are increasing at a rapid rate. He
concluded that such trends may seriously restrict future growth in the US swine industry. To overcome the problem he proposed a global surveillance program for animal diseases.

J. Kluge
Chairman

D. Thawley
Vice Chairman
REPORT OF THE COMMITTEE ON WILDLIFE DISEASES

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Vice Chairman: Dr. Victor F. Nettles, Athens, GA

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The Committee on Wildlife Diseases met at 1:30 p.m. on Monday, November 25, 1993; about 75 members and guests were present. The Committee's work for the past year was reviewed and new activities were planned for several items on the agenda. Summary statements of reports and the Committee's recommended actions and resolutions follow:

1. Bluetongue and Epizootic Hemorrhagic Disease Virus Serotype Distribution in Southeastern White-tailed Deer Populations.

In 1992, Dr. David Stallknecht gave a preliminary report on distribution of bluetongue virus (BTV) and epizootic hemorrhagic disease virus (EHDV) serotypes in Georgia. At this meeting, Dr. Stallknecht reported on expanded studies to examine distribution of BTV and EHDV serotypes, collectively referred to as hemorrhagic disease (HD), in white-tailed deer in the southeastern US. In order to better understand the epizootiology of HD in white-tailed deer, a surveillance network was established during 1991 in cooperation with wildlife management agencies in 14 southeastern states. The objectives of this ongoing long-term study are to determine annual extents of exposure to BTV and EHDV serotypes and to relate these data to occurrences of HD in deer. Ultimately, these data will be used in developing a predictive model of HD risk for the southeastern US.

Results from 1991 and 1992 indicate that antibody prevalence and BTV/EHDV serotype diversity are highest in extreme southern (FL) and western (TX) parts of the sampled region. Virtually all serological evidence of BTV exposure (BTV-2, BTV-11, BTV-13, BTV-17) was restricted to these areas; BTV-10 exposure was not detected anywhere in the region. In contrast, EHDV-1 and EHDV-2 exposures were widely distributed. When compared to reported HD outbreaks over the past 12 years, several apparent patterns related to herd immunity were suggested. Acute HD, usually fatal
REPORT OF THE COMMITTEE

in affected deer, has been reported most often from areas of low herd immunity where few BTV and/or EHDV serotypes are present. Chronic HD, which may debilitate but rarely kills deer, appears to be associated with areas of moderate herd immunity where multiple BTV and/or EHDV serotypes are present. Hemorrhagic disease was rarely reported in areas (e.g., FL, TX) where both herd immunity and serotype diversity were extremely high. These observations suggest HD may be naturally regulated within white-tailed deer populations in the southeastern US, but more data are needed to further understanding of HD epizootiology.

2. 1993 Michigan Captive Cervidae Project.

In early 1993, Dr. Karen Shank, currently with USDA/APHIS International Services, conducted a survey on captive cervids in Michigan while working for the office of the Area Veterinarian in Charge (AVIC). Dr. Shank was unable to attend this meeting, but she prepared a report on the Michigan Captive Cervidae Project, which was presented by Dr. John Clifford, AVIC, MI.

In Michigan, the number of commercial deer breeders registered with the Michigan Department of Natural Resources (MDNR) has increased from 181 in fall 1990 to 315 as of October, 1993. In addition, a number of individuals have been breeding captive elk. Relatively little was known about farming of captive cervids in Michigan with respect to herd composition, disease prevalence, animal husbandry, and management practices. Using a mail-in survey format, the Michigan Captive Cervidae Project was designed to provide this information. An additional goal was to gather data concerning producers' attitudes toward regulation of the captive cervid industry.

Of the 362 captive cervid farms in Michigan, 228 (63%) responded to the mail survey. Survey respondents reported owning a total of 4,972 white-tailed deer, 766 elk, 284 fallow deer, 114 sika deer, 6 red deer, 4 axis deer, and 2 caribou — 6148 captive cervids in total. Most farms (86%) had only one species of cervid, and white-tailed deer predominated (75%). Two cervid species were owned by 11%, and remaining farms held 3 (3%) or 4 (1%) species.

Captive cervid owners indicated they had 1 to 50 years of captive cervid–related experience (mean 6.7; median 5 years) and had owned cervids for 1 to 35 years (mean 5.7, median 4 years). Over half (55%, 122/220) of all respondents indicated they owned captive cervids primarily for fun. However, a substantial number indicated that profit (31%, 68/221) or both fun and profit (14%, 31/221) were their main purposes. When asked to list their top 3 reasons for keeping captive cervids, having them as pets ranked highest (46%, 90/192), breeding for sale ranked second (32%, 60/190), and game farm hunting ranked a distant third (10%, 17/170).

Data concerning illness and death in captive cervids during the last
12 months were provided for 5,493 cervids on 114 farms. Overall morbidity rate was 6% (336/5,493), and overall mortality rate was 4% (203/5,493). One or more cases of disease were reported by 63% (91/144) of farms; the number of cases per farm ranged from 0 to 34 and averaged 2.3, with a median occurrence of 1 case. One or more deaths occurred on 45% (65/144) of farms, with a range of 0 to 22, a mean of 1.4, and a median of 0. Injuries accounted for nearly 33% of all cases of illness and over 25% of all deaths. Together, injuries and stress from handling or transport accounted for nearly 50% of all deaths reported. A substantial number of deaths (18.2%) were from unknown causes. The most common forms of illness reported were digestive disorders, respiratory disorders, foot and leg problems, and fawning difficulty. Neurologic disorders, skin problems, and "poor doers" were also reported.

Veterinary consultation on some aspect of captive cervid management was sought by 73% (159/219) of respondents. Services provided included general consultation (58%, 93/159), treatment of injuries (28%, 44/159), deworming (25%, 40/159), health certificates (19%, 31/159), treatment of illness (18%, 28/159), vaccination (14%, 22/159), disease diagnosis (9%, 14/159), foot care (4%, 6/159), and other purposes such as necropsy, dystocia, and antler removal (11%, 18/159).

Preventive care and disease testing was practiced on many cervid farms. Routine deworming was practiced on 79% (173/219) of respondents' farms. Treatment frequency ranged from 1 to 6 times per year, with a mean of 2.2 and a median of 2 times/year. In-feed anthelmintics were most commonly used (80%, 139/173), followed by injectable products (39%, 67/173) and oral pastes (17%, 29/173). Anthelmintics were also given in drinking water and as pour-ons. Only 13% (28/215) of those responding reported routinely vaccinating their cervids. The most common immunization was against several species of *Clostridium* (other than *C. tetani*), and was practiced by 7.0% (15/215) of all respondents. Immunization against tetanus (*C. tetani*) was reported by 5.1% (11/215) of respondents and against leptospirosis by 1% (1/215); 1% (2/215) did not know which vaccinations were used. Routine testing was practiced on 14% (29/215) of the farms. Of those that reported testing, 52% (15/29) tested for tuberculosis, 41% (12/29) tested for meningeal worm, 41% (12/29) tested for brucellosis, 35% (10/29) tested for bluetongue, and 24% (2/29) tested for anaplasmosis. Some respondents (17%, 5/29) were uncertain what tests had been used in their herds.

Collectively, 84% (190/226) of respondents believed at least one government agency impacted them, while 16% (36/226) were not sure. When asked which agencies impacted them, MDNR was most often indicated (79%, 179/226). Other agencies mentioned included the Michigan Department of Agriculture (30%, 68/226), USDA/APHIS/VS (28%, 58/226), USDA/APHIS/REAC (12%, 27/226), and US Fish and Wildlife Service (12%,
When asked if they believed government regulations are necessary for their industry, 56% (121/217) agreed that some regulations were necessary; about 30% (66/217) disagreed. Those regarded as necessary included TB or other health regulations (17%, 37/217), various welfare-related rules (e.g., pen size or animal care) (21%, 45/217), regulations for meat production and inspection (3%, 7/217), and rules preventing capture of wild deer (6%, 12/217). Although about 35% (62/177) of respondents felt conflicts existed between the regulations of different government entities, they did not offer concrete examples of such conflicts. The majority, however, either did not feel conflicts existed (45%, 80/177) or were unsure (18%, 32/177). When asked if they felt any current regulations were inappropriate for the industry, 64% (127/200) answered "yes"; 36% (71/200) answered "no". Most frequently cited (41%, 82/200) as inappropriate were various aspects of TB testing. Specifically, 25% (50/200) expressed dissatisfaction with cost, accuracy, and/or convenience of the TB testing, 18% (36/200) disputed MDNR's requirement for TB testing on intrastate movements, and 5% (9/200) opposed TB testing of animals under 6 months of age. Another 5% (10/200) regarded some aspect of regulations on cervid housing and facilities as being inappropriate.

When asked if they supported forming an advisory or oversight board for cervid farming in Michigan, 55% (120/218) favored formation of such a board, 15% (33/218) were opposed, and 30% (65/218) were uncertain. Inquiries regarding their future plans revealed that 46% (102/221) of respondents planned to increase the herd size by 10% or more, 38% (83/221) planned to maintain current herd size, 7% (16/221) planned to decrease herd size by 10% or more, and 3% (7/221) planned to get out of cervid farming completely. In summary, 84% of survey respondents planned to retain or increase their herd size, while only 10% planned to reduce the herd size or leave the business. Clearly, the number of captive cervids can be expected to increase in Michigan, and a variety of regulatory issues will need to be addressed as cervid farming continues to grow.

3. Disease Issues Important to the North American Llama Industry and Wildlife

Mr. Bob Frost, Research Committee, International Llama Association, reported to the Committee on expansion of the North American Llama industry as it might relate to wildlife diseases.

Until the late 1970's, llamas numbered only a very few hundred across North America, and most were in zoos and exotic collections. Today, private ownership in North America has expanded to 7,000 small owners and ranches with about 70,000 llamas and 3,000 alpacas. Llamas and alpacas are not regarded as wildlife, but rather as domesticated animals that have a variety of uses and roles. The role of llamas as companion and pack
animals, accompanying human owners into the wildlands of North America, creates situations that are potentially of interest to the Wildlife Diseases Committee. Consequently, disease issues important to the North American llama industry and wildlife were discussed.

Llamas are selective browser/grazers with padded feet and prehensile lips that pass through an area with little or no evidence they have been there. Close interactions with wildlife are probably rare, except on occasions when a llama gets loose and lost, is not recovered, and is eventually killed by a predator. One area of concern on state and federal public lands might be lambing grounds of mountain sheep. According to Mr. Frost, these areas should be identified and managed as off-limit to not only llamas, but to all human and domestic intervention. However, this is not readily done.

Mr. Frost also stated that it appears unlikely that llamas pose significant threats to domestic livestock or wildlife in the wildlands with respect to transmission of infectious or parasitic diseases. Llamas do not share lice and do not share coccidia with wild or domestic animals because both parasites are host-specific for llamas. Regarding mange mites, sarcoptic mange has been virtually eliminated with widespread use of injectable ivermectin, and psoroptic and chorioptic mange have not been problems. Llamas do share gastrointestinal nematodes with other species, but most of these are rather ubiquitous and benign parasites.

Although no health-related conflicts are currently recognized, there may be disease issues involving llamas and free-ranging wildlife that arise in the future. The International Llama Association wants to be sure that potential problems are recognized early on and that responsible scientific research is immediately undertaken to resolve and minimize any disease conflict that may occur in order to protect wildlife resources while promoting continued and growing popularity of trekking llamas in wildlands of North America.


Historically, bovine tuberculosis (TB) has been described only 4 times in free-ranging native or exotic wild animals or populations in the US. Today this disease is not known to exist in native wild ungulate populations. However, since 1991, several outbreaks of TB in captive deer and elk herds throughout the United States have been reported. As a result, some concerns exist that under certain conditions TB might escape and establish a reservoir in large populations of wild cervids located in the Western United States.

During the past few years, surveys of hunter-killed elk and mule deer have been organized by State game and fish personnel, animal health officials, and laboratory diagnosticians in Montana, Wyoming, and Colorado.
in an effort to confirm that TB has not been transmitted to wild cervids from infected, captive cervid herds or from domestic herds of cattle. Dr. Robert Meyer, USDA/APHIS/VS Western Region, reported on these cooperative studies on behalf of numerous state and federal cooperators.

In Montana, the diagnosis of TB in captive elk near Corwin Springs in 1990 sparked concern that the disease might escape into wild elk wintering nearby or migrating through the area. These infected captive elk were located in a game farm near the northern boundary of Yellowstone National Park on winter habitat for 15,000–18,000 wild elk. The close proximity of large numbers of wintering elk to TB infected game farm elk raised considerable concern among animal health and wildlife officials in Montana and elsewhere. Beginning in 1991, the Montana Department of Fish, Wildlife and Parks (MDFWP) in cooperation with the National Veterinary Service Laboratories (NVSL) and the Montana Veterinary Diagnostic Laboratory began a surveillance program to evaluate the prevalence of various diseases and parasites in elk near Yellowstone National Park. Three herd groups were sampled including: 1) Approximately 15,000 elk wintering on the upper Yellowstone River near Yellowstone National Park; 2) 2,500 elk wintering on the Flying D Ranch in the lower Gallatin River Canyon; and 3) 2,500 elk wintering on the Sun Ranch in the upper Madison River. The northern herd is composed of migrant elk that summer within Yellowstone National Park. The elk herd on the Sun Ranch is composed of 50% migrants from Yellowstone National Park and 50% resident elk summering in the upper Madison. The Flying D elk are mostly resident elk from the lower Gallatin Canyon and associate very little with elk from Yellowstone National Park.

Specimens were collected from hunter-killed elk during or just after field dressing. Field specimens collected for TB evaluation consisted of any tissues with observable lesions, liver (including hepatic lymph nodes), mesenteric lymph nodes, distal ileum, trachea, lungs (including mediastinal and tracheobronchial lymph nodes), and head. Field specimens were taken to the MDFWP Research Laboratory in Bozeman, Montana, where tissues were examined and trimmed. Half of each tissue specimen was frozen and half fixed in 10% neutral buffered formalin. Frozen and fixed tissues were submitted to the NVSL for histopathologic and bacteriologic examination. Complete or partial sets of specimens were collected from 189 elk in 1991–92 and 68 in 1992–93. Specimens were collected from 141 elk in the northern range, 52 elk from the Flying D Ranch, and 64 elk from the Madison. Several gross lesions were noted including tonsillar abscesses, pulmonary abscesses, small lymph node granulomas, and liver lesions. Tuberculous lesions were not evident in lung tissue examined grossly. Histopathologic examination of tissue from 1991–92 is completed. Mycobacterial lesions were not observed. Other incidental findings included tonsillar abscesses, eosinophilic lymphadenitis, sarcocytosis, purulent
lymphadenitis, eosinophilic interstitial pneumonia, and a purulent bronchopneumonia. Tissues from 1992–93 are currently being examined, and results are pending. Neither *Mycobacterium bovis* nor *M. paratuberculosis* was isolated from any of the tissues cultured. *M. avium* was cultured from one lung specimen.

Montana has over 1.5 million wild cervids scattered throughout a land mass encompassing 150,000 square miles. The diverse wildlife communities distributed throughout this large land mass hinder broad surveillance programs for tuberculosis. Surveillance for tuberculosis in wild cervids will primarily be attempted in selected regions where the highest probability of transmission from captive wildlife may be expected. Future outbreaks of tuberculosis in game farms will initiate cooperative surveillance attempts in wildlife for at least 2 years following initial diagnosis. Additionally, all suspect mortalities that are detected opportunistically throughout the State will be subject to post mortem examination.

Bovine tuberculosis was also diagnosed in captive elk held on a game ranch near Powderhorn, Colorado in June 1991. Since that time, the Colorado Division of Wildlife (CDOW) has investigated the possibility that TB might have spread to free-ranging wildlife outside the infected premise. During October 1992–January 1993, retropharyngeal and other cranial lymph nodes and tonsils from about 80 mule deer and elk harvested in the Powderhorn vicinity were examined for gross lesions of TB. For comparison, similar tissues from about 67 mule deer and 32 elk harvested on the Forbes Trinchera Ranch and about 25 mule deer and 29 elk harvested along the northern Front Range near Ft. Collins were collected and examined. Representative subsamples of lymph nodes and tonsils, as available, were preserved in 10% buffered formalin; duplicate subsamples were frozen at -20°C. Fixed tissues were submitted to the Wyoming State Veterinary Laboratory in Laramie for histopathologic examination, to be followed up with culturing of frozen samples when warranted by microscopic findings. Samples were collected by field officers and from game processors. When possible, eviscerated carcasses were also examined for gross lesions suggestive of tuberculosis.

In about 17 of more than 200 harvested deer and elk examined from select areas, tonsillar and/or retropharyngeal cysts, abscesses, and/or granulomas were observed; all 3 sampling areas yielded such cases. Histologic evaluations have not been completed, but no microscopic lesions compatible with TB have been observed in samples examined to date.

Examinations of wild deer and elk collected or harvested in the immediate vicinity of the tuberculosis–infected game ranch near Powderhorn since surveillance began in 1991 have revealed no indication of infection in free-ranging animals. However, sample sizes are still somewhat small (about 100), and thus the probability of failing to detect infection is relatively high (e.g., ≥0.6 if prevalence is ≤0.5%). Consequently, CDOW plans to
continue developing and refining the ongoing sampling program for deer and elk populations in the Powderhorn area and other select locations during FY 1993–94.

During the fall of 1992, the Wyoming Game and Fish Department in cooperation with USDA/APHIS, Veterinary Services, the Wyoming State Veterinary Laboratory, and the Wyoming State Veterinarian's office, organized a pilot project to survey hunter–killed elk for TB near Jackson, Wyoming. The primary objective of this initial, pilot survey was to evaluate the feasibility of collecting tissues from hunter–killed elk of the Jackson herd unit as they migrated south from Yellowstone National Park and vicinity toward winter range on the National Elk Refuge near Jackson, and during special hunts located on the refuge itself. Eight thousand to 10,000 elk typically winter on the National Elk Refuge each year. Emphasis was placed on collecting lymphatic tissues from heads at the time animals were loaded onto vehicles near accessible roads or at nearby hunter check stations. Lymphatic tissues were collected from the heads of 123 elk. The tissues were examined grossly, fixed in 10% neutral buffered formalin, and forwarded to the Wyoming State Veterinary Laboratory for further microscopic examination. Duplicate samples of each tissue were identified and frozen. Survey protocol provided for forwarding frozen tissues to NVSL for bacteriologic examination in case lesions suspicious of tuberculosis were noticed during histopathologic examination. Acid-fast stains were used on all tissues with abscesses or pyogranulomas.

No gross or microscopic evidence of TB has been disclosed in any tissue examined to date. Based upon the general success of the 1992 pilot study, plans were formulated to expand the tuberculosis surveillance project in elk during the 1993 hunting season. More personnel have been committed to collect tissues during the elk hunts on or near the National Elk Refuge which should result in greater numbers of tissues being collected. Cervical lymph nodes taken from the heads of elk processed at local abattoirs will also be collected for examination.

5. Summary of Tuberculosis Testing Activities in Cervidae

Dr. Bob Meyer also gave an interesting report summarizing use of the single cervical tuberculin test (SCTT) and comparative cervical tuberculin test (CCTT) on cervids in Veterinary Services' Western Region. During the first 10 months of Fiscal Year 1993, 3,538 cervids were reported as being tested by regulatory personnel and accredited veterinarians using the SCTT. Of the 3,538 tested, 2,439 were elk or caribou, and 1,099 were various other species of deer. Responses to SCTTs were reported in 115 (3.2%) animals tested. Sixteen SCTT responses were in animals either confirmed as TB–infected or from herds with confirmed infections (i.e., exposed). The remaining 99 responses were reported from herds for which no further evidence of TB exists to date. From these data, estimated apparent
specificity for the SCTT in cervid herds located in the Western Region was about 97%. Follow-up CCTTs were conducted in 108 SCTT responders, resulting in classification of 19 animals (17.6%) as either CCTT reactors or suspects. Of the 19 animals classified as CCTT non-negative, 6 animals were cultured positive for *M. bovis*, 10 had no gross lesions indicative of TB upon post mortem examination, and 3 are yet to be evaluated. It follows that by using the SCTT and CCTT in a series testing regimen, it appears that 99.6% of presumably non-infected animals would have their status properly classified.

For those western States testing more than 200 cervids during the reporting period, SCTT response rates ranged from 2.3% in Colorado to 3.1% in Oregon. California reported a 53% SCTT response rate in 73 animals tested; however, most of testing conducted in California during this time involved one premises that has struggled with a persistent problem believed to be precipitated by *M. paratuberculosis*. Overall, elk or caribou elicited a 2.7% SCTT response rate (66 responses in 2249 tested), whereas 49 SCTT responses (4.4%) were noted in 1,099 deer tested. Single cervical tuberculin test response rates in deer varied from no responses in Alaska, Arizona, Idaho, Montana, and Washington to 0.6% in Oregon, and 54% in California; SCTT response rates in elk showed less variation by state, with no responses reported in California, Idaho, New Mexico, Oregon, Utah, and Washington and 2.8% in both Colorado and Montana.


Dr. Michael Daly, Field Veterinarian, Oregon Department of Agriculture (ODA), reported on results of disease surveys during depopulation by sale of an exotic wildlife ranch in Southern Oregon in March 1993, as well as difficulties experienced during this operation. This estate had previously been the subject of several years of legal involvement with creditors and with ODA. The ODA placed a quarantine on the property in 1990 because resident exotic animals had not been properly tested before importation into Oregon.

At depopulation, there were about 16 zebra, 10 yak, 1 gemsbok, 8 addax, 4 eland, 1 oryx, 50 fallow deer, 95 aoudad, 24 ibex, 8 blackbuck, and 3 nilgai. The owner elected to use chemical restraint for the depopulation because facilities had not been improved to allow alternative handling and because there was little time before the ranch was to be sold. Twenty one of the animals succumbed during the operation. Drugs used included various combinations of carfentanil, etorphine, telazol, xylazine, and ketamine. Blood and feces were collected, and ruminants were TB tested.

Serological testing revealed evidence of exposure to BTV serotypes 10, 11, and 17, as well as to EHDV. Both aoudads and fallow deer were
positive to compliment fixation (CF) tests for anaplasmosis and suspect to CF tests for Johne's disease. Fallow deer and aoudad fecal samples were lightly infected with roundworms, and aoudads were moderately infected with coccidia. One fallow deer was infected with lungworms (*Protostrongylus* sp.). All animals tested for TB and brucellosis were negative. Thirty-nine male aoudads were negative to tests for *B. ovis*. Of 15 animals necropsied, no evidence of infectious disease was observed.

RECOMMENDED ACTION:

It was apparent to the Committee that difficulties encountered and exotic animal mortalities experienced by the crew organized by the owner and ODA were due to lack of adequate animal restraint facilities; the wild, intractable nature of the exotic animals held; adverse weather conditions; and restrictions placed on the depopulation crew by the animals' owner.

Owners should consult with state animal health and wildlife management officials and comply with testing requirements before importing exotic wildlife. In addition, they should assure adequate handling and restraining facilities are available for each exotic species imported. Some Committee members may be able to offer advice in similar situations and expressed willingness to assist regulatory agencies facing similar difficult situations in the future.

7. Tri-state Interagency Brucellosis Committee for the Greater Yellowstone Area.

Problems associated with brucellosis infected free-ranging elk and bison of the Greater Yellowstone Area (GYA) of Wyoming, Montana, and Idaho has been an agenda item of this committee for many years. The GYA encompasses approximately 7.3 million acres of public and private land. It consists of two National Parks, portions of six national forests, three national wildlife refuges, Bureau of Land Management-administered federal land, and state and private lands. Approximately 98,000 elk and 3,300 bison inhabit the GYA. Even more cattle occupy the GYA; and like the elk and bison, cattle depend upon public lands for summer grazing. It is anticipated that the elk and bison of the GYA will soon be the last reservoir of *Brucella abortus* in the US. Although there are many ongoing activities designed to reduce the brucellosis problem in the GYA, there is no coordination or common goal.

In 1990, Wyoming's Governor Mike Sullivan appointed a state wide Brucellosis Task Force to recommend solutions to the problem. The Task Force established it's goal to "Protect the integrity of Wyoming's free-ranging bison and elk populations and livestock industry by eradicating wildlife brucellosis by the year 2010." A number of recommendations to begin addressing this goal were included in the Task Force's report released in 1993.
WILDLIFE DISEASES

The Task Force recognized that brucellosis in the GYA involves 3 states and a multitude of state and Federal agencies, which must compromise and cooperate if brucellosis is to be eradicated, and it recommended the Governors of Wyoming, Montana, and Idaho establish a Tri-state Interagency Brucellosis Task Force. The tri-state task force would take the lead in establishing a National consensus that assures the problem will be solved. Wyoming Governor Sullivan approved the recommendations, and he asked the Governors of Idaho and Montana to join in establishing an interagency task force. In August 1993, representatives appointed by the Governors met to explore the possibility of a uniform approach to brucellosis in the GYA.

Four members of the USAHA Committee on Wildlife Diseases were included as Governors' representatives, and Dr. Bob Hillman, Idaho Bureau of Animal Health, with the assistance of Dr. Dave Hunter, Idaho Department of Fish and Game and Idaho Bureau of Animal Health, reported on the outcome of the meeting, which was held in Jackson, Wyoming.

There was consensus among the representatives of the three states that an interagency, three-state approach to brucellosis with a common goal was necessary and possible. Consequently, the representatives agreed to ask the Governors to sign a memorandum of agreement establishing a Tri-state Interagency Brucellosis Committee with a goal "to protect and enhance the existing free-ranging elk and bison populations in the GYA and the interests and economic viability of the livestock industry in the three states." The mission of the committee would be to "develop elk and bison herd management plans relative to brucellosis for the GYA." Ten management objectives were established to guide the committee:

1) Maintain State regulatory authority when elk and bison migrate from exclusive Federal jurisdiction to state jurisdiction;
2) Maintain State regulatory authority over brucellosis affected elk and bison and livestock;
3) Maintain numerically, biologically, and genetically viable elk and bison populations in the respective states, National Parks, and wildlife refuges;
4) Maintain the brucellosis-free status of Wyoming, Montana, and Idaho and protect the ability of producers in those states to freely market livestock;
5) Eliminate brucellosis related risks to public health;
6) Eliminate potential transmission of *B. abortus* among elk, bison, and livestock;
7) Coordinate brucellosis related management activities among all affected agencies;
8) Base brucellosis related management activities on defensible and factual information while encouraging and
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integrating new advances and technology;

9) Communicate to the public the need to prevent the transmission of brucellosis, the need for its eradication, and the rationale for related agency actions; and

10) "Plan for eradication of B. abortus from the GYA by the year 2010."

The Wyoming Governor's Task Force's recommendations were generally adopted to serve as the foundation for a GYA regional and interagency approach. Federal agencies will be invited to join this partnership of regional cooperative efforts to solve the problem of brucellosis in the GYA, hopefully, by eradication of brucellosis.

8. Apparent Adenoviral-Induced Mortality in Black-tailed Deer in California.

During August–October 1993, a number of die-offs of deer (black-tailed and some mule) *Odocoileus hemionus* ssp. occurred in various locations in California. Dr. David Jessup, California Department of Fish and Game, reported that large numbers of carcasses have been found in Nevada and Tuolumne counties and smaller numbers in Siskiyou, Modoc, Lake, Colusa, Sonoma, Marin, Placer, El Dorado, and San Benito counties. All ages appear to be affected. Signs include depression, respiratory disease, diarrhea which is sometimes hemorrhagic, and sudden death. Necropsy findings included pulmonary edema, ulceration of the upper alimentary tract and hemorrhagic enteritis. Pharyngeal abscesses were common findings in adults and suspected to be a chronic sequelae of infection. Vasculitis and arteritis appear to be consistent microscopic lesions. Eosinophilic inclusion bodies in endothelial cells were seen in four fawns, a yearling, and an adult. Electron microscopy of these inclusions from several fawns from Nevada and Tuolumne counties revealed adenovirus like particles. Attempts to isolate an adenovirus and/or an orbivirus or other viruses have not yet been successful.

Re-examination of a previous case ascribed to a disease similar to BTV or EHDV from 1987 revealed similar inclusion bodies and adenoviral-like particles. The eosinophilic inclusions observed suggest the presence of a DNA virus as opposed to orbiviruses which are RNA viruses. These mortalities were significant because they were very large in number and widespread; because the seasonality, epidemiology and lesions were somewhat similar to those of BTV and other orbiviruses, and because there appeared to be an association with an as yet uncharacterized "adeno-like" virus. No similar adenoviral disease has previously been reported in deer. Investigations of this disease process are at a very early stage at this time with primary emphasis on developing a case definition, characterizing lesions, determining the extent of associated losses and isolation and characterization of an agent.

Dr. K.B. Poonacha, Livestock Disease Diagnostic Center, University of Kentucky reported on a survey for diseases in small wild mammals in central Kentucky done in cooperation with the Southeastern Cooperative Wildlife Disease Study.

Animals (n = 202) belonging to 13 different species were trapped in and around horse farms in central Kentucky. This study was undertaken to determine what role wildlife living in and around the horse farms play in the spread of leptospiral infection leading to abortion and stillbirth horses. All animals were euthanatized and necropsied. In addition to leptospiral culture and serology, blood and tissue samples were collected for serology, virology, pathology, and parasitologic study to determine the status of disease in these animals.

Eighty-five of 202 animals had microscopic lesions in one or more organs. Some of the lesions were besnoitiosis (opossum), sarcocystosis (raccoon, opossum, rabbit), parasitic gastritis (raccoon), leptospirosis (raccoon, skunk, opossum), and intestinal parasitism (opossum). Twenty-one of 50 opossums had nematodes in the lungs. All opossums were positive for intestinal nematodes. Fourteen of 202 cases (raccoon, skunk, coyote, rabbit) showed nonspecific reactivity to Sarcocystis spp. by immunoblot analysis.

Using direct fluorescent antibody technique 7 cases (raccoon, opossum, skunk) tested positive for leptospires, and in 6 cases leptospires were isolated from the kidney. Microagglutination titers against leptospires were demonstrated in the sera 23 of the 202 cases tested, and titers ranged from 1:10 to 12,800 against Leptospira interrogans serovars autumnalis, pomona, bratislava, grippotyphosa, copenhageni, australis, hardjo and ballum.

10. Resolutions.

A resolution on the control of duck plague was submitted by Dr. Tom Roffe, US Fish and Wildlife Service and presented by Dr. Victor Nettles and a resolution encouraging appropriate Federal agencies to join the states of Wyoming, Montana, and Idaho in establishing a Tri-state Brucellosis Committee for the Greater Yellowstone Area was presented by Dr. Bob Hillman, Idaho Bureau of Animal Health. Both resolutions were adopted by the Committee on Wildlife Diseases and recommended for adoption by USAHA.
REPORT OF THE COMMITTEE ON ZOOLOGICAL ANIMALS

Chairman: Dr. Wilbur B. Amand, Philadelphia, PA
Vice Chairman: Dr. R. L. Crawford, Silver Spring, MD

R.A. Cook, NY; P.M. Eppele, SD; W. P. Heuschele, CA; H. Hilderbran, TX; P.D. Hoctor, IN; D.L. Hunter, ID; D.A. Jessup, CA; C.W. Lum, HI; C.J. Mikel, OK; J.H. Olsen, FL; L.H. Rothe, CO; M.S. Silberman, GA; R. Temple, OH; C.O. Thoen, IA; E.T. Thorne, WY; D. Whittlesey, CO; P. Wolff, MN.

Members present: Robert A. Cook; R. L. Crawford; Pat Hoctor; Calvin Lum; C. J. Mikel; John Olsen; Robert Temple; Tom Thorne; Dave Whittlesey.

The committee meeting was held Wednesday, October 27, 1993 and was called to order by the Vice Chairman, Dr. R. L. Crawford at 1:30 p.m. There were nine members and eight visitors present.

Dr. Crawford advised those present that there were no presentations scheduled and that the agenda would consist of old business, new business, discussions or reports, and an APHIS update.

The meeting started with a discussion of TB testing in cervidae. It was pointed out that draft regulations have no provision for rare and endangered species for testing and treating. Under the draft regulations an animal must be euthanized or slaughtered within 15 days. It was suggested that provision needed to be made for treatment of rare or endangered species rather than euthanasia or slaughter.

The problem of Johnes Disease was then discussed. It was pointed out that there is a problem with Johnes in zoo ungulates in San Diego and Florida, and a 10–20% incidence in dairy animals. Animals could be tested repeatedly by various tests with no assurance at having a negative animal as only culture will show positive infection and not all infected animals will shed the organisms. It was pointed out that due to serology problems there was no good test for zoo animals. The committee felt that this would be an area to address at the next meeting with presentations and discussion by appropriate persons, such as the San Diego Zoo.

The problem of TB in zoo primates was then discussed. It was pointed out that acid fast bacteria could be found but was not able to be cultured for positive diagnosis. Due to active trading between zoos, this could pose a dissemination problem. It was pointed out that the TB test in primates was fairly accurate and that primates could be treated as necessary. The main concern with zoo primates was for human exposure to TB and that zoo employees working with primates were tested at 6 to 12 month intervals.

A question was raised as to the status of farm animals under the Animal Welfare Act. It was pointed out that farm animals have been regulated since June of 1990 when used for nonagricultural research or nonagricultural exhibition. A discussion was held as to the application of
REPORT OF THE COMMITTEE

regulations to livestock markets and auctions. It was pointed out that the Act specifically excluded food, fiber, and production animals.

APHIS updates addressed the following issues:

  Exotic Animal Auction Sales – Regulations are presently in the clearance process to regulate exotic animal auctions.
  A Voice Response System is in operation for Animal Welfare issues and for other livestock information. Pamphlets are available.
  Farm Animals – Information is being developed and gathered to begin drafting proposed standards for farm animals used for nonagricultural research or exhibition. A workshop was held in Oklahoma City the end of September and valuable information was received. A meeting will be held with Federal agencies and another public meeting is planned.
  Regulations for the implementation of the Pet Protection Act became effective on August 23, 1993. This requires a minimum 5-day holding period and certification for dogs and cats sold to dealers by pounds.
  Marine Mammal Standards are being reviewed for proposed revision.
  Public hearings will be held
  Zoo Intern Program – Two Animal Care inspectors rotated through various types of exhibitors over the past year. The program will be completed in November and appears to be working well and of value to REAC. Final results will be reviewed for necessary adjustments.
  Psychological Wellbeing of Primates – Court case instigated by humane groups resulted in a Federal Court decision invalidating present standards for dogs and nonhuman primates. Appeal will be up to the Solicitor General.
  Facility Break-In Law – Joint report by the Secretary of Agriculture and The Secretary at the Department of Justice was submitted to Congress last month. APHIS provided information to assist DOJ in developing the report.
  Stolen Dogs – This is a nation-wide problem, especially in the Midwest area, and is being pushed strongly by humane and animal rights groups. APHIS has investigations ongoing in Wisconsin, Mississippi and the Midwest. The problem involves Class B random source dog dealers. Serious records and ID violations have been identified to date.
  Puppies Imported into Canada from the U.S. – Canada has established a permit and border inspection system which seems to satisfy all concerned parties.
  Horse Protection Program – An outside program review is being developed and will be chaired by Dr. Mort Silberman. The review is to assess program operations, methods, and effectiveness.

Animal Care Staff Changes:
  Dr. Bonnie Buntain; Staff Director
  Dr. Barbara Kohn; Marine Mammals and Animal Behavior
ZOOGICAL ANIMALS

Mr. Steve Smith, Dealers and Transportation

A question was raised concerning USDA reorganization and its effect on APHIS. In general APHIS is not affected by the reorganization. It is directed basically at support groups for consolidation.

No further discussions were held and the meeting was adjourned at 2:30 p.m. No resolutions were presented and no papers were given to be printed in the proceedings.
ESTABLISHMENT AND USE OF A GEOGRAPHIC INFORMATION SYSTEM (GIS) TO CONTROL AVIAN INFLUENZA

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INTRODUCTION

In the last decade the Commonwealth of Virginia has experienced two major and several minor outbreaks of Avian Influenza among commercial poultry and backyard flocks. A major problem during these outbreaks has always been to pinpoint the exact geographic location of the index or first farm experiencing an outbreak and, as importantly, the existence and locations of all other poultry farms surrounding the index farm. Efforts to do so usually consisted of asking the index grower and his company for information about any nearby farms they were aware of and driving around the area trying to identify other poultry operations from the road. These efforts were generally hit-and-miss and from a disease control standpoint were very time consuming as well as incomplete resulting in reactive instead of proactive control programs.

In 1990 a new position was created in the Division of Animal Health expressly for the purpose of developing and implementing a Geographic Information System (GIS) covering the commercial poultry industry in Virginia. A GIS is a computer program that combines a map drawing function with a relational database to create a sum that is greater than its parts. Anything that has a geographic location can be represented in the mapping portion of the program while all relevant data about that location can be stored in the database. The program allows for the traditional analytical tools associated with relational databases to be used (sorting, selecting, relating) as well as spatial analyses (layering, buffering, site selection, routing). The interconnection of the two functions allows the simultaneous display of location (map) and the data associated with that location. Because the data is stored in a relational database any item or field that is common to any other location or database can be used to link them together for sorting, selecting, etc...

The application of GIS to veterinary epidemiology and disease control is growing with projects underway in multiple countries concerning diseases such as bovine tuberculosis, fascioliasis, theileriosis, pseudorabies, Lyme's disease, dracunculiasis and foot-and-mouth disease among others (1–7). This trend is certain to continue as more and more states and countries realize the potential power, usefulness and cost-effectiveness of a GIS.
MATERIALS AND METHODS

The GIS software used for this project was PC ARC/INFO written by ESRI, Inc. of Redlands, California. The current version uses DBASE IV (Ashton-Tate, Torrance, California) as the relational database. In addition, a new, user-friendly graphic user interface called ARCVIEW, also from ESRI, was recently installed to facilitate use of the system. The ARCVIEW software runs under the Microsoft company's WINDOWS system so this software must also be installed on the machine.

The system was originally installed on a personal computer (PC) with an 80386 processor running at 20 Mhz, an 80387 math co-processor (required), 2 MB of RAM and a 110 MB hard disk. An external Read/Write Optical Disk Drive was connected to the system primarily for storage of the map data layers. Each portable optical disk holds approximately 600 MB of data. This hardware configuration was found to be adequate for basic use but was intolerably slow for a very few of the most intensive processing demands of the program. The software has recently been moved to a PC with an 80486 processor running at 50 Mhz, math co-processor, 4 MB of RAM and a 200 MB hard disk. This has greatly improved the response time of the program.

The U. S. Geological Survey's digitized map data layers were obtained to create base maps and the state, county, and city boundaries were obtained from another state agency, the Council on the Environment, Ecomapping Section.

To establish the exact locations of poultry farms portable LORAN C navigation units were used. These small units run on 12 volt DC and can use a car cigarette lighter outlet as a power source. The LORAN C system works by picking up signals from three of the many LORAN C beacons set up along the coast and triangulating from those three signals to give an exact latitude and longitude fix. Although the LORAN C system is primarily intended as a marine navigation aid it was found to be very reliable even in the Blue Ridge mountains, more than 300 miles from the ocean.

A survey form was developed (Fig. 1) to capture the relevant data about each farm location. The type of operation (chicken broiler, chicken breeder, turkey breeder, commercial toms and hens, poults, hatchery) was recorded as was an inventory of the number of poultry houses and their capacity when full. Because of the dynamic nature of poultry flock flow through a farm no effort was made to determine the inventory of birds on a farm at the time of survey. The source of water for the farm as well as the method of litter/manure disposal was recorded. Method of disposal of daily mortality, disinfectants used, biosecurity measures used and pest control procedures were also included. Other types of animals maintained on the farm were noted. The source of the birds brought onto the farm (Supplier), where the birds went (Consumer) when they left the farm (e.g. slaughter plants), who supplied feed to the farm (Feed Source) and how the birds
USE OF A GIS SYSTEM TO CONTROL AVIAN INFLUENZA

were moved on and off the farm (Transport/Shipper) were also determined and their locations mapped as well. The names of any Utilities Suppliers that may have occasion to come on the farm and thus become potential mechanical vectors of disease were also identified. In addition to the latitude/longitude location of the farm a set of instructions (Location) was recorded that described how to drive to the farm.

Data was collected and locations determined by three field inspectors who were paired up with the poultry servicemen from each integrated poultry company and accompanied them on their daily rounds of that company's growers. In addition, once the feedmills, slaughter facilities, hatcheries and transport companies were identified the inspector would stop at their location to obtain a latitude/longitude fix.

RESULTS

Approximately 1300 commercial poultry and egg-laying farms from 7 major integrated companies and 6 independent companies were enumerated by the survey. A total of 21 hatcheries, 16 slaughter facilities, 16 transporters, and 21 feed mills were identified and located.

Since the completion of the initial survey in the spring of 1991 the Poultry GIS has been put to use whenever serologic surveillance or traceback has indicated the possibility of Avian Influenza on a farm. The system has facilitated the rapid location of the affected farm and was able to identify all other known poultry operations within any specified radius of the index farm. This permitted the establishment of more precise quarantine areas. It also allowed quick notification of those grower's parent companies to arrange for immediate testing of those farms. In addition, the ability to look at those locations interactively on a map permitted evaluation of other potentially significant epidemiologic factors such as surface water (as possible sources/reservoirs of infection or avenues of disease spread), other farms that may have been contaminated because they were supplied by the same feedmill, and which farms would be at risk if birds were moved from an affected farm to a slaughter plant. In the last eventuality the GIS can select the route of travel that would impact the fewest farms.

DISCUSSION

It is certain that the GIS more than paid for itself the first time it was used. Therefore, the cost–effectiveness of this technology cannot be overstated. It's success can be measured in man–hours saved responding to a disease outbreak, dollars saved by the rapid containment of a disease and the reduced impact on commercial operations due to precise quarantine boundaries. An intangible benefit is the reassurance given by the availability of the information necessary to make the best informed decisions during a crisis.
Continuing advances in technology are making GIS more and more accessible throughout the world. A locating system called the Global Positioning System (GPS) which employs signals from as many as 8 orbiting satellites is now available for less than $1,000. The GPS is accurate to within 25 feet anywhere on the earth's surface. The most recent development in this technology is a GPS unit which can be plugged into a notebook-sized computer so that data can be gathered and the location automatically recorded in the field, on the go. It would be hard to overestimate the potential for GIS in the fields of veterinary epidemiology and regulatory medicine (1, 8).

REFERENCES

USE OF A GIS SYSTEM TO CONTROL AVIAN INFLUENZA

Recently, much discussion has centered on the prospects for pre-harvest control of \textit{E. coli} O157:H7. Some people seem confident that new tests will lead to effective control. Others seem pessimistic on the grounds that traditional infectious disease control practices are unlikely to be effective for this agent. A critical look will lead us to discard both positions and conclude that pre-harvest control of \textit{E. coli} O157:H7 and certain other foodborne disease agents will require a fundamental change in how we approach infectious disease problems.

\textit{E. coli} O157:H7 was first recognized as a human pathogen in 1982, although good evidence exists that a pathogenic relationship existed prior to that date (Griffin and Tauxe, 1991). Cattle have been implicated as a major source for human exposure (Griffin and Tauxe, 1991); although other sources have not been ruled out, and it has not been established beyond doubt that cattle are a reservoir rather than incidental hosts. Some have speculated that dairy rather than beef cattle represent the main source of human exposure for \textit{E. coli} O157:H7, but our work at Washington State University has found similar prevalences in dairy and beef cattle: 3,570 fecal samples from 60 Northwestern dairy herds yielded a prevalence of \textit{E. coli} O157:H7 of 2.8/1000; 1,412 fecal samples from 25 cow-calf herds revealed a prevalence of 7.1/1000; 600 fecal samples from 20 pens of feedlot cattle revealed a prevalence of 3.3/1000. The 95\% confidence intervals of these prevalence estimates broadly overlap.

Another speculation has been that cattle in northern states harbor \textit{E. coli} O157:H7 while those in southern states so not. As the speculation goes, this explains the preponderance of human disease reports associated with \textit{E. coli} O157:H7 from northern states. Yet, a recent study in dairy calves conducted by Veterinary Services (USDA:APHIS) in 28 states in all U.S. geographic regions found an overall prevalence of \textit{E. coli} O157:H7 3.6/1000 among 6,894 calves sampled in 1,068 herds; positives were found in all regions with no hint of north-south regional differences. A more likely explanation for the regionalization of human disease reports is the > 20-fold state-state reporting differences of foodborne disease outbreaks, with southern states consistently below the median (Bean et al., 1990; Hancock and Holler, 1993). Also, many states, including most southern ones, do not
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routinely screen submitted human fecal samples from foodborne disease cases with sorbitol MacConkey and would thus be unlikely to detect *E. coli* O157:H7–associated disease should it occur. An active surveillance project by Centers for Disease control is currently examining possible regional differences in the occurrence of *E. coli* O157:H7–associated disease in humans. While early results (as of August, 1993) indicate that some regional differences in risk may exist, *E. coli* O157:H7–associated disease cases have been found in all regions. It seems evident from these data that *E. coli* O157:H7 is a national problem.

*E. coli* O157:H7 is one of many *E. coli* which produce verotoxin (VT). VT is known under the synonym of Shiga–like toxin due to its similarity to Shigatoxin, produced by Shigella. The clinical signs associated with *E. coli* O157:H7, such as hemorrhagic colitis and hemolytic uremic syndrome (HUS), appear to result from the actions of VT; however, other critical and more specific virulence factors are likely to exist. Other VT *E. coli* are more common in cattle and in ground beef but are much less commonly associated with human disease than *E. coli* O157:H7. Nearly all the outbreaks associated with VT *E. coli* and most of the diagnosed sporadic cases have been associated with *E. coli* O157:H7. It seems likely that *E. coli* O157:H7 possesses other critical virulence factors beyond VT production, perhaps a unique adherence factor. Whatever properties account for its special virulence, *E. coli* O157:H7–associated disease has come to be reported with increasing frequency over the past decade (Griffin and Tauxe, 1991). Some of this is undoubtedly a reporting artifact, but a real increase in HUS (the diagnosis of which is not dependent on laboratory detection of *E. coli* O157:H7) appears to have occurred during the period since 1970 (Tarr et al., 1989; Coad et al., 1991). At least three hypotheses have been posited to account for the apparent increase in *E. coli* O157:H7–associated disease.

Firstly, changes in meat processing or preparation might account for some of the increased risk of human *E. coli* O157:H7 infection. Ground beef has been the most commonly implicated food, and processing in larger batches would be expected to increase risk due to the very high dilutions of *E. coli* O157:H7–contaminated fecal material that could pose an infection risk. Based on the outbreak of January, 1993 in Washington State, it appeared that exposure to as few as 10 viable *E. coli* O157:H7 cells posed a risk of infection. Extrapolating from this dose, 5 grams of feces containing *E. coli* O157:H7 at the concentration of 10⁵/gm could conceivably contaminate 50,000 quarter–pound servings, or 12,500 lbs of ground beef, with an infectious dose. This low dose phenomenon is a critical feature which differentiates *E. coli* O157:H7 from most other foodborne agents and which, as discussed later, increases the potential utility of pre–harvest food safety efforts.

A second hypothesis is that *E. coli* O157:H7 is a recently emergent
organism. Thomas Whittam of Pennsylvania State University has presented evidence that *E. coli* O157:H7 is a recent offshoot from *E. coli* O55:H7 (Whittam et al., 1993). He found that hundreds of *E. coli* O157:H7 collected from around the world were very closely related based on multilocus enzyme electrophoresis and were only distantly related to other pathogenic *E. coli* strains (including other O157's). They are presumed to have derived quite recently, phylogenetically speaking, from a single ancestral cell. Yet, the wide geographic distribution suggests that "recent" in phylogenetic terms must long antedate the apparent increase in *E. coli* O157:H7–associated disease that seems to have occurred since 1970. A sub-hypothesis states that, although *E. coli* O157:H7 may have emerged some thousands of years ago, the clone only recently acquired VT genes (which are bacteriophage vectored). The increase in human disease observed over the past several decades would simply reflect the spread of an *E. coli* O157:H7 clone newly endowed with VT. Some plausibility is lent to this by the absence of VT from *E. coli* O55:H7, *E. coli* O157:H7's closest relative and the existence of VT in numerous serotypes of *E. coli* (all of which are only distantly related to *E. coli* O157:H7) from which horizontal transmission might have occurred. Yet, virtually all *E. coli* O157:H7 are VT positive, and isolates from around the world share VT genes that are very similar. It seems unlikely that all the members of a strain of *E. coli* that had previously spread around the world would—over the course of a few decades—have acquired closely related VT genes, leaving few if any members of the original VT negative *E. coli* O157:H7 clone to be found. Thus, the newly–emergent–organism hypothesis does not seem to adequately account for the recent increase in human disease associated with *E. coli* O157:H7.

A third hypothesis is that, while *E. coli* O157:H7 may have been present for thousands of years, something has occurred more recently to expand its niche. If cattle are the chief reservoir for *E. coli* O157:H7, expansion of the niche for the agent would presumably have involved one or more geographically widespread changes in the way that cattle are maintained. As the hypothesis goes, this would have caused a slight shift in the exceedingly complex ecosystem of the gastrointestinal flora to the advantage of *E. coli* O157:H7. Such an orchestrated change in the gastrointestinal ecology of cattle, occurring widely in the industrialized world over a short time span, may seem unlikely; yet several candidate factors are worthy of consideration. For example, waste management has undergone widespread changes in dairy herds and, to a lesser degree, in feedlots. Several byproduct feeds previously only rarely used in cattle feeds have come into widespread use in recent years. Certain feed additives, such as ionophores, were not used commercially prior to the 1970's but are now used very commonly in cattle production in both beef and dairy cattle. Although very little data exist regarding associations with particular management factors, the apparent clustering of *E. coli* O157:H7 we have observed in
Certain herds indicates that a closer examination of the expanded-niche hypothesis is warranted. The identification of one or more factors directly under management control which influence the existence or prevalence of *E. coli* O157:H7 on a farm would have profound impacts for the control of this agent.

Although we presently have only a crude sketch of the epidemiology of *E. coli* O157:H7, it seems to be a prime candidate for pre-harvest food safety. There seems little doubt that cattle are a major source for the agent, and the low infective dose makes the elimination of risk virtually impossible through processing steps short of irradiation. Even if effective steps are taken in processing, a multiplicative reduction in risk would be expected by reducing the level of contamination of cattle coming into slaughter plants. Successful control of an agent with such a low infective dose will require incremental interventions at all stages of the food chain. Although the temptation may be to do nothing until we can completely eliminate risk, the best we may be able to do for *E. coli* O157:H7 is reduce risk by a factor of, say, 100.

Some have proposed that developing rapid and more accurate tests for *E. coli* O157:H7 will lead to elimination or reduction of human exposure to this agent. However, based on the three uses which have been proposed for rapid tests, elimination or even great reduction in risk is unlikely to be forthcoming. A more sensitive and less labor intensive test would surely be convenient as a pre-harvest tool, but it is difficult to see how a program would be greatly enhanced by having results in one hour instead of three days—particularly if the cost is increased several fold (as is true with currently available, relatively rapid tests). In either case, long term modifications in management would presumably be the controlling mechanism; testing would provide a monitor of the success of the program rather than being a control point itself. Although the tendency has been to relegate test development to the realm of technology and on-farm hygiene to the domain of common sense, the chief constraint to pre-harvest food safety is not the ability to detect *E. coli* O157:H7 but the lack of knowledge of what to do once the agent has been detected. It is important that we not forget, in our rush to fund biotechnology research, that an understanding of on-farm epidemiology of *E. coli* O157:H7 will be central to controlling the agent.

Controlling human *E. coli* O157:H7 exposure via rapid testing at the slaughter plant seems even more implausible. *E. coli* and other fecal organisms occur as surface contaminants on carcasses. Totally preventing such contamination appears to be an impossible goal, and testing every square centimeter of the surface of each carcass for *E. coli* O157:H7 seems unworkable. Reductions in the level of contamination with fecal organisms is feasible, however; and would be expected to decrease the risk of human infection with *E. coli* O157:H7 and other fecally carried foodborne agents. Furthermore, some monitoring mechanism is necessary for successful re-
duction of bacterial contamination of carcasses. Yet, a rapid test for \textit{E. coli} O157:H7 would be a very poor choice for monitoring critical control points influencing contamination with fecal organisms. Even where gross fecal contamination occurred, tests for \textit{E. coli} O157:H7 would only rarely give positive results. In the terminology of bacterial monitoring of food, \textit{E. coli} O157:H7 would be a poor choice as an indicator organism.(Mossel and Struijk, 1992) Justifying tests for specific pathogens would require demonstrating that their critical control points are different from other fecal indicator organisms; this seems highly improbable in the case of \textit{E. coli} O157:H7. Many slaughter and processing plants have been monitoring coliform and total bacterial counts for years. Notably this includes the processor for the ground beef involved in the January, 1993 outbreak of \textit{E. coli} O157:H7-associated disease in Washington and several other states—a fact that is testimony to the impossible task of controlling \textit{E. coli} O157:H7 at the slaughter or processing levels.

A final, and perhaps more utilitarian, use for rapid testing for \textit{E. coli} O157:H7 would be batch testing of ground meat immediately prior to distribution. This could possibly reduce the risk of catastrophic outbreaks such as the one which occurred in January, 1993, since, in that case, entire batches were contaminated at detectable concentrations. However, spot checking of ground beef would likely have little impact on sporadic cases which account for most total cases of \textit{E. coli} O157:H7-associated disease. As Mossel and Struijk (1992) put it, "if particular organisms are found to be non-detectable in a given sample drawn from a consignment of food, this result is only of statistically-limited significance for the sampled consignment."

Thus, while measures can be taken at slaughter and processing to somewhat reduce the risk of foodborne \textit{E. coli} O157:H7 infection, reduction in the prevalence of \textit{E. coli} O157:H7 among slaughtered animals would be expected to synergistically multiply the effectiveness of efforts taken at later steps in the food chain. Yet, in discussions on possible means for controlling \textit{E. coli} O157:H7, some officials and food safety authorities seem to have prematurely dismissed the prospect of pre-harvest control of \textit{E. coli} O157:H7 based on the failure of the agent to conform to the behavior of infectious agents that have been controlled through the application of traditional methods. \textit{E. coli} O157:H7 does not appear to be pathogenic in cattle, and thus endemic herds experience no evident marker conditions. Furthermore, our testing efforts to date have failed to demonstrate the existence of carrier animals which might be targeted by a control program similar to that used for brucellosis (even if another such program were economically feasible). Rather, \textit{E. coli} O157:H7 appears to be part of the dynamic coliform flora which colonizes cattle herds rather than individuals; and the brute force of test, removal, and eventual eradication seems implausible. Thus, it seems that some people have concluded that little can be done at the farm level.
against this agent. Yet, the clustering of *E. coli* O157:H7 on particular farms and in particular groups of animals at particular times suggests that some factors must control the prevalence of this organism. While much more developmental work is necessary to go from this preliminary observation to recommendations for specific control proposals, at least three possibilities exist which would exploit ecologic control of the gastrointestinal flora.

The first possibility would capitalize on the natural "experiments" provided by the diversity among livestock operations. Where some farms are endemic for a particular agent and others lack the agent, there must be identifiable reasons for this diversity. By carefully collecting data on a variety of differences in housing, feeding, waste management, etc., solid clues can be gained as to the critical factors involved in creating a niche for a particular pathogen. The approach is not necessarily limited to pathogen presence/absence but could also be used in a quantitative mode to determine associations with level of contamination or, say, percent of animals contaminated at harvest. The ultimate goal is to identify management changes which would close or reduce the niche for *E. coli* O157:H7. Candidate factors identified in such natural experiments would then be targeted by prospective studies to confirm relationships and to set the stage for intervention trials and ultimate industry-wide implementation. Limited work has been done in this area by us and by Veterinary Services (USDA:APHIS), but funding has been notably difficult to obtain.

A second pre-harvest ecologic approach to controlling *E. coli* O157:H7 would focus on the week prior to slaughter. Under this strategy, what happens in the gastrointestinal tract during most of meat producing animals' lives would be considered secondary to what happens immediately prior to slaughter. The contamination level of the haircoat, an important source of bacteria on carcasses, would also be considered a critical control point. The tools available would consist of specific (and yet to be identified) modifications of diet, transportation, and housing.

A final possibility for pre-harvest control of *E. coli* O157:H7 would be through the use of competitive exclusion (CE). CE is based on observations, made over many years, that the normal intestinal flora of adult animals plays a key role in resistance to colonization by exogenous enteropathogens (Dubos and Schaedler, 1963; Hentges, 1982, Tancreade, 1992). It was first used as a pre-harvest food safety tool by Nurmi and others in the early 1970's (Nurmi, 1992). Thus far, use of CE has been limited to controlling salmonella in poultry, but the concept has appeal for other foodborne agents (Nurmi, 1992). As presently used (mainly in Europe), CE consists of inoculation of chicks with mixed bacterial cultures (via aerosol or in water) which have been obtained, directly or indirectly, from the gastrointestinal tracts of adult chickens. Several large studies have generated a wealth of data supporting the efficacy of CE.(Wierup et al., 1988; Wierup et al., 1992). The mechanisms of action of CE against salmonella are exceedingly com-
plex and appear to require the interaction of a number of mainly anaerobic, bacterial species (Hinton et al., 1991a; Hinton et al., 1991b; Nurmi, 1992; Corrier et al., 1993). For an E. coli, CE might take advantage of the natural competition for nutrients and binding sites which exists among diverse E. coli strains in the gastrointestinal tract (Freter, 1983). Given the practicality and affordability of CE, efforts are needed to determine the nature of E. coli O157:H7's niche in the ecosystem of the bovine gastrointestinal tract and to identify possible microfloral species which might be used for CE.

The varied responses to the growing problem with E. coli O157:H7 are similar to those for many other emergent problems we face as a society. The pessimists—much in the majority—look through the eyes of tradition and see no road to resolution. Others trust in the magic of high tech even though they can't articulate credible hypotheses of how a particular high tech product or technique would lead to resolution. Finding a solution for E. coli O157:H7 will require a much better definition of the problem, especially as regards its reservoir; and the solution which finally emerges may not conform to traditional visions of how infectious diseases ought to be controlled.

REFERENCES


bacteria isolated from the cecal contents of adult chickens. J. Food Prot. 54:496–501.

Mossel DAA, Struijk CB. The contribution of microbial ecology to management and monitoring of the safety, quality and acceptability (SQA) of foods. J Appl Bacteriol 1992 73:1S–22S.


The committee met for two days. Total attendance of the two day meeting was 68. This year the committee had one theme for each day of the meeting. A discussion panel was assembled at the end of the meeting to formulate recommendations and resolutions. The two themes were:

1. Health information records and systems that can be utilized for food safety (pre-harvest): Available sources and future plans.
2. Integration of animal health information and data: Applications and Programs.

Speakers were selected to represent several agencies, organizations, and interest groups.

Dr. L. King, USDA/APHIS was the first speaker for our Monday meeting. The title of his presentation was "Pre-harvest Food Safety: Future Role". Dr. King gave the audience his personal vision of APHIS' future direction in monitoring animal diseases for food safety reasons. He stated that the driving forces of the food safety issue are: Human illness, Public confidence and awareness, Global marketing, Litigious society, Reaction to prevention. He emphasized that an integrated systems approach to the entire food chain is needed. He stressed continuous research, education and improvement focused on disease prevention rather than crisis management. The implementation of HACCP strategies at the pre-harvest stage on the farm will require resolution of several critical issues including animal identification and data management systems. The approach should be market driven emphasizing Quality Assurance with the government's role being that of a facilitator, setting minimum standards. Feedback of process information to producers is essential to reinforce that Quality Assurance
results in better marketability and profitability.

Dr. B. Lautner, National Pork Producers Council, presented a report on Industry Response to Food Safety Issues. She called for a change in mindset by producers, to focus on the end product instead of the animal alone. The Pork Quality Assurance Program was cited as model. Critical areas of research and improvement include enhanced monitoring of food-borne illnesses, on-farm epidemiological studies and investigations of pathogen ecology and development of diagnostic tests suitable to each stage of the food production process. Once again, programs that provide feedback to the producer and are market driven and government facilitated were emphasized. The focus should be on food-borne zoonotic diseases, not just animal diseases. This may require a drastic restructuring of the industry but it must also be economically compatible with producers.

Dr. D. Hancock, Washington State University, spoke on Macro- and Micro-Epidemiology of E. coli O157:H7: Prospects for Pre-Harvest Control. He described the low prevalence (< 1%) of the organism in cattle and dairy cows in the northwest and the seasonal distribution of occurrence, highest in the summer months. Surveys have shown that it is found nationwide. Current research indicates that it is probably not feasible to maintain a negative herd however, there are very different prevalence rates among herds, indicating the possibility of management factors that may control its spread. He recommended against large expenditures to develop new diagnostic tests for this organism at this time because of its low prevalence which it makes it a poor indicator of fecal contamination of product. Instead the focus should be on husbandry practices which may affect its prevalence and possibly competitive exclusion or pre-slaughter conditioning of animals.

Dr. T. Kindard addressed the committee on the topic of USDA:FSIS Health Information Records and Systems that Can be Utilized for Food Safety: Available Sources and Future Plans. She stated that elimination of bacteria from animal products is virtually impossible therefore contamination of carcasses with bacteria does not make them unsuitable for entry into the food chain. FSIS is now moving towards a zero visible fecal contamination program. The cost of microbial testing is prohibitive, an estimated $58 billion to test 20% of the carcasses for 2 organisms, therefore we must focus on prevention, based on HACCP principles applied to both the pre- and post-harvest sectors. A national survey to establish baseline levels of microbiologic contamination will be conducted. Government will facilitate development of new, rapid, in-plant test methods by establishing standards, disseminating information and providing feedback. There will also be emphasis on the food service/retail sector to provide proper food handling training for employees. A national, multi-media campaign to improve consumer awareness of the risks of foodborne illness and the need to properly handle and cook food will be conducted. Industry practices and inspection procedures will have to change.
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A panel of the first day's speakers was convened and discussed the lack of a current model for gathering pre-harvest information, although the Salmonella enteritidis project may be a start, the fact that pathogens that cause food-borne illness are not necessarily animal pathogens and therefore initiatives will be driven by public health concerns and the need to include CDC in any national program. The panel also addressed the need for industry Quality Assurance programs to encompass technology and information transfer as well as become monitoring tools, the need for more coverage of food safety in veterinary school curricula and the largely untapped potential of epidemiological data maintained by FSIS.

The second day of the meeting, which focused on integration of data sources, started with a presentation by Dr. B. Akey, Virginia Department of Agriculture and Consumer Services, entitled Establishment and Use of a Geographic Information System (GIS) to Control Avian Influenza. His presentation emphasized the power of GIS to integrate data from different sources and provide insights into a variety of important epidemiologic questions and problems. The technology of GIS is evolving rapidly with the result being that the cost of implementing GIS is rapidly decreasing while the user-friendliness of the technology is rapidly increasing. An important consideration in choosing GIS software should be its ability to import a wide variety of data types to avoid having to spend valuable resources replicating already existing data.

Dr. D. Hird, University of California – Davis, spoke on Examples of Integration of Animal Health information in Chile which described that governments' efforts to combine private sources of animal health data with information from federal health programs to expand the scope of surveillance in that country. Private information comes mainly from a program similar to the Dairy Herd Improvement program in the U.S.. Government sources include several programs jointly funded by international organizations such as the FAO and the IICA as well as a voluntary program for certification of farms as free from brucellosis, tuberculosis or bovine leucosis. A major problem is that since participation is voluntary, the data may not be completely representative of the entire country.

Dr. K. Wise, AVMA, described a new computer-based communications and information services system being developed by the AVMA called the Network of Animal Health (NOAH). NOAH is a communications system, accessible by a computer modem and telephone line, that will enable veterinarians and associated professionals to send/receive electronic mail, post and read messages in bulletin boards, and access databases and information resources worldwide. NOAH, to be launched in the first quarter, 1994, will be an important medium by which databases are identified, integrated, and delivered to professionals in an economical and efficient manner. It will facilitate compilation of clinical data, animal disease incidence reports, and may be a vehicle for diagnostic
laboratories to route test results and other information to private veterinarians. Subscription will probably be in the area of $25.00 per month plus line charges.

Dr. R. Crom, USDA:APHIS:VS, next presented a talk entitled Data Sources and Their Utilization for a Food Safety Initiative in which he described a variety of public and private resources that can provide information useful for monitoring and decision-making in food safety and other agricultural programs. In the public sector these include: FSIS, USDA's National Animal Health Monitoring System, the Human Nutrition Information Service, the Economic Research Service, the Packers and Stockyards Administration, the National Agricultural Statistics Service, and the Department of Commerce. Private sources include: The American Meat Institute, the Food Marketing Institute, the National Cattlemen's Association, Hoard's Dairyman, Doane's Marketing Research, original surveys, scientific literature, personal contacts, text books, and lay literature. Caution must be exercised regarding confidentiality of data from all sources. In addition, use of any data source will present challenges of missing data, data errors, verifiability, summary totals vs. individual observations, unweighted analyses, formats, and cost.

Dr. B. Sischo, Pennsylvania State University, shared his experiences in a presentation entitled Integrating Clinical, DHIA and Laboratory Data for Decision Reports in which he stressed that there will be no single source of data that will be sufficient for decision making. Traditionally diagnostic labs have focused on providing reports of testing that are accurate and timely but contain little or no contextual information about how those results relate to the producers herd as a whole. He has attempted to combine submission data, microbiologic results and DHIA data into an integrated report that addresses the context of the particular herd and situation. A report can deal with running history of an individual animal but it also puts that individual animal in context with the herd's historical data so that the producer and veterinarian can see how a particular cow relates to the rest of the herd. The report also shows trend data over time for the herd. The aim is to remove responsibility for developing such a report from the laboratory, instead it will become an integral component of a field disease investigation team which will provide herd summaries and trends.

A panel of the second days speakers discussed establishing incentives for submitters of diagnostic samples to provide additional desirable epidemiologic data, "Enhanced 911" telephone programs as sources of GIS map data, and the Data Integration Project underway in the USDA Center for Epidemiology and Animal Health.

A recommendation was passed by the committee which requested each USAHA committee to provide a standardized diagnostic and clinical definition or case criteria for each disease within it's purview as the basis for development of state and national surveillance and monitoring programs.
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A resolution that the USAHA contact the Executive Board of the AVMA and request the appointment of a representative of the AAVLD to the Informatics Committee of the AVMA was also passed by the committee.
Please permit me to set the stage for my remarks.

As Chairman of my county's Animal Welfare Advisory Committee, as a member of the Board of my state's Animal Health Foundation, as a former officer of the world's largest animal registry, and, in their behalf, testifying throughout the country on animal-related legislative matters to protect both the public and the animals in matters of cruelty, overpopulation and other issues, my view is one of both opportunity and challenge for this organization.

It is not surprising, taking into consideration this background, that I am a member of the Committee on Animal Welfare of USAHA, as well as their Committee on Public Relations.

As I study the Constitution and By-Laws of our organization closely, I note that we have almost completely excluded - not by intent, but by omission - small animal issues and concerns. Yet we know, in the minds of the public, what a large part of total veterinary service is made up of companion animal care. Certainly this is so in the everyday work of the practitioners, whose practices have broadened greatly within the past twenty years to include companion animals.

In fact our present membership is made up of many who share deep concern for the welfare, health and maintenance of companion animals. Whether the state's animal health officer presently defines his responsibilities to include this group or not, we can assume the public, and most probably the practicing veterinarian, will assume it is part of the state animal health officer's concern.

Is this concern for small animals a contradiction in view of the state animal health officer's commonly reporting to his state Agricultural Department? Certainly no more so than APHIS (REAC) being under the U.S. Department of Agriculture.

My orientation and experience suggest that it would be advantageous to see more small animal practitioners involved with the USAHA and vice versa. Certainly, Hurricane Andrew in my state demonstrated the importance of the state's Animal Health Officer having a solid working relationship with the practitioners. Present planning, through ADPAC - the Animal Disaster Protocol Advisory Committee - will strengthen these ties.

But as a matter of operating policy, not just in emergencies, would not a closer bond between USAHA and the small animal practitioners offer a variety of benefits? Would not the official recognition within USAHA of the de facto existence of this large segment of animal health care and concern strengthen the state animal health officers' role?
TODAY'S REALITIES – TODAY'S CHALLENGES

If USAHA chooses to look at these realities more closely, what are the concerns and what are the opportunities?

Let's take the states' "Lemon Laws" for starters. These ostensibly protect consumers from purchasing sick, congenitally-defective or knowingly misrepresented animals, and permits redress, in many cases based on veterinarians' statements. But these laws languish in many states, and the public remains unprotected. Why? Because the lawmakers have not provided the funding to ensure enforcement, inspection and the ability to take action against the offenders. With the prestige of USAHA's national status behind it, the opportunity exists for this organization to reach out to those state lawmakers and be heard.

Animal cruelty issues is another opportunity for more USAHA involvement. Can't cruelty investigators be better trained in animal abuse? Being certified by a county judge is hardly enough. What does the judge really know about the investigator's competence?

We need better definitions of and delineations between the following: abuse – neglect – ignorance. My own experience at the American Kennel Club in close association with their field agents, as well as those of APHIS(REAC) and other humane investigators have shown a vast opportunity for greater success in approaching and disposing of these cases if the differences between abuse, neglect and ignorance can be made clearer. Could not USAHA deal with this issue?

Within the opportunities to deal more effectively with animal cruelty, USAHA could again help through the drafting of model legislation, to get state regulations in place, rather than county ordinances. The benefit is clear – more consistent investigations and determinations throughout the states. I think we would all agree we need a better record of successful cruelty convictions in the courts, and, of course, we need to be able to do a better job getting these cases before the courts.

As I have noted, my orientation is toward small animals, but within the responsibilities of our county's animal-welfare advisory committee, we deal with issues concerning panthers, wild boar, horses, deer and other wildlife, and cattle and other food-chain animals as well as companion animals.

So I would like to now look at other opportunities for USAHA to be more involved: There is the task of helping to see that the codes get rewritten to insure that health certificates issued for animals being shipped intrastate require certification. Presently, they don't, and this can be a big problem in weeding out the sick animals from the healthy before the entire shipment becomes infected.

Specifically in the area of large animal transport, cruelty and negligence are more common than we want to believe. Regulations which would give the state veterinarian the power to deal more effectively with horse and cattle shipments that transit his state, not just at the loading and
destination stages, which, very often can be too late, could prevent much needless loss. The procedures to handle these in-transit cases need to be developed.

Greyhounds also suffer in transit, and enhanced in-transit inspection powers by veterinarians would be valuable. And greyhounds are still being trained on live lures, so there is more work for the state veterinarian in that area.

Updated and enhanced regulations for veterinary supervision of horse racing and horse shows from both a federal and state perspective would utilize the expertise that resides within the USAHA membership.

Speaking of involvement, early spay/neuter is now a viable option, endorsed by many, practiced by some, but to my knowledge not addressed as an important control method for dealing with overpopulation at the state veterinarian level. Do the state animal health officers recognize overpopulation as a problem?

What is their position on early/spay neuter? For that matter, what is the policy position of USAHA on overpopulation and early spay/neuter?

On the issues of animal cruelty, better certification, overpopulation, disaster planning, "Lemon Law" inspections, I would like to see more cooperation upward, to get more attention and support from the states' governors and their staffs, and on a federal level, and downward, to the working veterinarians within the states.

To attain more support from those above the state animal health officer, and from the federal level, could well require new policies, commitments and programs from the USAHA to bring this into being. Perhaps an advisory council, meeting regularly, to include the AVMA, AAHA, AHA, USDA and the academic community in addition to this organization, could help focus issues and draw upon the expertise of others in solving problems.

To strengthen the relationship and cooperation downward, between the state veterinarian and other entities within the state, a model for cooperation, not just in times of disaster, could include the veterinary bodies within the state, the humane societies' and animal control cruelty investigators, and the regional and local animal advisory boards, to provide a framework for working more closely together. We, in Florida, have an Animal Health Foundation of veterinary membership, but to date it has been a largely independent organization, filling needed gaps and providing needed services not attended to by others in the state.

I feel there is a great need to network more, both from our organization to others, and from our members downward within each state, to get veterinarian expertise more involved in public policy issues. Two veterinarians, responding to a request for testimony, are much more impressive than a single opinion. I feel communication with other organizations – the Delta Society and Morris Animal Foundation, for example
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– on their grants and programs, can offer important benefits.

Turning inward to this organization itself also offers a chance to see realities and opportunities. For example, the subject of Animal Welfare is the number one item most asked about by the press who follow the activities of USAHA. But does our own Committee on Public Relations know about the meetings of the Animal Welfare Committee and the topics considered? Could there not be a joint session, in view of public and press interest, during the next Annual Meeting to share those issues, the public’s concern for them, and our Welfare Committee members’ remarks regarding these issues? Can we not take full advantage of this public relations opportunity in behalf of the full organization? Certainly, there should be a closer liaison with the Public Relations Committee.

But more than that, on a larger issue than simply publicizing those matters discussed by the Animal Welfare Committee, would be urging the Committee on Public Relations to be more outwardly focused, to reach the general media, the animal-interest media, and the general science oriented media. By telling the accomplishments and commitments of the USAHA more broadly and effectively, it will, in turn, make its members’ work more understood, better appreciated, and easier to succeed in, from the federal level on down.
The meeting of the committee on Animal Welfare was called to order by Chairman Dr. Morton Silberman at 1:30 p.m., October 26, 1993. The meeting was attended by 17 members and 33 guests and speakers.

The Chairman announced that this was his last meeting as chair and thanked committee members for their support. Vice Chairman John Lang told members that public concern about animals welfare continues to increase and that the industry needs to address several needs. They are:

1. The need for both consumer and industry education about animal welfare.
2. The need to develop new techniques for assuring and improving the welfare of animals.
3. The need for national standards for animal husbandry practices.
4. The need to assure mechanisms for fair and proper enforcement of animal welfare regulations.
5. The need for a means of getting at real wrong-doers. The program consisted of eight speakers.

Dr. Richard Crawford, USDA-APHIS-REAC, reported on the agency's activities including the development of regulations for farm animals used in biomedical research, and for marine mammals, its work on stolen dogs allegedly going into research and its work on horse protection programs was also reviewed.

Dr. Alan Stern, Advocate for Animals, Inc., was unable to attend. Dr. Silberman summarized his paper for the committee. It recommends that the committee place more emphasis on companion animals.

Dr. Norman Willis, Agriculture Canada, discussed animal welfare regulations in Canada, their efforts to work with the Canadian livestock industry in developing standard of practice for all livestock species, livestock transportation and the importation of puppies from the United States.

Mr. Adam Roberts, Animal Welfare Institute, presented his organization's concerns about the effects of the North American Free Trade Agreement (NAFTA) on animals welfare regulations in the United States, leg
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hold traps and the livestock industry's handling of downer animals.

Dr. Ken Olson, American Farm Bureau Federation, told the committee about the work of several dairy, livestock and farm organizations to develop national voluntary guidelines for dairy animal care and a protocol which dairy farmers can use to evaluate welfare of dairy cattle on their farms.

Mr. Terry Medley, USDA-APHIS, was unable to attend the meeting, but he video taped his presentation on future directions of APHIS in areas of animal welfare regulations. Currently, Medley said, USDA is expanding the Animal Welfare Act to include non-agricultural farm animals (those used in biomedical research and some exhibitions). He said that APHIS is committed to developing regulations based on performance standards that allow for flexibility in compliance by those being regulated.

Ms. Nancy Robinson, Livestock Marketing Association, reported that her organization was emphasizing animal welfare with its members. It urges its members to consistently conduct employee education programs and to take strong action to correct employees who abuse animals. She also recognized educational efforts by the entire livestock industry on livestock welfare that emphasize shipping animals to market before they become infirm and proper handling techniques that reduce injuries to animals.

Dr. David Coffey, Western Kentucky University, presented his work in developing an animal welfare curriculum for middle school or junior high, high school and post secondary science and agri-science teachers. The project includes animal welfare concerns relating to pets, research animals and livestock. The project is being funded by the National FFA Foundation.

No resolution were presented to or approved by the committee.

The meeting was adjourned at 5:00 p.m.
PROTECTION OF SHEEP AGAINST BLUETONGUE DISEASE AFTER VACCINATION WITH CORE–LIKE AND VIRUS–LIKE PARTICLES: EVIDENCE FOR HOMOLOGOUS AND PARTIAL HETEROLOGOUS PROTECTION

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SUMMARY

Bluetongue virus–like particles (VLPs) with double capsids have been synthesized in insect cells using baculovirus multiple gene expression vectors. The purified particles were administered to sheep, while the control sheep received saline. The virus neutralizing antibody responses were measured. The sheep were challenged with homologous or selected heterologous viruses either after 4 months or 14 months. Disease, viraemias and clinical reactions were monitored. The results indicated that 2 doses of 10⁻⁹ of VLPs elicited a long–lasting immune response which protected the sheep against challenge with the homologous virulent virus. In certain cases, partial protection was afforded against challenge by heterologous bluetongue virus (BTV) serotypes.

To investigate whether proteins of virus cores have any role in protection, BTV core–like particles (CLPs), were synthesized and examined for their protective efficacies in sheep. The data indicated that the vaccinated sheep were partially protected by CLPs in the absence of neutralizing antibodies and developed reduced disease compared to control sheep.

INTRODUCTION

The difficulties associated with obtaining completely safe, live virus vaccines by the traditional procedures of virus passage and selection of attenuated forms, as well as the risks and expenses involved in preparing killed, or subunit vaccines from virulent viruses, may now be overcome using recombinant DNA technologies. Genetic engineering offers a variety of approaches to the preparation of viral vaccines. With knowledge of the genetic structure of pathogens and what is required to elicit a protective vaccine, it is possible to assemble and express the components needed in a protective vaccine. Of the various expression vector systems that have been developed, baculoviruses have received considerable attention in
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recent years, due to their ability to express large amounts of protein in a eukaryotic cell. An exciting advance in this field is the ability to construct virus-like particles that resemble their natural counterparts, but which lack genetic information (i.e., they are unable to replicate per se). This technology has been utilized to develop candidate vaccines for bluetongue disease.

Bluetongue disease is an economically important disease of sheep caused by a gnat-transmitted virus in certain parts of the world, including Africa, parts of the United States, Australia and South East Asia. BTV also infects cattle. Currently the only vaccines that are available are modified live virus vaccines developed in South Africa and the USA. To-date some 24 serotypes (BTV-1, BTV-2, etc) around the world have been recognised.

The architecturally complex BTV has a diameter of 810 Å and contains seven structural proteins (VP1-7), that are organized into two protein shells (see review by Roy, 1992). The outer shell contains two major protein species, VP2 (111 kD) and VP5 (58 kD) of which VP2 is the principal protein that determines the virus serotype. Both VP2, and to a lesser extent VP5, are the most variable proteins of the virus (Roy et al., 1990). VP2 also exhibits haemagglutinin activity and induces virus neutralizing antibodies that can protect sheep against virulent BTV challenge (Huismans and Erasmus 1981; Huismans et al., 1987; Roy et al., 1990). The inner shell contains two other major protein species, VP3 (103 kD) and VP7 (38 kD) which encapsulate the 10-segmented, double-stranded RNA (dsRNA) genome and the three minor proteins, VP1 (150 kD), VP4 (76 kD) and VP6 (36 kD). All five proteins of the virus inner capsid (i.e. core) are highly conserved between BTV serotypes (see review by Roy, 1989).

The use of baculovirus multiple gene expression vectors based on Autographa californica nuclear polyhedrosis virus (AcNPV) has provided a new strategy for vaccine development. Such vectors are capable of the simultaneous expression of several foreign genes within the host insect cell in which AcNPV replicates. Using this technology we have demonstrated that co-expression of the VP3 and VP7 proteins of BTV resulted in the formation of CLPs (French and Roy, 1990). The expression of the four major structural proteins of BTV resulted in the synthesis of double-shelled VLPs (French et al., 1990). These double-shelled particles not only appeared to be similar to the authentic virus particles in terms of morphology (see Fig. 1) and protein composition, but also elicited neutralizing antibodies in guinea-pigs. On this basis it was anticipated that VLPs should elicit protective responses in sheep, perhaps better than that obtained with VP2 alone.

Synthetic VLPs were used to vaccinate the sheep to determine their protective efficacies. The data obtained from several studies demonstrated the strong protective immune responses of VLPs against homologous and certain heterologous viruses. Subsequent studies with CLPs have indicated that homologous and heterologous viral infections can be controlled in sheep
in the absence of outer capsid proteins and the formation of neutralizing antibodies.

RESULTS

Immunization of sheep with VLPs afford protective immunity against BTV challenge

BTV-susceptible, 1-year old Merino sheep in an insect-proof isolation stable were divided into three groups. One group of eight sheep was immunized subcutaneously with VLPs in saline (0.15 M NaCl) containing the indicated amount of protein (Table 1) and suspended in 50% Montanide Incomplete Seppic Adjuvant (ISA-50, Seppic, Paris). Each animal received 2ml of the mixture. For each concentration of protein, two sheep were used. For control experiments, one group of four sheep received only saline and another four, a live attenuated BTV-10 (SA strain) vaccine. Apart from the sheep that received BTV-10, each vaccinated animal was boosted with the same amounts of protein on day 21.

From day 21 to day 117, serum from each animal was collected at intervals as indicated in Table 1 and virus neutralization tests were performed. Antibody titers were expressed as the reciprocal of the serum dilution estimated to cause a 50% reduction in plaques.

As shown in Table 1, sheep that received VLPs developed demonstrable neutralizing antibodies, albeit to different levels. The levels of neutralizing antibodies depended on the amount of VLPs administered. Significant levels of neutralizing antibodies were elicited with all concentrations of VLPs and persisted throughout the study. The four control sheep inoculated with saline remained sero-negative. The four sheep immunized with modified live virus vaccine developed high levels of neutralizing antibodies.

All sheep were challenged by subcutaneous inoculation of 1ml of infective sheep blood containing virulent BTV-10 (SA strain) at day 117. The clinical reactions of the animals and the viraemia were monitored from 3 to 14 days post-challenge (Huismans et al., 1987). Antibody titers of serum collected up to 21 days were also monitored.

As shown in Table 2 the challenged sheep developed neither clinical signs nor viremias, indicating suppressed replication of BTV. The anamnestic antibody response that was observed indicated that some replication of the challenge virus occurred. The post-challenge blood samples of the sheep that only received saline were viraemic and these sheep developed high neutralizing antibody titres indicative of a primary infection. In summary, protective immunity to BTV disease was obtained by vaccinating sheep with doses of 10^9 or more of BTV VLPs. Long-lasting antibody and protective responses in sheep following vaccination with BTV VLPs.
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To analyze further the protective effects of VLP vaccination, a similar protocol was employed for VLPs representing BTV-10 and BTV-17. Groups of 2 sheep each were vaccinated with 10 or 50 µg of VLPs representing BTV-10 or BTV-17. In addition, groups of 5 sheep each were given mixtures of 10 (or 50) µg VLPs representing BTV-10 and BTV-17. Another group of 6 sheep was only given saline in adjuvant. All sheep were boosted with the same materials 28 days later.

The neutralizing antibody titers of the vaccinated sheep were determined at weekly intervals and over a sixty week period after the booster. As illustrated in Table 3, both types of VLP elicited (to various levels) antibodies that neutralized the homologous virus. In almost all cases these neutralizing titers remained high throughout the 60 week period. The neutralizing antibody titers for the animals that received 50 µg doses of VLPs were not significantly higher than those that received the 10 µg doses. Sheep vaccinated with the mixture of the two types of VLPs induced antibodies that neutralized both types of virus when tested by plaque reduction assays (Table 3). As expected, the six control sheep that were inoculated with saline remained seronegative.

The ability of the sera to neutralize the heterologous BTV-4 was examined since BW-4 is considered to be a close relative of these viruses (Erasmus, 1990). The results of these assays indicated that only low levels of neutralizing antibodies against BTV-4 were induced in some of the vaccinated animals. When the neutralization of BTV-9, BTV-11, BTV-13, BTV-20 and BTV-24 serotypes was tested, no cross--neutralization was observed.

To determine whether the vaccinated sheep were protected, all the sheep were challenged 14 months after the booster vaccination by the subcutaneous injection of virulent BTV (Table 3). The animals that were challenged with the homologous viruses (BTV-10, BTV-17) were completely protected and showed no clinical reactions, even those that received 10 µg doses of VLP. Also, no viraemias were detected in these animals after challenge. By comparison, the control animals developed high or moderate signs of disease (BTV-10, CRI: 7.1–8.0; BTV-17, CRI: 1.6–2.7) and produced viraemias (data not shown).

Since it was reasonable to assume that animals vaccinated with mixtures of VLP would be protected against both BTV-10 and BTV-17, the animals that received the mixture of the 2 VLPs were challenged only with heterologous viruses, namely BTV-4, or BTV-11. One animal (no. 9) that received a dose of 10 µg of the VLP mixture (see Table 3) and developed low neutralizing antibody titers to BTV-10 and BTV-17, gave a high CRI (7.1) after BTV-4 challenge and produced a viraemia. However a second animal (no. 10) which developed higher neutralizing antibody titers to BTV-10 and BTV-17 was completely protected when challenged with BTV-4 (CRI: 0) and did not develop a viraemia. Sheep that received doses of 50
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_\text{g} of the VLPs (no. 14–16) either gave a very mild clinical reaction (1 animal, no. 14; CRI: 0.5), or none at all (2 animals, no. 15,16; CRI: 0), indicating that they were protected from the BTV-4 challenge. These animals also did not develop viraemias. Although due to the limited number of sheep employed in this study only one control animal (no. 23) was challenged with BTV-4, it developed a CRI of 3.7 and a viraemia, in keeping with the type of disease usually observed with this virus serotype.

None of the animals that received the 10 \text{A}_g doses of the VLP mixture gave any evidence of protection against BTV-11 virus challenge (Table 3, sheep no. 11–13, CRI: 3.0–3.9), even though all three had neutralizing antibodies to BTV-10 and BTV-17 (Table 3). The challenged sheep all developed viraemias. As noted above, no neutralizing antibodies were detected against BTV-11 in these sheep. The control sheep (no. 24) gave a CRI of 3.2 following BTV-11 challenge. Of the two sheep that were vaccinated with the 50 \text{A}_g mixtures, one (no. 17) was completely protected against BTV-11 challenge (CRI: 0) and did not become viraemic, while the other gave a CRI (2.3) and viraemia essentially similar to that of the control sheep challenged with BTV-11.

In summary, the data showed that long lasting protection against homologous BTV challenge was provided by vaccination with VLPs. Some preliminary evidence was obtained for cross-protection, depending on the challenge virus and the amounts of antigen used for vaccination.

Core-like particles without the outercapsid can mitigate the viral infection

The question of whether CLPs would provide a measure of homologous and heterologous BTV protection by cell mediated mechanism was investigated. CLPs were produced containing the VP3 of BTV-17 and the VP7 of BTV-10. For initial studies two groups of five sheep each were used. One group of five sheep inoculated with 50 \text{A}_g BTV-10 CLP in ISA50; and a second group of five sheep was inoculated with only saline in ISA50. All sheep were boosted on day 21, and were challenged with BTV-10 two weeks later.

All post-challenged sheep developed viraemias and neutralizing antibodies (Table 4), however, with the exception of fever, the vaccinated sheep developed only slight clinical reactions whereas controls showed characteristic mouth and feet lesions in addition to fever. The average CRI of the vaccinated sheep was 3.5 whereas that of the control sheep was 9.0.

In summary, partial protection against BTV challenge was afforded by CLP vaccination. Further experiments are planned to study this phenomenon further.

CONCLUSION

Recent developments in biotechnology have made it possible to
synthesize BTV double–shelled VLPs that mimic authentic virions but lack the genetic material and viral replicating machinery. Both biochemically and immunologically these particles are similar to the authentic virus. In sheep, doses as low as $10^{-6}$ g of VLPs elicited immune responses that were sufficient to protect sheep against virulent virus challenge. Moreover, protective immunity was also afforded against certain heterologous virus challenges. Whether sheep are protected for periods longer than 14 months has not yet been tested.

Generally, virus–antibody interactions that result in the neutralization of virus infectivity are the basis for the development of many viral vaccines, including BTV. The serotype–specific BTV VP2 protein is considered to be the main antigen that is responsible for inducing virus neutralizing responses in vaccinated animals. The roles of other antigens in procuring a protective immune response, such as that involving cell mediated responses, are not known. To investigate this issue we initiated a study in sheep using CLPs in order to determine whether they elicit protection, specifically cross–protection since the BTV VP3 and VP7 antigens are highly conserved. Preliminary data indicate that CLPs stimulate partial protection in sheep, suggesting that cellular immunity may play a role in the overall protection process.

REFERENCES


ANIMAL PATENTS--IMPLICATIONS FOR LIVESTOCK PRODUCERS

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ABSTRACT

Should genetically engineered animals be patented? This issue has been one of the most contentious as lawmakers have grappled with how best to protect intellectual property. Since the 1980 case of Diamond v. Chakrabarty, in which the U.S. Supreme Court ruled that a living microorganism is patentable, the U.S. Patent and Trademark Office has determined that plants and nonhuman animals can be patented. These policy decisions have led to congressional debate on whether animals should be patentable subject matter. Patenting of living organisms is unique for three reasons: the invention itself is alive; the invention in some instances can reproduce itself; and the invention sometimes cannot be adequately described for patent specification purposes, leading to the need for deposit of the invention for patent purposes.

INTRODUCTION

Intellectual property protection—that area of the law involving patents, copyrights, trademarks, and trade secrets—is not new. Much in biotechnology, on the other hand, is relatively new. In the past 15 years, dramatic new developments in the ability to manipulate genetic material have created heightened interest in the commercial uses of living organisms. Biotechnology, broadly defined, includes any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants or animals, or to develop microorganisms for specific uses. Although people have used organisms since the dawn of civilization to improve agriculture, animal husbandry, baking, and brewing, it is the novel uses of certain biological techniques (e.g., recombinant DNA techniques, cell fusion techniques, monoclonal antibody technology, and new bioprocesses for commercial production) that have caught the imagination of many people.

One novel result of the development of biotechnology is the creation and patenting of inventions that are themselves alive. The patenting of new life forms raises arguments in favor of and against the issuance of such patents. Most recently, public debate has centered on patenting of animals. Such debate is to be expected when an old and relatively well–settled body of law must be applied to unforeseen technologies.

The debate over whether to permit the patenting of living organisms frequently goes beyond simple questions of the appropriateness of patents per se, focusing instead on the consequences of the commercial use of
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patented organisms or the underlying merits of biotechnology itself. Discussion regarding the patenting of a genetically engineered organism, for example, can turn to the environmental application of the organism (e.g., the field test of a microorganism that is patented), the welfare of the organism (if it is an animal), scientific questions (e.g., whether the method of creating the organism represents a radical departure from traditional scientific or breeding methods), ethical issues (e.g., the morality of creating novel organisms or transferring genetic information between species), and economic considerations (e.g., whether the federal government should finance biotechnology-related research). One inherent difficulty in examining the patenting of living organisms is determining which arguments raised are novel and directly related to patent issues, as opposed to those questions that would exist independent of patent considerations.

This article, based on an Office of Technology Assessment report (U.S. Congress, 1989), analyzes some of the legal, economic, ethical, religious, and practical considerations raised by the patenting of living organisms, particularly transgenic animals.

INTELLECTUAL PROPERTY

Rooted in the Constitution, intellectual property law provides a personal property interest in the work of the mind. Modern intellectual property law consists of several areas of law: patent, copyright, trademark, trade secret, and breeders' rights.

Patents

A patent is a grant issued by the U.S. Government giving the patent owner the right to exclude all others from making, using, or selling the invention within the United States, and its territories and possessions, during the term of the patent (35 U.S.C. 154). A patent may be granted to whomever invents or discovers any new, useful, and non-obvious process, machine, manufacture, composition of matter, or any new and useful improvement of these items (35 U.S.C. 101). A patent may also be granted on any distinct and new variety of asexually reproduced plant (35 U.S.C. 161) or on any new, original, and ornamental design for an article of manufacture (35 U.S.C. 171).

The first patent act was enacted by Congress in 1790, providing protection for "any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement [thereof]." Subsequent patent statutes were enacted in 1793, 1836, 1870 and 1874, which employed the same broad language as the 1790 Act. The Patent Act of 1952 replaced "art" with "process" as patentable subject matter (35 U.S.C. 101). The Committee Reports accompanying the 1952 Act demonstrate that Congress intended patentable subject matter to include "anything under the sun that is made by man." However, the Supreme Court has held that laws of nature,
physical phenomena, and abstract ideas are not patentable. Patents have many of the attributes of personal property (35 U.S.C. 261). Property is generally viewed as a bundle of legally protected interests, including the right to possess and to use, to transfer by sale and gift, and to exclude others from possession. Patents are designed to encourage inventiveness by granting to inventors and assignees a limited property right—the right to exclude others from practicing the invention for a period of 17 years. In return for this limited property right, the inventor is required to file a written patent application describing the invention in full, clear, concise, and exact terms, setting forth the best mode contemplated by the inventor, so as to enable any person skilled in the art of the invention to make and use it. Although a patent excludes others from making, using, or selling the invention, it does not give the patent owner any affirmative rights to do likewise. As with other forms of property, the right to make, use, or sell a patented invention may be regulated by federal, state, or local law. Patents are more difficult to obtain than other forms of intellectual property protection. All applications are examined by the PTO, which is responsible for issuing patents if all legal requirements are met. Once obtained, the enforceability of a utility patent is maintained by the payment of periodic maintenance fees.

PATENTING OF MICROORGANISMS AND CELLS

Patents on biotechnological processes date from the early days of the United States. Louis Pasteur received a patent for a process of fermenting beer. Acetic acid fermentation and other food patents date from the early 1800s, and therapeutic patents in biotechnology were issued as early as 1895.

The development of recombinant DNA technology (rDNA), the controlled joining of DNA from different organisms, has resulted in greatly increased understanding of the genetic and molecular basis of life. Following the first successful directed insertion of recombinant DNA into a host microorganism in 1973, scientific researchers began to recognize the potential for directing the cellular machinery to develop new and improved products and processes in a wide variety of industrial sectors. Many of these products were microorganisms (microscopic living entities) or cells (the smallest component of life capable of carrying on all essential life processes). With the development of recombinant DNA technology, the potential of patenting the living organism resulting from the technology arose.

Prior to 1980, the United States Patent and Trademark Office (PTO) would not grant patents for such inventions, deeming them to be "products of nature" and not statutory subject matter as defined by 35 U.S.C. 1012. Although patent applications were rejected if directed to living organisms per se, patent protection was granted for many compositions containing living things (e.g., sterility test devices containing living microbial spores, food yeast compositions, vaccines containing attenuated bacteria, milky spore
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insecticides, and various dairy products). In the absence of congressional action, it took a catalytic court decision to clarify the issue of patentability of living subject matter.

The Chakrabarty Case

The Supreme Court's single foray into biotechnology occurred in 1980 with its ruling in the patent law case of Diamond v. Chakrabarty. Chakrabarty had developed a genetically modified bacterium capable of breaking down multiple components of crude oil. Because this property was not possessed by any naturally occurring bacteria, Chakrabarty's invention was thought to have significant value for cleaning up oil spills.

Chakrabarty's claims to the bacteria were rejected by the PTO on two grounds: microorganisms are "products of nature" and, as living things, microorganisms are not patentable subject matter under 35 USC section 101.

Following two levels of appeals, the case was heard by the U.S. Supreme Court, which in a five to four ruling, held that a live, human-made microorganism is patentable subject matter under section 101 as a "manufacture" or "composition of matter." The court reached several conclusions in analyzing whether the bacteria could be considered patentable subject matter within the meaning of the statute: The plain meaning of the statutory language indicated Congress' intent that the patent laws be given wide scope. The terms "manufacture" and "composition of matter" are broad terms, modified by the expansive term "any." The legislative history of the patent statute supported a broad construction that Congress intended patent protection to include "anything under the sun made by man."

Although laws of nature, physical phenomena, and abstract ideas are not patentable, Chakrabarty's microorganism was a product of human ingenuity having a distinct name, character, and use. The passage of the 1930 Plant Patent Act (affording patent protection for certain asexually reproduced plants) and the 1970 Plant Variety Protection Act (providing protection for certain sexually reproduced plants) does not evidence congressional understanding that the terms "manufacture" or "composition of matter" do not include living things. The fact that genetic technology was unforeseen when Congress enacted section 101 does not require the conclusion that microorganisms cannot qualify as patentable subject matter until Congress expressly authorizes such protection. Arguments against patentability based on potential hazards that may be generated by genetic research should be addressed to the Congress and the Executive for regulation or control, not to the Judiciary.

Events and Trends After Chakrabarty

The Chakrabarty decision provided great economic stimulus to
patenting of microorganisms and cells, which in turn provided stimulus to the growth of the biotechnology industry in the 1980s. In addition to the Chakrabarty decision, revisions in federal patent policy promoted increased patenting of inventions in general, including living organisms and related processes. The Patent and Trademark Amendments of 1980 (Public Law 96–517), as amended in 1984 (Public Law 98–260) encourages the patenting and commercialization of government–funded inventions by permitting small businesses and nonprofit organizations to retain ownership of inventions developed in the course of federally funded research.

These policies, which gave statutory preference to small businesses and nonprofit organizations, were extended to larger businesses by executive order in 1983. The Technology Transfer Act of 1986 (Public Law 99–502) granted federal authority to form consortia with private concerns. An executive order issued in 1987 further encouraged technology transfer programs, including the transfer of patent rights to government grantees. Increased patenting of biotechnology inventions has led to litigation, primarily related to patent infringement issues. Already, patent battles are being fought over interleukin–2, tissue plasminogen activator, human growth hormone, alpha interferon, factor VIII, and use of dual monoclonal antibody sandwich immunoassays in diagnostic test kits. It is likely that patent litigation relating to biotechnology will increase given the complex web of partially overlapping patent claims, the high–value products, the problem of prior publication, and the fact that many companies are pursuing the same products.

One negative trend arising from the increase in patent applications is the inability of the PTO to process biotechnology applications in a timely manner. The number of these applications has severely challenged the process and examination capabilities of the PTO. In March 1988, the PTO reorganized its biotechnology effort into a separate patent examining group. As of July 1988, 5,850 biotechnology applications had not yet been acted on. Currently, approximately 15 months lapse, on average, before examination of a biotechnology application initiates, and an average of 27 months passes before the examination process is completed by grant of the patent or abandonment of the application. Turnover among patent examiners, lured to the private sector by higher pay, is cited as a significant reason for the delay in reviewing patents.

PATENTING OF ANIMALS

In April 1987, the Board of Patent Appeals and Interferences ruled that polyploid oysters were patentable subject matter. Subsequently, the PTO announced that it would henceforth consider nonnaturally occurring, nonhuman multicellular living organisms, including animals, to be patentable subject matter under general patent law. This statement initiated broad debate and the introduction of legislation concerning the patenting of animals.
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The first animal patent was issued in April 1988 to Harvard University for mammals genetically engineered to contain a cancer-causing gene (U.S. 4,736,866). Exclusive license to practice the patent went to duPont Co., which was the major sponsor of the research. The patented mouse was genetically engineered to be unusually susceptible to cancer, thus facilitating the testing of carcinogens and of cancer therapies. Specifically, the patent covers "a transgenic nonhuman eukaryotic animal (preferably a rodent such as a mouse) whose germ cells and somatic cells contain an activated oncogene sequence introduced into the animal . . . which increases the probability of the development of neoplasms (particularly malignant tumors) in the animal." The 1987 PTO policy and the 1988 issuance of the first patent on a transgenic animal spurred public debate on scientific, regulatory, economic, and ethical issues.

Producing Transgenic Animals

Most potentially patentable animals are likely to be transgenic animals produced via recombinant DNA techniques, or genetic engineering. Transgenic animals are those whose DNA, or hereditary material, has been augmented by adding DNA from a source other than parental germplasm, usually from different animals, including humans.

Laboratories around the world are conducting research that involves inserting genes from vertebrates (including humans, mammals, or other higher organisms) into bacteria, yeast, insect viruses, or mammalian cells in culture. A variety of techniques, most developed from early bacterial research, can now be used to insert genes from one animal into another. These techniques are known by a number of exotic names: microinjection, cell fusion, electroporation, retroviral transformation, and others. Of the currently available scientific techniques, microinjection is the method most commonly used and most likely to lead to practical applications in mammals in the near future. Other methods of gene insertion may become more widely used in the future as techniques are refined and improved. If protocols for human gene therapy now being developed in animal models or laboratory cultures of mammalian cells prove successful and broadly adaptable to other mammals, other gene insertion techniques could supplant microinjection.

Although the number of laboratories working with transgenic animals remains small (no more than a few hundred, worldwide), and researchers with the required skill and experience are not common, the number of research programs using these techniques has grown steadily in recent years. For reasons of convenience, much research involving transgenic mammals continues to be done using mice, although programs using several larger mammals have made significant progress. It is anticipated that some animals of research utility or substantial economic importance will become more common as subjects of transgenic modifications in the near future.
(within 5 to 10 years). Beyond mice, the major research efforts involving transgenic modifications focus on cattle, swine, sheep, poultry, and fish.

Producing transgenic animals by microinjection, although tedious, labor intensive, and inefficient (only a small fraction of injected eggs develop into transgenic animals) compares favorably in at least three respects with traditional breeding techniques: The rapidity with which a specific gene can be inserted into a desired host means that the time it takes to establish a line of animals carrying the desired trait is much reduced. The specific gene of interest can be transferred with great confidence, if not efficiency, and if proper purification protocols are followed, without any accompanying, unwanted genetic material. With the proper preparation, genes from almost any organism can be inserted into the desired host, whether it is a mouse or some other animal. Historically, genetic material exchanged by classical hybridization (cross breeding) could only be transferred between related species or different strains within a species.

If there is a fundamental difference arising from the new techniques, it is that breeders have greatly augmented ability to move genes between organisms that are not close genetic relatives (e.g., human and mouse, or human and bacterium). Most transgenic animal research in the near future will likely focus on traits involving a single gene. Manipulation of complex traits influenced by more than one gene, however, such as the amount of growth possible on a limited food regimen, or behavioral characteristics, will develop more slowly (perhaps within 10 to 30 years) because of greater technical difficulty and the current lack of understanding of how such traits are controlled by genes.

**Federal Regulation and Animal Patents**

To gain an understanding of the potential use and regulation of genetically altered animals that might be patented, OTA asked selected federal agencies the following questions: How are genetically altered animals currently used in research, product development, and mission-oriented activities conducted or funded by your agency? What are the potential uses of such animals during the next five years? How does (or would) your agency regulate such animal use? What statutes, regulations, guidelines, or policy statements are relevant?

Several agencies currently use transgenic animals. The National Institutes of Health is currently the largest user of such animals for biomedical research projects. The USDA has conducted research on the genetics of animals for many years. The USDA's Agricultural Research Service reported projects involving the use of growth hormone in sheep and swine, and chickens engineered by recombinant DNA technology to be resistant to avian leukosis virus. The USDA's Cooperative Research Service is in the early stages of supporting extramural research projects involving genetically engineered animals. The National Science Foundation (NSF)
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currently funds research involving transgenic animals in a range of experiments, all involving laboratory animals. With the use of transgenic animals becoming central to whole lines of investigation, NSF expects that work with such animals will increase. The Agency for International Development (AID) funds research involving conventional and transgenic animals at international research centers that are only partially funded by the United States. Accordingly, AID has minimal control over such research activities. Several federal agencies regulate the experimental use or commercial development of genetically altered animals. Because current statutes regulate various uses and protections for animals, no single federal policy governs all uses of genetically altered animals. In the absence of a single policy, federal agencies will rely on existing statutes, regulations, and guidelines to regulate transgenic animal research and product development. Current federally funded research efforts could lead to patents on animals. The patentability of an animal however, does not affect the manner in which the animal would be regulated by any federal agency.

Economic Considerations

Economic considerations will influence the order in which different transgenic animals are produced for commerce. Transgenic animals used for biomedical research are likely to be developed first, primarily due to extensive research in this area. Transgenic agricultural animals are also likely to be produced, although large-scale commercial production of such livestock and poultry is unlikely in the near future (5 to 10 years). The largest economic sectors likely to be influenced by animal patents are the different markets for agricultural livestock, and possibly some sectors of the pharmaceutical industry. The principal agricultural markets involve poultry, dairy, and red meat. These markets are organized quite differently, and they are subject to different degrees of economic concentration. Poultry is most concentrated (though still diffuse by the standards of other industries, such as automobiles), and the dairy and red meat sectors much more diffuse. Different economic forces are important in markets as well: federal price supports are of major importance in the dairy market, while the market for poultry is more open and competitive. It is difficult to predict the manifold consequences of any particular approach to protecting intellectual property, especially across so wide a range of economic activity as that spanned by patentable animals. This range embraces diverse sectors of the agricultural livestock markets, pharmaceutical and other chemical production, as well as academic research or industrial testing. The economics of patenting and the effect on inventors and consumers will be determined by the potential use of the animal, its market, its reproduction rate, and its relative value. The existence of animal patents and the degree to which they are employed in the different markets may introduce some new economic relationships. It is not now clear that these are likely to have any substantially adverse effects
on the major markets or existing market forces. The same types of pressures that have driven economic choices in the past are likely to continue to dictate them in the future. If an innovation increases costs (e.g., if a patented animal costs more than the unpatented alternative) it is unlikely to be adopted unless it commensurately increases outputs or product values. It therefore seems that although cost savings can be anticipated to follow from animal patenting in some areas (e.g., pharmaceutical production or drug testing), innovations attributable to patented animals are likely to advance more slowly in low margin operations such as raising beef cattle. In some cases, efficient alternatives to protection of intellectual property via patents are feasible. Trade secrets or contractual arrangements might serve well where the animals involved have a high intrinsic value and are limited in number (e.g., animals used for pharmaceutical production). When faced with the complexity of the markets for pork or beef production, however, such alternatives are clearly less practical, although the same complexity complicates any scheme for enforcement or royalty collection associated with patenting animals per se.

**Ethical Considerations**

A number of ethical issues have been raised in regards to patenting animals. Many of these arguments focus on the consequences that could occur subsequent to the patenting of animals. Other arguments focus on religious, philosophical, spiritual, or metaphysical grounds. These issues have been used to support and oppose the concept of animal patenting. Many arguments relating to the consequences of animal patenting are difficult to evaluate since they are speculative, relying on factual assertions that have yet to occur or be proven. Arguments based largely on theological, philosophical, spiritual, or metaphysical considerations are likewise difficult to resolve, since they usually require the assumption of certain presuppositions that may not be shared by other persons. Thus, such arguments are not likely to be reconciled among those persons holding opposing and often strongly held beliefs. Most arguments that have been raised both for and against the patenting of animals concern issues that would be materially unchanged whether patents are permitted or not. Most arguments center on issues that existed prior to the current patenting debate (e.g. animal rights, the effect of high technology on American agriculture, the distribution of wealth, international competitiveness, the release of novel organisms into the environment). It is unclear that patenting per se would substantially redirect the way society uses or relates to animals. Many concerns about the consequences of patenting can be addressed by appropriate regulations or statutes, rather than by amendments to patent law. Other arguments, particularly those of theological, philosophical, spiritual, or metaphysical origin, need to be debated more fully and articulated more clearly.
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Implications for Major Livestock Sectors

Livestock, including poultry, dairy, and red meat animals, is the largest component of the agriculture sector in the United States. The various livestock markets are organized quite differently and are subject to different degrees of economic concentration. Poultry is the most concentrated (though still diffuse by other industry standards, e.g., automobiles) with the dairy and red meat sectors being much more diffuse. Different economic forces are important in the several markets as well. Federal price supports are of major importance in the dairy market, while the market for poultry is more open and competitive.

The existence of animal patents and the degree that they are employed in the different markets may introduce some new economic relationships. It is not now clear that these are likely to have any substantially adverse effects on the major markets or existing market forces. The same types of pressures that have driven economic choices in the past are likely to continue to dictate them in the future—if an innovation increases costs (e.g., if a patented animal costs more than an unpatented alternative), it is unlikely to be adopted unless it increases outputs or product values commensurately. It therefore seems that although cost savings can be anticipated to follow from animal patenting in some areas (e.g., pharmaceutical production or drug testing) innovations due to patented animals are likely to advance more slowly in low margin operations such as the raising of beef cattle.

In some cases, efficient alternatives to protection of intellectual property protection via patents are feasible. Trade secrets or contractual arrangements might serve well where the animals involved have a high intrinsic value and are limited in number, e.g., animals used for pharmaceutical production or for breeding stock. When faced with the complexity of the markets for pork or beef production, however, such alternatives are clearly less practical, although the same complexity complicates any scheme for enforcement or royalty collection associated with patenting.

DEPOSIT CONSIDERATIONS

In 1949, the PTO began recommending that patent applications for inventions involving microorganisms should include the deposit of the pertinent microorganism with a culture collection. Although not a formal requirement, patent examiners advised applicants that in cases where words alone were not sufficient to describe the invention adequately, a deposit was advisable. Currently, patent applications for inventions involving microorganisms, plasmids, vectors, cells, plant tissues, seeds, and other biological materials that are not generally available to or reproducible without undue experimentation by persons skilled in the pertinent field are often supported by a deposit in a recognized patent depository. Whether or not a deposit is necessary is a decision made on a case-by-case basis. The decision
generally takes into account the reproducibility of the invention based upon a written description alone, the level of skill in the art, the teachings of the prior art, and the availability of the starting materials. Although not automatically required, a deposit is employed in many cases to meet the requirement that a patent provide enablement or the best mode of practicing an invention. The PTO first published guidelines on the deposit of microorganisms in 1971. In 1977, establishment of the Budapest Treaty required contracting States that allow or require the deposit of microorganisms as part of their patent procedure to recognize the deposit of a microorganism with any International Depositary Authority. In 1985, the Court of Appeals for the Federal Circuit held that the enablement provision of the patent statute did not require a deposit in a recognized depository by the filing date of the patent application, but only before the issuance of the patent. The PTO published rules for deposit of biological materials for patent purposes. These rules assist the inventor and the depository in defining the position of the PTO on deposits. A culture depository accepts, maintains, and distributes cultures of microorganisms, viruses, cells, or other genetic-type material. The deposit of seeds and plant tissue culture has become established practice. A depository may be public or private; nonprofit or for profit. The main function of a public culture depository is the preservation and distribution of reference cultures that serve as standards for users in the scientific and educational communities. The new patentable status of animals raises the possibility that the PTO will encourage or require the deposit of animal forms to support certain patent applications. To date, no animal has been deposited with a depository. In the case of the first animal patent granted (U.S. 4,736,866), the deposit requirement was satisfied not by deposit of a mouse or other animal, but by deposit of the cancer-causing genes intended for transfer into an animal. DNA plasmids bearing those genes were deposited. In the patent, the inventors describe detailed instructions for inserting those genes into mouse embryos to produce transgenic mice. The patenting of animals could cause problems for a depository if deposit of the animal is required. Currently no depository is willing to accept the deposit of animals for the following reasons: The cost of facilities and expertise that might be needed to maintain animals would be prohibitive. A depository maintaining animals for patent purposes might be subject to adverse publicity. If it were necessary to maintain the animal, a depository might need to grow another sample to prove the replication of the animal. After growth of the animal, disposal might not be acceptable, and, therefore, maintenance of progeny would be necessary. How would a depository make samples of the animal available? Grow more animals? Maintenance of many kinds animals for the current required period of 30 years would not be practical or possible, as their life spans are shorter than 30 years.

The deposit of animal embryos may not present the same difficulties
as long as the embryos can be successfully frozen and recovered. To date, at least 13 species of animal embryos (cattle, mice, rats, rabbits, hamsters, sheep, goats, horses, cats, antelopes, and three species of nonhuman primates) have been successfully frozen and recovered.

INTERNATIONAL PROTECTION FOR MICRO-ORGANISMS, PLANTS, AND ANIMALS

Intellectual property protection of microorganisms, plants, animals, and biological processes is of increasing concern to the world community. Subject matter patentability is an important consideration facing an inventor who wants to patent living matter in a foreign country. In addition, international subject matter patentability is one element of the current debate in the United States regarding the scope of patentable subject matter. For example, those who favor patenting of animals point out that other countries either permit or do not expressly exclude the possibility of such patents. Opponents of patenting of animals conclude that other nations expressly exclude or have yet to issue patents on animals. Several international treaties and agreements are relevant to biological inventions. These agreements are efforts by member countries to harmonize various procedural and substantive elements of international patent practice. The patenting of animals is not the subject of any existing treaty. Of the existing agreements, the European Patent Convention (EPC) is most relevant to the substantive issue of patenting plants and animals. Article 52(1) of the EPC defines patentable subject matter as inventions, which are susceptible to industrial application, which are new, and which involve an inventive step. This definition is extraordinarily general and broad. Rather than providing a precise, positive definition of patentable subject matter, the EPC instead takes the approach of narrowing this broad definition by explicitly specifying negative restrictions thereto. One such exclusion is Article 53(b), which stipulates that European patents will not be issued for plant or animal varieties and essentially biological processes for the production of plants and animals (with the exception of microbiological processes or the products thereof). Although plant varieties are specifically excluded, there is no general exclusion for plants. According to the Technical Board of Appeal of the European Patent Office, (EPO) EPC Article 53(b) prohibits only the patenting of plants which are in the genetically fixed form of a plant variety (i.e., a specific variety, such as the rose 'Peace' or the wheat cultivar 'Chinese Spring.' Thus, the EPO will grant utility patent (generic) protection for plants, for example, where a gene has been inserted into a plant, e.g., corn having gene X, but is not fixed in a single plant variety, e.g., corn inbred A having gene X. Similarly, a process for transforming a plant to insert a desired gene would be patentable because human intervention played a greater role in the final result than biological forces. This viewpoint has been adopted by the Swiss Patent Office as well as by the European Patent
Office, which in early 1988 granted a patent on a technique for increasing the protein content of forage crops such as alfalfa and for the plants produced with the aid of the technique. This decision arguably opens the door for plant and animal patenting in Europe, subject to the specific treatment of European patents on a country-by-country basis. Differences exist between nations regarding intellectual property protection of biotechnological inventions, including the issue of what constitutes patentable subject matter. Patent protection is widely available for microorganisms, as are various forms of patents and breeder's certificates for plant life. Analysis of the laws of other nations indicate that patent protection on animals is permissible or theoretically possible in a number of nations. Any projection of the number of nations permitting animal patents must be considered speculative in the absence of patent prosecution in this area. To date, only the United States has both announced a policy permitting patents on animal life forms and issued a patent on an animal invented through biotechnological techniques. It is likely that other nations will issue such patents in the future. The Japanese patent office, for example, recently issued an internal notice announcing its intention to grant patents on non-human animals if they meet the requirements of their patent law.

POLICY ISSUES AND OPTIONS FOR CONGRESSIONAL ACTION

Three policy issues relevant to patenting of living organisms were identified during the course of the OTA study. Of these, the issue of whether the patenting of animals be permitted by the federal Government has garnered the most debate. Six options were provided to the Congress by OTA: take no action; enact a moratorium on the issuance of animal patents; enact an animal variety protection statute modeled after the Plant Variety Protection Act; enact a statute amending the patent law to address the patenting of animals.

To date, no law has been passed by both houses of Congress on this issue. However, as patents are issued, Congress may well return to the public policy ramifications resulting from animal patenting.
DIFFERENTIAL DIAGNOSIS BETWEEN RINDERPEST–VIRUS VACCINATED AND INFECTED ANIMALS USING THE NUCLEOCAPSID PROTEIN EXPRESSED IN BACULOVIRUS

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ABSTRACT

Rinderpest (RP) is a viral disease of ruminants in Africa and Asia causing greater than 95% morbidity and mortality. We have cloned the cDNA of the nucleocapsid (N) gene of the virulent Kabete O strain of rinderpest virus (RPV) and developed a recombinant baculovirus that expresses the N protein (rRVN) in insect cells (Sf9) and larvae (Spodoptera frugiperda). rRVN was used as the coating antigen in an ELISA to distinguish animals infected with RPV from those vaccinated with a recombinant vaccinia virus expressing the hemagglutinin and/or fusion genes of RPV. Crude lysate of a single infected larva (0.2–0.3 g) was sufficient to coat 150 standard 96-well ELISA plates for serological diagnosis of 7200 serum samples in duplicate.

INTRODUCTION

Rinderpest (RP) or cattle plague is an acute, febrile, and highly contagious viral disease of ruminants characterized by inflammation, hemorrhage, necrosis, and erosion of the gastro-intestinal tract that is manifested by bloody diarrhea, wasting, and death. RP is found mainly in Africa and Asia; there is a recent report of its introduction into Turkey and Russia. The causative agent, the rinderpest virus (RPV), is a member of the family Paramyxoviridae and the genus Morbillivirus. Other members of the genus include measles virus of humans (MV), canine distemper virus (CDV), peste des petits ruminants virus (PPRV), and phocid distemper virus (PDV). Morbilliviruses are antigenically related and can confer varying degrees of cross-immunity against each other.

RPV is enveloped and has a helical nucleocapsid containing a single-stranded RNA genome with a minus polarity. We have described eight proteins encoded by the virus, including the large (L), the phosphoprotein (P), the hemagglutinin (H), the nucleocapsid (N), the fusion (F), the matrix (M), the V, and the C proteins. The N protein constitutes the major component of the nucleocapsid core and is believed to play an important role in transcription and replication of the virus.
A RAPID DIAGNOSTIC KIT FOR RINDERPEST-VIRUS

Major problems have been encountered with the control of rinderpest in endemic areas. Although the tissue culture rinderpest vaccine (TCRV) in current use is effective, it is thermolabile and expensive to produce. This limits its use in the hot and arid regions of Africa and Asia. Further, TCRV does not allow serological distinction between vaccinated and RPV–infected animals. The most reliable test currently in use for the serological diagnosis of RP is the serum neutralization test (SN). This test is expensive and time-consuming (5 to 7 days) to complete, and requires tissue culture facilities with skilled personnel. Further, the test does not lend itself to making a distinction between vaccinated and infected animals. We have been engaged in the development of inexpensive and thermostable vaccinia virus recombinant vaccines for RPV that can be used with a simplified ELISA diagnostic test to alleviate these problems.

Here we report the cloning and expression of the N gene of RPV in insect cells (Sf9) and larvae (Spodoptera frugiperda) by a recombinant baculovirus (bRVN). A rapid and inexpensive diagnostic ELISA kit for RP was developed by using crude lysates of bRVN–infected insect cells or larvae as a coating antigen. A single larva infected with the recombinant baculovirus is adequate to coat 150 ELISA plates for the diagnosis of 7200 serum samples in duplicate. The kit can be used to distinguish animals infected with RPV from those vaccinated with a recombinant vaccine devoid of the N protein.

MATERIALS AND METHODS

The RPV was propagated in primary bovine kidney cell monolayers in Joklik's modified medium supplemented with 10% calf serum. Poly(A)* RNA was isolated by oligo (dT) cellulose chromatography, and viral messenger RNAs were characterized by in vitro translation. We constructed the λgt11 cDNA library from poly(A)* RNA as described previously. The recombinant clones containing sequences derived from RPV N mRNA were identified by high-stringency plaque hybridization using a 32P-labeled Pvull internal fragment of the N gene of MV as probe as described before. The cDNA inserts of N gene in λgt11 were amplified directly from bacteriophage plaques through 30 cycles of PCR. The entire coding region of the N gene was excised as a Dral and Kpnl fragment and cloned into pVL1393 at the Smal and Kpnl sites by standard procedures to generate pVL1393N. The recombinant plasmid was characterized by restriction enzyme analysis.

For homologous recombination, 1 μg of wild type baculovirus plus 10 μg of pVL1393N DNAs were transfected into 2.5 X 10⁶ Sf9 cells by the calcium phosphate method. Successful transfection was confirmed by the presence of polyhedrin protein (produced by the wild–type virus) within 5 days of transfection. A plaque assay was performed using serial dilutions of culture supernatant obtained from transfected Sf9 cells, and recombinant baculovirus plaques with the RPV–N gene inserts (bRVN) were screened for
the absence of the polyhedrin protein normally found in wild-type plaques.

Sf9 cells were infected with bRVN or wild type baculovirus at a multiplicity of infection (m.o.i.) of 10, and then harvested at 12 hr intervals over a 72 hr period. Cell lysates were prepared in lysis buffer, resolved on a 9% SDS–polyacrylamide gel, and stained with Coomassie brilliant blue. rRVN was characterized by Western blot (immunoblot) analysis. Briefly, proteins were transferred onto an immobilon-P membrane and the membrane was probed with the primary polyclonal antibody (1:1000 dilution), rabbit anti–(RPV) (gift of Dr. James House, USDA, APHIS, PIADC). After washing, the membrane was probed with the secondary antibody (goat anti–rabbit serum conjugated to alkaline phosphatase diluted 1:2000) as described previously.

We have injected subcutically Spodoptera frugiperda larvae (weight 0.2–0.3 gm) with approximately 5 X 10^4 PFU of bRVN. Control larvae were inoculated with 5 X 10^4 PFU of wild type baculovirus. Inoculated larvae were kept at room temperature on an artificial diet for 5 days before they were quick-frozen for analysis, as described previously. Lysates containing rRVN and the wild type baculovirus proteins were further characterized by SDS–PAGE and Western blot analysis.

In order to evaluate the effectiveness of the rRVN in the diagnosis of RP, microtiter plates were coated with the optimum concentration of the crude bRVN–infected or wild type baculovirus–infected larval lysate. The levels of anti–rRVN antibodies were measured in sera of cattle vaccinated with vaccinia virus recombinants expressing H (vRVH), F (vRVF) and both H and F (vRVFH) genes of RPV, as well as sera from cattle vaccinated with a fowlpox double recombinant virus expressing F and H genes of RPV (fRFH). Cattle sera collected at different times post–vaccination with TCRV were titrated for anti–N RPV antibody. ELISA was run as described previously. rRVN ELISA titers were expressed as the reciprocal of the highest serum dilution that gave an OD reading at least twice that of the wild type baculovirus antigen (Tables 1–3).

RESULTS

We identified a number of recombinant λgt11 plaques that hybridized to the measles virus N gene. Inserts from these plaques were amplified by 30 cycles of PCR, and the largest fragment (1.7 kbp) was isolated from a 1% agarose gel, blunt–ended, and cloned at the Smal site of pUC18 to generate pUC18N.

The bRVN, generated by homologous recombination of pVL1393N with wild type baculovirus DNAs in Sf9 cells, was identified by the absence of polyhedrin inclusion bodies and plaque–purified for further analysis. The expression of rRVN was determined from crude lysates of bRVN–infected Sf9 cells and larvae by SDS–PAGE and Western blot analyses. Prominent rRVN bands of 59 KDa were apparent in the Coomassie brilliant blue stained
A RAPID DIAGNOSTIC KIT FOR RINDERPEST–VIRUS

gel. rRVN from both Sf9 cells and larvae was reactive to hyperimmune anti–RPV serum. The N protein was first detected in Sf9 cells at 24 hr post-infection and continued to be expressed at high levels up to 72 hr post-infection. No differences by biochemical and immunological analyses were detected in the rRVNs obtained from larvae or from Sf9 cells.

The potential for use of a crude lysate containing rRVN in diagnosing RPV was determined by standard EUSA. Anti–RPV antibodies reacted with lysates from bRVN–infected Sf9 cells and larvae, but not with control antigen. Conditions were varied to optimize the test; 0.001% Triton X–100 in PBS gave the best results (data not shown).

Crude rRVN–containing lysates were serially diluted in 0.001% Triton X–100 in PBS solution to ascertain optimal concentrations of protein for detection of anti–N antibodies in bovine sera. The rRVN obtained from 1.5 X 10^4 Sf9 cells proved to supply an optimal concentration of antigen/well. Lysate from one larva (0.2–0.3 g) provided sufficient rRVN to coat 150 96–well ELISA microtiter plates, adequate for testing 7200 serum samples in duplicate.

Cattle vaccinated with TCRV developed rRVN ELISA titers of 32 to >512 at various times post–vaccination (Table 1). Sera from cattle that were vaccinated with either a mixture of vRVH and vRVF or vRVFH had no detectable antibodies to rRVN. These cattle remained negative after they were challenged with >1000 (10^3 TCID_{50}) times the lethal dose of RPV (Table 2). Sera of cattle previously vaccinated with fRVFH did not react to rRVN; however, following challenge with virulent RPV they developed ELISA titers ranging from 128 to >512 (Table 3).

DISCUSSION

RPV_{k} is one of the most virulent strains of RPV, and is associated with high morbidity and mortality rates in cattle. In this study, we have expressed the N gene of the virus in a baculovirus expression vector. We have used this protein as a coating antigen for the development of an inexpensive, rapid diagnostic ELISA kit for RP. This ELISA kit distinguishes animals infected with virulent RPV from those vaccinated with a recombinant vaccinia virus expressing the hemagglutinin (H) and/or fusion (F) proteins of RPV.

Both insect cells and larvae (Spodoptera frugiperda) infected with bRVN supported the expression of a 59 kDa rRVN. This, however, is less than the estimated molecular weight rRVN found in infected bovine kidney cells (65 kDa)^9. Measles virus N protein expressed in baculovirus was reported to co–migrate with the authentic nucleoprotein, and both have a molecular weight of 58 kDa^10. A molecular weight of 58 kDa for the N protein of RPV, has been described before^12. The recombinant N protein of RPV_{k} retained its antigenicity, reacting to rabbit hyperimmune serum against RPV in Western blot analysis.
rRVN was used as a coating antigen in ELISA plates. Inclusion of 0.001% Triton X-100 in PBS solution provided optimal conditions for detecting anti–RPV antibodies, presumably by breaking up the aggregation of the N protein. An ELISA using partially purified whole RPV as coating antigen has been developed for the diagnosis of RPV in cattle. However, the propagation and purification of RPV is expensive, and the use of whole virus raises safety concerns. Further, this test cannot distinguish between vaccinated and infected animals. We have demonstrated the utility and efficacy of crude lysates of bRVN–infected insect cells and larvae for detection of anti–RPV antibodies in cattle sera, as well as in sera of animals infected with other morbilliviruses such as peste des petits ruminants (Table 4).

N proteins of a number of viruses, including vesicular stomatitis virus of cattle, measles virus, and Lassa and hepatitis C viruses, have been expressed in baculovirus and used to recognize specific N antibodies. Therefore, proteins from lysates of Sf9 cells infected with recombinant baculovirus have been shown to be appropriate ELISA antigens for use in the diagnosis of infectious diseases of animals and humans. rRVN has proved to be an effective diagnostic antigen. Unlike the SN test, the ELISA kit based on rRVN is a simple, rapid, and inexpensive method for routine diagnosis of rinderpest.

In our previous study, we demonstrated that cattle vaccinated with either a mixture of vRVF and vRVH or vRVFH were protected when challenged with >1000 times the lethal dose of virulent RPV. Sera from these cattle were not reactive to the N protein 30 days post–vaccination, which was expected since they were vaccinated with only F and/or H genes of RPV. Two weeks after challenge, they continued to be non–reactive, which indicates that the virulent virus could not replicate and that these animals have developed a sterilizing immunity. A study using a fowlpox double recombinant vaccine expressing F and H genes of RPV showed that vaccinated cattle developed an anamnestic immune response after they were challenged with virulent RPV. Sera of these cattle did not react to N protein 30 days post–vaccination; however, after they were challenged they did mount ELISA titers to N protein, indicating replication of the challenge virus.

The rapid ELISA diagnostic kit we have developed is economical, safe, and simple. It can distinguish between cattle infected with virulent RPV and those vaccinated with vaccinia virus expressing F and/or H genes of RPV. In addition, this kit can be used to diagnose other morbilliviruses. Because of the high levels of expression, the crude recombinant N protein from one infected and homogenized larva (0.2–0.3 gm) provides antigen sufficient for coating 150 standard 96–well ELISA plates, which can provide serological diagnosis of 7200 serum samples in duplicate. Purification of the N protein proved to be unnecessary, as use of the crude larval lysate for coating ELISA plates showed there was no interference or loss of sensitivity.
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These findings reflect the potential for using N protein as a diagnostic reagent, accompanying the field application of a recombinant vaccinia virus vaccine expressing F and/or H genes of RPV. This provides a fully protective vaccine along with a rapid diagnostic tool for distinguishing infected from vaccinated animals, a major benefit to stockmen currently barred from export markets when such distinction cannot be made.

ACKNOWLEDGMENTS

We thank Dr. S. Owens for critical review of the manuscript. The measles probe and anti–RPV antibodies were gifts of Drs. W. Bellini and J. House, respectively. This work was supported by a grant from the U.S. Agency for International Development (USAID/ Egypt) under Cooperative Agreement 263–0152–A–00–1021–00.

REFERENCES


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TABLE 1

ANTI-rRVN ELISA TITERS OF SERA FROM CATTLE VACCINATED WITH $10^{2.5}$ TCID$_{50}$ OF TISSUE CULTURE ATTENUATED RPV VACCINE (TCRV)

<table>
<thead>
<tr>
<th>Cow</th>
<th>0 dpv</th>
<th>12 dpv</th>
<th>20 dpv</th>
<th>37 dpv</th>
</tr>
</thead>
<tbody>
<tr>
<td>8005</td>
<td>&lt;4</td>
<td>ND</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>8007</td>
<td>&lt;4</td>
<td>64</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>8009</td>
<td>&lt;4</td>
<td>64</td>
<td>64</td>
<td>32</td>
</tr>
<tr>
<td>8021</td>
<td>&lt;4</td>
<td>ND</td>
<td>128</td>
<td>128</td>
</tr>
<tr>
<td>8024</td>
<td>&lt;4</td>
<td>&gt;512</td>
<td>ND</td>
<td>&gt;512</td>
</tr>
<tr>
<td>8025</td>
<td>&lt;4</td>
<td>ND</td>
<td>&gt;512</td>
<td>&gt;512</td>
</tr>
<tr>
<td>8029</td>
<td>&lt;4</td>
<td>64</td>
<td>64</td>
<td>128</td>
</tr>
</tbody>
</table>

ND, not done; dpv, day post–vaccination.
**TABLE 2**

**COMPARISON OF SN AND ANTI-RRVN ELISA TITERS OF SERA FROM CATTLE VACCINATED WITH EITHER A MIXTURE OF vRVF AND vRVH OR vRVFH**

<table>
<thead>
<tr>
<th>Cow</th>
<th>Type of vaccine</th>
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<th>0 dpc</th>
<th>14 dpc</th>
</tr>
</thead>
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<tr>
<td></td>
<td></td>
<td>SN</td>
<td>ELISA</td>
<td>SN</td>
</tr>
<tr>
<td>101</td>
<td>vRVF + vRVH</td>
<td>&lt;2</td>
<td>&lt;4</td>
<td>128</td>
</tr>
<tr>
<td>124</td>
<td>vRVF + vRVH</td>
<td>&lt;2</td>
<td>&lt;4</td>
<td>96</td>
</tr>
<tr>
<td>131</td>
<td>vRVF + vRVH</td>
<td>&lt;2</td>
<td>&lt;4</td>
<td>128</td>
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<tr>
<td>118</td>
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<td>&lt;4</td>
<td>12</td>
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<td>112</td>
<td>vRVFH</td>
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<td>&lt;4</td>
<td>48</td>
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<tr>
<td>13</td>
<td>vRVFH</td>
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<td>&lt;4</td>
<td>24</td>
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<tr>
<td>126</td>
<td>vRVFH</td>
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<td>&lt;4</td>
<td>24</td>
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<tr>
<td>134</td>
<td>vRVFH</td>
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<td>135</td>
<td>vRVFH</td>
<td>&lt;2</td>
<td>&lt;4</td>
<td>64</td>
</tr>
</tbody>
</table>

vRVF, vaccinia virus recombinant expressing the F gene of RPV; vRVH, vaccinia virus recombinant expressing the H gene of RPV; vRVFH, vaccinia virus double recombinant expressing both the F and H genes of RPV; dpv, day post-vaccination; dpc, day post-challenge.

* animals were challenged 30 dpv with $10^3$ TCID$_{50}$ of virulent RPV.
### Table 3

Comparison of SN and Anti-rRVN ELISA Titers of Sera from Cattle Vaccinated with FRFH

<table>
<thead>
<tr>
<th>Cow</th>
<th>0 dpv</th>
<th>0 dpc&lt;sup&gt;a&lt;/sup&gt;</th>
<th>14 dpc</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>SN</td>
<td>ELISA</td>
<td>SN</td>
</tr>
<tr>
<td>045-C</td>
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<td>&lt;4</td>
<td>&lt;2</td>
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<tr>
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<tr>
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<td>ND</td>
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<td>&lt;2</td>
</tr>
<tr>
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<td>8</td>
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</tr>
<tr>
<td>083-V</td>
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<tr>
<td>085-V</td>
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<tr>
<td>089-V</td>
<td>&lt;2</td>
<td>4</td>
<td>&lt;4</td>
</tr>
</tbody>
</table>

<sup>a</sup> animals were challenged 30 dpv with 10<sup>3</sup> TCID<sub>50</sub> of virulent RPV.

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<sup>a</sup> FRFH, fowlpox double recombinant expressing the F and H genes of RPV; C, control animals; V, vaccinated animals; ND, not done; dpv, day post-vaccination; dpc, day post-challenge.
TABLE 4
COMPARISON OF SN AND ANTI-rRVN ELISATITERS OF SERA
FROM GOATS VACCINATED WITH VRVFH

<table>
<thead>
<tr>
<th>Goat</th>
<th>0 dpv SN PPRV</th>
<th>0 dpv ELISA</th>
<th>14 dpv SN PPRV</th>
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</tr>
<tr>
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<tr>
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<td>&lt;4</td>
<td>&lt;2</td>
<td>&lt;2</td>
</tr>
</tbody>
</table>

C, control animals; V, vaccinated animals; ND, not done; dpv, day post-vaccination; dpc, day post-challenge. * Animals were challenged 30 dpv with 10<sup>8</sup> TCID<sub>50</sub> of virulent PPRV.
* Animals showed clinical signs of PPRV and recovered at 13 dpc.
The Biotechnology Committee Meeting was attended by 25. There were 9 contributions at the Committee meeting.

The Committee heard from a USDA representative that 57 products had been licensed through Biotechnology including 49 in the non-infectious disease category I products for diagnosis and 8 gene deleted products classified as category II. One category III product, live vectored rabies vaccine has been licensed for and is currently in field study. At present there are 10 vectored products under study, the largest number thus far.

Difficulties associated with obtaining completely safe, live virus vaccines by the traditional procedures of virus passage and selection of attenuated forms, as well as the risks and expenses involved in preparing killed, or subunit vaccines from virulent viruses may now be overcome using recombinant DNA technology. Biotechnology offers a variety of approaches to the preparation of certain vaccines. Others do not yet lend themselves to manipulation by the new technologies. There have been several gene deleted vaccines on the market for pseudorabies for years and we heard about technology just applied to blue tongue virus where the genes for the four major proteins of the virus were cloned into an insect virus and subsequently expressed in insects (caterpillars) or insect tissue cultures. When produced by this manner the four proteins are expressed as virus like particles without nucleic acid and thus the ability to replicate. Because of their shape which is identical with that of the virus, they are equally as immunogenic and without risk of infection.

The committee heard about developments in technology on foot and mouth disease virus. Technology was discussed which involved mutating the viral sequence at the binding site of the virus. Cells infected with these products produced viruses carrying different RNA's bordering the sensitive attachment sites. Tissue cells infected with these viruses produce non-infectious particles indistinguishable from wild type virus in other dimensions except they are unable to bind in order to infect cells. These mutant viruses were only defective in cell binding. These results confirm the essential role of this site in binding FMDV to susceptible cells and demonstrate that the
REPORT OF THE COMMITTEE

natural cellular receptor in the virus only serves to bind virus to the cell. The development of these "non-infections" viruses could aid in the construction of safer vaccines for FMD.

There were two contributions on studies underway on African swine fever, a deadly disease of swine for which no vaccine exists. Neither contribution seemed to offer the technology leading towards an immediate vaccine, however the basic studies reported show steady progress towards a better understanding of the nature of this complicated virus and disease.

While there are several gene deleted viruses on the market for pseudorabies of swine, one paper described a completely new type of vaccine developed by genetic recombination of pseudorabies virus genes that code for what are thought to be the most important immunogenic proteins of the virus with the genome of highly attenuated vaccine virus vector. Tests are continuing to determine whether there are advantages over those in current use.

The basic studies which have been underway for several years on development of a vaccine vectored rinderpest vaccine are continuing. This past year the investigators have compared the nucleotide sequences of virulent rinderpest virus with that of the N genes of the lapinized strain of rinderpest virus, measles virus and canine distemper. These comparisons are 88, 68, and 63% homologous, respectively. The N protein of rinderpest virus has also been expressed in insect cells and larvae. This protein is useful in distinguishing vaccinated from infected animals and can also be used in the diagnosis of two other morbilli viruses, measles and peste de petits ruminants. This protein is proving to be extremely useful for serological diagnosis.

The investigator published on development of an indirect enzyme linked immunosorbent assay (ELISA) to detect antibodies to the porcine reproductive and respiratory syndrome virus (PRRS). The sensitivity of the test has been adjusted to detect three different strains of the virus.

Finally, we have just heard a paper on patenting of animals. Creating and patenting living organisms is one new development in biotechnology. While many issues in biotechnology are new, the concept of patents is not. Now the subjects have merged into an important policy issue. In protecting intellectual property, are bioengineered life forms patentable? While no transgenic livestock have been patented, such activity could have economic implications for livestock producers.

Our Committee looks forward to a review again next year of the developments in biotechnology which have an impact on concerns of USAHA.
INTRODUCTION

Bluetongue virus (BLU) is now recognised as an infectious, non-contagious arthropod-borne agent which causes a disease of sheep and occasionally other ruminants. Bluetongue viruses occur in a variety of serotypes and are now known to be endemic in all tropical, semitropical, and temperate zones of the world where they have a wide distribution in ruminant populations.1

The first detailed descriptions of bluetongue disease (BT) were in sheep in South Africa.2 While BT infections of cattle are common in endemic countries of the world, there are few descriptions of overt clinical disease and these usually apply to isolated episodes and occasional epizootics.3,4,5,6,7,8

In countries of the world where BTV is endemic, the cattle population is often exposed to infection with multiple serotypes which cause no evidence of clinical disease.9,10,11,12

Clinical BT disease of cattle has not been experimentally satisfactorily demonstrated and only transient mild signs have been reported.13,14,7,15,16,17,18,19,20,21,22

Restrictions on the international movement of cattle and bovine gametes, due to concerns about persistent BTV infection has resulted from undue reliance being placed on a small number of experimental studies. These studies have not been substantiated by field experiences nor by the accumulated research experimental results which have since been carried out around the world.

Persistent BTV infection in cattle

The only reports of experimental clinical BT disease in cattle are those of Bekker et al and Luedke et al 1977. Mason and Neitz (1940) were unable to repeat the Bekker studies using the same material for inoculation and concluded that although BTV was present and produced a viremia without clinical signs, the disease previously described as BT was probably ulcerative stomatitis.

Several experimental studies in cattle have been carried out around the world to try to repeat the studies of Luedke et al 1977 and in particular, because of the possible disruption to cattle breeding programs and subsequent potential calf losses, the role of BTV as a persistent infection in cattle has attracted most attention.

A retrospective study of the serologic and virologic responses of a Hereford bull, persistently infected with BTV for 11 years, set out the timetable during which virus isolations and serologic responses occurred.23 Although in previous papers, the bull had been reported as being
seronegative for BTV antibody, in this retrospective report both precipitating and neutralising antibodies were present from 105 days of age (21 days after challenge with BTV 13), until 3,848 days (10.5 years) after challenge. This meant, that if the serologic status had been correctly reported at each bleed, the bull would not have been acceptable as a semen donor for artificial breeding throughout his life.

Bluetongue infections in the fetus

The bull (B28A) had been born in an experiment in which abortions and congenital anomalies in calves resulted from cattle being exposed to the bites of BTV–infected *Culicoides variipennis* at 60 and 120 days of pregnancy. In the experiment, two cows aborted and one fetus was dead at birth. The remaining 7 live calves were born alive with gross anomalies and BTV was isolated from 4 animals. Later, one of these animals, the bull calf designated B28A, was found to be persistently viremic from birth through 11 years and to excrete BTV in his semen. When the bull was 5 years of age, he was used in a natural breeding experiment and mated to 14 cows. Twelve live calves were born all of which had a variety of congenital defects compatible with life, each had a sporadic persistent viremia with no evidence of precipitating or neutralising antibodies. The subsequent history of these animals was described and it was suggested that their survival under field conditions would have been unlikely. Because of the above experimental history of Bull 28A and the reports of excretion of BTV in the semen of persistently infected bulls experimental studies were developed to examine the hypothesis of congenital defects, fetal abnormalities, and the vertical transmission of BTV and its persistence in subsequent progeny.

Experiments with BTV–11 strain CO–75B300

Bluetongue virus serotype 11 Strain CO–75B300 derived from the persistently infected bull B28A, has now been used in several experiments. Transmission of BTV by intrauterine inoculation or insemination of virus contaminated semen was attempted in 9 heifers. Of the 9 inseminated heifers, 6 became pregnant and 3 of these were viremic and produced antibodies to BTV. There was no evidence of fetal infection.

Two groups of 10 pregnant cows were inoculated with BTV Serotype 11 strain CO–75B300 at either 40 or 60 days gestation. All the cows became infected, developing viremia and producing serum antibodies to BTV. None showed clinical signs. Seventeen cows produced live calves none of which showed evidence of prenatal infection. When aged between four and nine months, the calves were challenged using the same BTV–11 strain, 15 calves from the experimental group
and 6 control calves became infected, all eliciting the same response. It was concluded that the infection of pregnant cows in early gestation did not result in transplacental infection of the fetuses and did not produce immunotolerant, latently infected calves, and all calves were grossly normal.30

A group of 4 cows were bred naturally to the bull B28A. Two groups of 4 cows were inoculated with an insect-derived BTV-11 (strain C075B300). One group, by direct deposit into the uterus at estrus, the other by subcutaneous and intradermal inoculation when the cows were 43 to 143 days gestation. Another group of 4 cows were inoculated with sheep blood-passaged BTV-11 by the intradermal and subcutaneous routes when the cows were 70 or 140 days gestation. A group of 3 cows received non-infected insect material and non-infected sheep blood by intrauterine, intradermal and subcutaneous routes. This latter group were controls and received the final inoculum when their fetuses were at 48 or 70 days gestation. Infection was detected in 3 cows receiving the insect derived BTV material by intradermal/subcutaneous routes and in the 4 cows inoculated with sheep blood-passaged BTV. An additional cow was infected with the insect-derived BTV by direct inoculation into the fetus at 90 days gestation. The 8 animals developed viremias and produced serum antibodies to the virus. No clinical signs were observed in any of the animals in the experiment.

The cows were slaughtered when the fetuses were at gestational ages ranging from 69 to 217 days. All the cows and fetuses appeared grossly normal at necropsy. In histopathologic and immunofluorescence studies of a wide range of cow and fetal tissues no abnormal pathology was detected. No serum antibodies were found in any fetuses that were at a gestational age (>150 days) when immunocompetence could develop.

Tissues collected from the fetuses and cows as 1 to 10g samples were stored as individual samples at -70°C. There were 25 separate tissues or fluids (blood, amniotic and chorioallantoic fluids) taken from each fetus. Representative tissues and fluids were submitted to the polymerase chain reaction (PCR) using a nested sequence.31,32 None of the tissues showed any evidence of BTV and all samples were tested at least 3 times. There have been several reports of the successful use of PCR for BTV in clinical samples.33,34

Five sheep were inoculated subcutaneously with a tissue homogenate of a pool of tissues from fetuses from each group of cows. One sheep was assigned to each tissue pool. After inoculation blood was collected for virus isolation and for detection of serum antibodies at 3 day intervals for 28 days. No clinical signs, virus, or serum antibodies were detected. The sheep, including a control animal, were challenged by the intradermal inoculation of BTV-11 strain C075B300 (1 ml 3 x 10 5 chicken embryo lethal doses). All sheep responded by exhibiting clinical signs of BT disease and developing viremias by 7 days after challenge (DAC).
BLUETONGUE VIRUS INFECTION OF CATTLE

Precipitating antibodies were detected by day 7 DAC and neutralising antibodies by day 14 DAC.

Conclusion

Confirmation of the original experimental data by the use of PCR and animal inoculation and challenge has shown that there was no evidence for persistence of BTV in the Hereford bull B28A in this and associated experiments. Also there was no evidence of infection of the cows or their fetuses following natural mating and no fetal abnormalities were produced.

A number of attempts to carry out similar experiments and complementary studies have been reviewed and have shown that BTV does not normally cause disease in cattle. While BTV can be excreted in semen for about the same time as viremia is detectable in the bull it does not persist beyond the viremic stage to be excreted as a contaminant over lengthy time periods. There is no strong evidence that BTV does cross the placental barrier to infect the fetus causing abnormalities and immuno-tolerant infections.

The experimental data is confirmed by data from artificial breeding records, cattle herd records, and the lack of field evidence from many countries of the world.

LITERATURE CITED


BLUETONGUE VIRUS INFECTION OF CATTLE


REPORT OF THE COMMITTEE ON BLUETONGUE
AND BOVINE RETROVIRUS

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Vice Chairman: Dr. Lyle D. Miller, Ames, IA

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The Bluetongue and Bovine Retrovirus Committee met in Room 10, Sahara Hotel in Las Vegas, Nevada, from 1:30 pm to 5:50 pm on Tuesday, October 26, 1993. There were 52 in attendance.

BLUETONGUE (BT):
Dr. Bennie Osburn, Chair of the Committee introduced Dr. James Pearson of the National Veterinary Services Laboratory, APHIS/USDA, Ames, Iowa for a report on bluetongue and related orbiviruses.

BLUETONGUE AND EPIZOOTIC HEMORRHAGIC DISEASE (EHD) ISOLATIONS

In calendar year 1992, the National Veterinary Services Laboratories (NVSL) made BT isolations from tissues submitted from California, Idaho, Iowa, Oregon, and Washington (Table 1). Domestic animals were the source of all isolations. One BT isolation was made from imported fetal calf serum. There was also an isolation of BT from bovine fetal tissue submitted from a Guatemalan herd experiencing abortion problems. BT-17 was the predominant serotype isolated during this period.

NVSL serotyped six BT and one EHD isolates submitted from other laboratories (Table 2). There were 74 bovine fetal calf serum safety test submissions, 46 import/export submissions for BT/EHD isolation, and 90 diagnostic submissions for BT/EHD isolation.

In 1993, the Arthropod-borne Animal Disease Laboratory (ABADRL), Laramie, Wyoming, isolated EHD-2 from a deer from Wyoming and BT-10 from a sheep in Wyoming. The Southeastern Cooperative Wildlife Disease Study isolated EHD-1 from a deer in Tennessee.
REPORT OF THE COMMITTEE

There have been no BT isolations in calendar year 1993. There has been an isolation of EHD from the tissues collected in July from an Arizona deer. Typing of this isolate is in progress.

BLUETONGUE SURVEY

A BT survey of the 20 northeastern and north central states plus Alaska and Hawaii was conducted from October 12 through December 18, 1992. A total of 12,160 slaughter samples were tested, of which 304 were immunodiffusion (ID)-positive. Ten of the 15 geographic areas sampled had 2.0% or less ID-positive samples with Virginia exceeding 2.0% again this year as did Illinois, Indiana, North Dakota, and Ohio. (Table 3). One hundred and twelve ID-positive samples were negative for neutralizing antibody against BT and EHD. The other samples had neutralizing antibody against BT (20 samples), BT and EHD (61 samples), and EHD only (107 samples).

All the BT positive samples were tested with the BT competitive enzyme-linked immunosorbent assay (C-ELISA). The C-ELISA confirmed BT ID-positive and neutralization test (NT) results in 76 samples. In addition, there were 21 samples which were BT ID-positive and BT C-ELISA-positive but BT NT-negative although EHD NT-positive. Also, there were 9 samples that were BT ID-positive and BT C-ELISA-positive but BT and EHD NT-negative.

The Canadians have approved the use of the C-ELISA for the 1993-1994 survey. The first samples were collected the week of October 11, 1993.

TESTING OF SERUM FOR EXPORT TO CANADA

A decision by Agriculture Canada made the BT C-ELISA the only official test for BT for the importation of live ruminants, semen, and embryos into Canada as of August 1, 1993.

There was a 90-day phase-in period during which Agriculture Canada continued to accept either agar gel immunodiffusion (AGID) or C-ELISA results. This allowed animals that were currently being tested for export to meet the requirements.

On November 1, 1993, only the C-ELISA test will be accepted, and only laboratories approved by the U.S. Department of Agriculture to do the BT AGID test will be allowed to do BT C-ELISA testing for Canadian export.

QUALIFYING SEMEN FOR EXPORT TO THE EUROPEAN COMMUNITY

The European Community (EC) established a Directive in 1991 for the importation of semen that was very restrictive due to the BT test requirements. November 5, 1992, the EC removed all the BT virus isolation requirements. The current test requirement is that at 21 days after the semen collection period the bull must be negative for BT and EHD antibody using BT C-ELISA and the EHD AGID and virus neutralization tests.
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The C-ELISA procedure is outlined in detail in the EC directive. The test must use the monoclonal antibody developed by the Pirbright Laboratory in England. This has limited this testing to NVSL. A request has been made to the EC to allow the use of the commercial kits that have been licensed by the U.S. Department of Agriculture and approved by Canada. At this time, approval has not been obtained.

**TABLE 1. Isolations for Calendar Year 1992**

<table>
<thead>
<tr>
<th>SEROTYPE</th>
<th>LOCATION</th>
<th>SOURCE</th>
<th>MONTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT 17</td>
<td>Mexico</td>
<td>Fetal calf serum</td>
<td>January</td>
</tr>
<tr>
<td>BT 13</td>
<td>Guatemala</td>
<td>Bovine</td>
<td>February</td>
</tr>
<tr>
<td>BT 10</td>
<td>Washington</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Idaho</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Idaho</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Washington</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Idaho</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Idaho</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Idaho</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Iowa</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 11</td>
<td>Oregon</td>
<td>Bovine</td>
<td>October</td>
</tr>
<tr>
<td>BT 11</td>
<td>Washington</td>
<td>Sheep</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>California</td>
<td>Goat</td>
<td>October</td>
</tr>
<tr>
<td>BT 17</td>
<td>Washington</td>
<td>Bovine</td>
<td>October</td>
</tr>
<tr>
<td>BT 10*</td>
<td>Wyoming</td>
<td>Sheep</td>
<td>Unknown</td>
</tr>
<tr>
<td>EHD 2*</td>
<td>Wyoming</td>
<td>Deer</td>
<td>Unknown</td>
</tr>
<tr>
<td>EHD 1**</td>
<td>Tennessee</td>
<td>Deer</td>
<td>Unknown</td>
</tr>
</tbody>
</table>

* Isolated by Arthropod-borne Animal Disease Laboratory, Laramie, Wyoming
** Isolated by the Southeastern Cooperative Wildlife Disease Study

**TABLE 2. BT and EHD Isolates Serotyped in 1992**

<table>
<thead>
<tr>
<th>SEROTYPE</th>
<th>LOCATION</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 17</td>
<td>California</td>
<td>Bovine</td>
</tr>
<tr>
<td>13</td>
<td>California</td>
<td>Gazelle</td>
</tr>
<tr>
<td>17</td>
<td>Colorado</td>
<td>Bovine</td>
</tr>
<tr>
<td>EHD-2</td>
<td>Alabama</td>
<td>Deer</td>
</tr>
</tbody>
</table>
**REPORT OF THE COMMITTEE**

**TABLE 3. Bluetongue ID Test Results for the 15 Geographic Areas from Slaughtered Animals**

<table>
<thead>
<tr>
<th>STATE</th>
<th>SAMPLES</th>
<th>POSITIVE</th>
<th>PERCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>854</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>Hawaii</td>
<td>618</td>
<td>4</td>
<td>0.6</td>
</tr>
<tr>
<td>Illinois</td>
<td>639</td>
<td>102</td>
<td>16.0</td>
</tr>
<tr>
<td>Indiana</td>
<td>620</td>
<td>26</td>
<td>4.2</td>
</tr>
<tr>
<td>Maryland–Delaware</td>
<td>691</td>
<td>8</td>
<td>1.2</td>
</tr>
<tr>
<td>Michigan</td>
<td>627</td>
<td>3</td>
<td>0.5</td>
</tr>
<tr>
<td>Minnesota</td>
<td>762</td>
<td>13</td>
<td>1.7</td>
</tr>
<tr>
<td>New England</td>
<td>1,424</td>
<td>10</td>
<td>0.7</td>
</tr>
<tr>
<td>New York</td>
<td>1,122</td>
<td>2</td>
<td>0.2</td>
</tr>
<tr>
<td>North Dakota</td>
<td>705</td>
<td>26</td>
<td>3.7</td>
</tr>
<tr>
<td>Ohio</td>
<td>681</td>
<td>15</td>
<td>2.2</td>
</tr>
<tr>
<td>Pennsylvania–New Jersey</td>
<td>605</td>
<td>7</td>
<td>1.2</td>
</tr>
<tr>
<td>Virginia</td>
<td>1,460</td>
<td>72</td>
<td>4.9</td>
</tr>
<tr>
<td>West Virginia</td>
<td>667</td>
<td>7</td>
<td>1.1</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>685</td>
<td>7</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,160</strong></td>
<td><strong>304</strong></td>
<td><strong>2.6</strong></td>
</tr>
</tbody>
</table>

**BLUETONGUE RISK ASSESSMENT**

Dr. Hugh Metcalf, Veterinary Services, APHIS/USDA summarized the risk assessment study that was undertaken by APHIS as background information for possible export of animals to Canada. The assessment was based upon the prevalence of BT in BT-free areas (northeast–north central), BT-enzootic areas (southwest–south), and BT-epidemic areas during the vector season (April 1–September 30) and the nonvector season (October 1–March 31). The 6 scenarios that were evaluated were:

- Probability of viremia when moved into Canada
- Probability of infected animal in contact with vector
- If infection established what is probability of enzootic in Canada
- Probability of seronegative/positive animal harboring virus
- Possibility of competent vectors in Canada at 1/20 years

The probability of a single animal being viremic in a vector season in an endemic area is:

- 1/50 chance of infection
- Exposure to competent Canadian vector 1/1000
- Canadian vector feeding on susceptible cattle 5/100,000
- Establishment of BT in Canada 5/billion
BLUETONGUE AND BOVINE RETROVIRUS

If 100,000 U.S. cattle moved to Canada the probability of establishing BT in Canada is 5 chances out of 10,000. The chances of establishing infection in Canada would be once in 2500 years.

U.S.–CANADIAN EXPORT/IMPORT SUMMIT ON BT

Dr. Gary Wilson of the National Cattlemans Association (NCA) reported on a jointly sponsored NCA–Canadian Cattlemens Associations recent meeting between Dr. Lonnie King of APHIS/USDA and Dr. Barry Stemshorn, Agriculture Canada. The meeting was to evaluate the scientific information, the risk assessment for establishing BT in Canada and the need for or level of testing required for moving cattle into Canada from the U.S. The recommendations would include no test for cattle from BT–free areas, no tests during the winter months (vector–free periods) from low incidence areas, and movement during early part of winter months from all of the U.S. A final decision should be coming shortly.

PCR–ELOSA FOR BLUETONGUE DIAGNOSIS

Dr. John Katz of NVSL/VS, APHIS, USDA, Ames, Iowa presented the technical approaches used in the PCR–ELOSA that he has developed and applied to diagnostic situations at NVSL. The PCR primers directed to gene segment 6 are used to detect viral nucleic acid. The advantage of this test include that it is highly sensitive and specific, it is more rapid taking two to three days rather than weeks to make a diagnosis and it costs approximately the same as the other tests. The test detects viral nucleic acid and not viral infectivity.

The application of this test to both experimental as well as field testing for bluetongue virus provided important implications for determining the limitations of the test procedure in diagnostic settings. Sheep experimentally infected with bluetongue were followed by C–ELISA, virus isolation and PCR–ELOSA. The experimental sheep seroconverted by day 14 post inoculation (PI) and PCR–ELOSA was positive through 119 days PI. No virus was recovered after 43 days PI. Blood from sheep that were PCR–ELOSA positive at 50, 56, 71, and 89 days PI was inoculated into 4 susceptible sheep and followed for evidence of seroconversion. None of the sheep seroconverted. A retrospective epidemiological field study conducted in Washington state on 28 yearling cattle in a bluetongue endemic area was undertaken in late 1992 and 1993. The calves were evaluated for exposure to BT and the presence of viremia and viral nucleic acids in February, March, May and June of 1993. The results of the study are summarized in the following table:
TABLE 4. Monitoring 28 Calves For Bluetongue Virus Infection

<table>
<thead>
<tr>
<th>Month</th>
<th>Serology</th>
<th>Virus Isol.</th>
<th>PCR</th>
<th>Sheep Serocon*</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>24/28</td>
<td>0/28</td>
<td>21/28</td>
<td>0/28</td>
</tr>
<tr>
<td>March</td>
<td>24/28</td>
<td>-</td>
<td>9/28</td>
<td>0/28</td>
</tr>
<tr>
<td>May</td>
<td>24/28</td>
<td>-</td>
<td>2/28</td>
<td>0/28</td>
</tr>
<tr>
<td>June</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0/28</td>
</tr>
</tbody>
</table>

*Sheep Seroconversion – Sheep were inoculated with calf blood that was PCR positive but not infective for BT.

These results demonstrate the sensitivity of the PCR–ELISA assay for detecting BT nucleic acid. A negative BT PCR test can be interpreted to mean that there is no BT virus in the animal. A positive BT PCR test indicates that the viral nucleic acids are present but it does not mean that the animal has infectious virus. A PCR positive test and a negative embryonated chicken egg test is considered a BT negative animal. A combination of PCR and serology that shows a decline in the number of PCR positive serial samples from a seropositive animal would indicate that there is no infectious virus present in the animal.

EXPERIMENTAL BT VIRUS INFECTION IN CATTLE

Dr. James MacLachlan of the School of Veterinary Medicine, University of California, Davis, California reported on a collaborative study between the University of California, the Arthropod-borne Animal Disease Research Laboratory at Laramie, Wyoming, and the NVSL at Ames, Iowa. The study evaluated the comparative means of diagnosing BT virus infection by virus isolation in sheep, virus isolation in Culicoides and PCR. The results of the study were that infectious virus was recovered between 3 and 8 weeks PI, the Culicoides were infected by blood up to 2 weeks PI and noninfectious viral nucleic acid could be detected by PCR 16 to 20 weeks PI. These results complimented those reported by J. Katz (NVSL) in sheep and field cases in cattle.

The Culicoides midges were infected by both feeding of infected blood as well as by intrathoracic inoculation at ABADRL. Insects that received PCR-positive, virus isolation-positive blood were always infected. Those that received PCR-positive and virus isolation-negative bloods as determined by sheep inoculations were always noninfectious.

COMPARATIVE EVALUATION OF EPIZOOTIC HEMORRHAGIC DISEASE VIRUS

Dr. William Wilson of USDA,ARS,ABADRL discussed sequence analysis of the two outer capsid proteins and the three nonstructural proteins
BLUETONGUE AND BOVINE RETROVIRUS

from epizootic hemorrhagic disease viruses, showing a high degree of conservation between serotype and among field strains of the same serotype. He also described work at the ABADRL which has identified a protein from the North American insect vector of bluetongue and epizootic hemorrhagic disease viruses which binds these viruses.

CULICOIDES VECTOR WORK AT ABADRL

Dr. Walter Tabachnick, USDA, ARS, ABADRL indicated that the emphasis of the research on vectors was to define those factors related to the distribution of vector capability and competence as this controls the distribution of bluetongue virus infection. Identification of the factors controlling the competence and capability of infection of the vector will give the basis for predictability of viral transmission to ruminants. The approach is to identify the receptor protein and gene function that allows for viral infection of the midge and to do genetic mapping and correlate with phenotype information. Dr. William Wilson described the gene product work that appears to bind the viral protein and another protein based upon microsatellite mapping has been identified that appears to be associated with vector susceptibility.

BLUETONGUE STUDIES IN BULLS IN NORTHERN AUSTRALIA

Studies that were carried out in bulls in Northern Australia were described by Dr. Ian Parsonson of Ocean Grove, Australia. In experimental studies with wild type and laboratory adapted BT-1 and BT-23 viruses inoculated into bulls, virus was isolated from semen in 3/10 of BT-23 inoculated bulls with both laboratory and wild viruses. Blood was found in the semen of the bulls receiving wild type virus, but not those receiving the laboratory virus. In the case of BT-1 virus was recovered from semen only in those bulls that received laboratory adapted virus. In a field study on bulls that were infected with BT-1 or BT-23 sheep receiving blood or semen from the infected bulls were all infected with the blood but not the semen. This suggests that BT virus is uncommonly found in semen of viremic bulls.

RESOLUTIONS:

Two resolutions were proposed for the BT portion of the program. The resolutions were:

1. Epidemiological Significance of the Infectivity of Bluetongue Virus Infected Blood Detected By Polymerase Chain Reaction Technology To Vector Gnats;
2. Reducing Bluetongue Testing For International Trade With Canada

Both resolutions were passed by votes of 10 to 0 and 12 to 0 respectively.

BOVINE RETROVIRUSES

The session on Bovine Retroviruses was conducted by Dr. Lyle
The first paper entitled "U.S. Isolates of Bovine Retroviruses" was presented by Dr. Cecelia Whetstone, National Animal Disease Center, Ames, Iowa. Dr. Whetstone reviewed some of the work on bovine lentivirus since the original report by M. J. Van Der Maaten et al in 1972 describing isolation of a maedi--virus--like agent called R29. Cattle inoculated with R29 developed lymphocytosis and enlarged hemal nodes. In 1987, Gonda et al published on the similarity of the R29 isolate to human immunodeficiency virus and called it bovine immunodeficiency--like virus. Garvey et al 1990 reported on cloning the agent and identified R29 clone 106 and R29 clone 127. It has been found that most stocks of R29 virus contain bovine virus diarrhea virus (BVDV). Also higher passage isolates of R29 virus have not induced lymphocytosis when inoculated into calves. Two new wild type isolates were obtained from cattle by co--cultivation of blood buffy coat cells and fetal bovine lung cells. A report by Suarez et al in the Journal of Virology 67:5051, 1993 compared the two new isolates (FL 112, FL 491) with a BVDV free isolate R29--1203. The isolates were compared using culture characteristics, western blot, and polymerase chain reaction analyses. Isolates FA 112 and FL 491 were inoculated into cattle and FL 112 induced lymphocytosis and enlarged hemal nodes similar to that originally reported for R29 virus. Other investigations on proviral DNA components have shown 96% homology between FL 112 and FL 491 and lesser homology between them and the R29--127 clone of bovine lentivirus. Envelope gene analysis has shown 6 or 7 hypervariable regions exist among various lentivirus isolates.

Methods to detect bovine lentivirus infection include virus isolation, serodiagnosis and direct detection of antigen. More recent lentivirus isolates have been made from Louisiana and Oklahoma and those viruses await further characterization.

Dr. Whetstone also discussed Jembrana disease, an affliction of Bali cattle in Indonesia. The cause of Jembrana disease has not been determined. Possibilities include rickettsia and viruses. Preliminary evidence for lentivirus involvement has been reported. Dr. Whetstone reported on plans for collaborative work to examine the role lentivirus in Jembrana disease.

Dr. Lyle Miller discussed the appearance of lentivirus induced lesions in experimentally infected cattle. Characteristic changes include lymphoid follicular hyperplasia in lymph nodes, hemal nodes, and other lymphoid areas such as splenic white pulp, bronchus associated lymphoid tissue and gut associated lymphoid tissue. Also he discussed the unexpected finding of neurologic lesions in cattle inoculated by Dr. David Suarez with lentivirus isolates FL 112 and FL 491. Two cattle were killed 6 moths post inoculation. They did not show ante mortem signs of neurologic disease however multifocal microscopic lesions were found in the leptomeninges.
BLUETONGUE AND BOVINE RETROVIRUS

cerebrum, brain stem and cerebellum. Lymphocytes and histiocytes predominated in the meningeal infiltrates, perivascular cuffs, and cell nodules within the neuroparenchyma. Lesions were present in both gray and white matter areas. Further studies are needed to determine if the neurologic lesions are lentivirus associated.

Dr. Janice Miller, National Animal Disease Center, Ames, Iowa, presented data on immunohistochemical detection of lentivirus antigens in tissues. Positive staining was detected within lymphoid follicles (light-zone) in lymph node, hemal node, and tonsil specimens from a cow inoculated with FL 112 lentivirus isolate which were preserved in a commercially available fixture (Histochoice, Amresco Co.). Brain, liver, kidney, and lung specimens did not contain demonstrable antigen by the immunohistochemical procedure. Formalin fixed tissues from the same animal did not stain.

Dr. Don Lein, Cornell University, Ithaca, NY presented a status report on the Bovine Leukosis Virus (BLV) certification program in New York State. The program was initiated in 1985 and 110 herds are enrolled. Forty of the 110 herds have achieved BLV free status. Yearly retest of all cattle in the herd is required to maintain BLV free certification. Dr. Lein discussed a number of observations about the program and emphasized the importance of reducing or eliminating opportunities for blood transfer between cattle in preventing spread of infection. His presentation provided excellent background information for the next agenda item which was a proposal entitled "Standards For Certification of Cattle Herds as Bovine Leukosis Virus Free."

A nine member ad hoc committee composed of Robert Bohlender, North Platte, NE, Gary Colgrove, Hyattsville, MD, Ed Dubovi, Ithaca, NY, James Evermann, Pullman, WA, Larry Kruse, Earlville, IA, Don Monke, Plain City, OH, Richard Nelson, Brattleboro, VT, Mark Thurmond, Davis, CA, and Lyle Miller, Ames, IA, committee chair, has been working on the project. Other interested persons including Hugh Metcalf, Hyattsville, MD, have been helpful in developing the proposal. Free ranging discussion followed introduction of the proposal regarding specific requirements such as the testing and movement of cattle as well as the philosophy for the proposal. Chairman Miller emphasized that the intent was to develop a workable voluntary program to achieve and recognize BLV free status. It is not intended to be a national BLV eradication proposal. Following additional discussion the committee voted 12–0 to recommend that USAHA submit the proposal to USDA/APHIS for implementation of the voluntary program. The proposed program is included as an addendum.

A proposal to restrict sale of raw milk from BLV infected herds was introduced by committee member Dr. Virgil Hulse. Discussion followed and the resolution failed by a vote of 9 to 1.
Recommendation:
Standards for Certification of Cattle Herds as Bovine Leukosis Virus Free

I. Introduction

Owners of cattle participating in the voluntary certification program are required to obtain the services of accredited veterinarians and to submit samples to the National Veterinary Services Laboratories or other laboratories approved by the National Veterinary Services Laboratories to conduct test for bovine leukosis. The serologic test(s) to be used must be approved by USDA, APHIS.

II. Definitions

A. Herd

1. All cattle under common ownership or supervision that are grouped on one or more parts of a single premises (lot, farm, or ranch). More than one herd may be maintained on a single premises if they are separated to preclude any physical contact between herds and have separate feed, water and drainage systems. or

2. All cattle under common ownership or supervision on two more premises that are geographically separated, but on which cattle have been interchanged or where there has been contact among cattle on different premises. Contact between cattle on the different premises will be assumed unless the owner establishes otherwise. or

3. All cattle on common premises, such as community pastures or grazing association units, but owned by different persons. Other groups of cattle owned by the persons involved that are located on other premises are considered to be part of a herd unless the epidemiologic investigation establishes that cattle from an affected herd have not had the opportunity for direct or indirect contacts with cattle from that specific premises.

B. Identification. All cattle in BLV certified free herds will be identified with a mark which identifies the animal to the herd and identifies the individual animal in the herd. This mark may be permanent or semipermanent. Permanent indelible marks may include tatoos, brands, electronic nonremovable implants or registration certificates issued by a recognized breed registry organization that uniquely identifies each animal. Additionally, animals should have a semipermanent visible identification device. Alternatively, two semipermanent visible devices can be used. Semipermanent visible devices may include eartags or other tags which are surgically attached to the animal. Neck chains or other externally attached numbers are not considered semi-permanent devices.

C. Representatives of the State Department of Agriculture and USDA, APHIS shall approve applications for BLV herd certification and recertification.
III. Initial Certification
A. To qualify a herd for certification, all cattle must have two negative test not less than 6 months nor more than 12 months a part.
B. Send application for Bovine Leukosis Free Herd Certification to the cooperating State/Federal Animal Health officials along with copies of the last two negative herd test reports. Application must be signed by the herd owner and the accredited veterinarian who did the herd testing.
C. On acceptance by the State/Federal Animal Health officials herd certification will be approved for one year from the date of the second negative herd test. The Month and Day of the second negative herd test will become the anniversary date for subsequent recertification.

IV. Recertification
A. A complete test of all cattle in the herd must be completed within 60 days prior to the anniversary date to maintain certification of the herd. Certification terminates on the anniversary date if the herd test is not completed prior to the anniversary date. Certification may be reinstated with one complete negative test of all cattle in the herd conducted within 60 days after the anniversary date. Reinstatement of certification will not change the anniversary date.
B. Application for recertification must be submitted to the State/Federal Animal Health officials along with a copy of the herd recertification test. Test results of all herd additions during the previous certification period must be included. A complete accounting for all cattle in the herd including all herd additions or deletions is required.

V. Herd Additions
A. Cattle originating from a Certified BLV-free herd. Cattle from another certified herd must have one negative test 30 days prior to or 30 days after entry into the certified herd. Included are cattle returning to the herd from show or sales or in transit situations where contact with cattle of unknown status could have occurred. Additions should be segregated from the herd until they have a negative test.
B. Battle originating from a BLV negative herd. Cattle originating from a herd with a complete negative herd test within 1 year prior to addition may enter the herd with a negative test 30 to 60 days prior to addition to the herd and a second test 30 to 60 days after entry onto the premises of the certified herd. Additions must be segregated from certified herd until after the second negative test.
C. Cattle originating from infected herds or herds of unknown status. Cattle from such herds must have 3 negative tests conducted at not less than 60 day nor more than 120 day intervals. During that time they must be segregated from untested and BLV seropositive cattle and not commingled with cattle in the certified herd. If cattle can be segregated at the place of
origin, the first or first and second qualifying tests may be completed there; however, the third qualifying test must be conducted after entry onto the premises of the certified herd. If any cattle in the group are found to be positive none of the group may be added to the certified herd until the positive cattle are removed and the testing process started again from the beginning.
For the fourth year in a row, the Cooperative State–Federal Brucellosis Eradication Program made significant progress during fiscal year (FY) 1993, lending additional evidence that the Rapid Completion Plan, under which the program operates, provides sound guidelines for completing the eradication effort. Although the total number of market cattle reactors increased, the number of newly infected herds, the number of herds under quarantine, and the number of on–farm reactors were all less than in the previous FY. Only one State, Oregon, advanced from Class A to Class Free status in FY 93; however, seven other Class A States went for several months without an infected herd and should qualify for Class Free status during FY 1994. Currently, 32 States plus Puerto Rico and the Virgin Islands hold Class Free status, 17 States are Class A, and 1 State, Texas, is Class B. Texas expects to apply for Class A status within the next several months.

The 601 reactor herds found during the year was a decrease of 19 percent from the 744 found in PI 92, and at the end of August, there were only 7 dairy herds under quarantine for brucellosis in the United States. The task force in California's Chino Valley successfully eliminated brucellosis from that area's large dairies with the last herd released from quarantine on May 25, 1993. This outstanding achievement required close cooperation of herd owners, a carefully planned and technically based approach to the problem, and a task force that had the trust and support of the community. California is expected to qualify for Class Free status in the very near future.

There were 283 brucellosis infected herds under quarantine in the United States at the end of September 1993 with more than half of these located in Texas. All States are continuing to work very hard to achieve brucellosis Class Free status by the end of FY 1998. To help ensure that this goal is met, APHIS is closely monitoring program progress and activities in each State to identify problems that need to be corrected. If the program maintains its current progress the only remaining problem of consequence may soon be the wild free ranging bison and elk in the Greater Yellowstone Area (GYA) which includes parts of Wyoming, Idaho, and Montana.

As reported last year, an Environmental Impact Statement (EIS) on brucellosis in Yellowstone National Park is being prepared by representatives from the Interior Department, Forest Service, the State of Montana, and APHIS/VS. There is growing optimism that the disease problem in Yellowstone can eventually be resolved since Park officials are now in agreement with the goal of brucellosis eradication. Yet to be determined,
however, are the types of eradication procedures that will be acceptable to Park officials. VS veterinarians have also developed a brucellosis eradication plan for the entire Yellowstone area and are working with other interested agencies to gain support for these procedures. The Governors of Montana, Idaho, and Wyoming have independently acted to establish a cooperative interagency bison committee whose goal is the eradication of brucellosis from the GYA by 2010.

There were 2,540 elk calves vaccinated during the year on 12 Wyoming feed grounds by Wyoming Game and Fish Department personnel using bio bullets containing Strain 19. This vaccination project, and research by Texas A&M University on the efficacy of vaccinating elk orally for brucellosis, is being funded by APHIS.

On September 30, 1993, 32 States, Puerto Rico, and the Virgin Islands held Class Free status, 17 States were Class A, and only 1 State, Texas, was Class B. During the year Oregon advanced from Class A status to Class Free. (Figure 1)

Thirty-three percent of all beef cows that have calved are located in Class Free States, 53 percent in Class A States, and 14 percent in the one Class B State. (Figure 2) Of the Nation's 9.7 million dairy cows, 69 percent are in Class Free States, 28 percent in Class A States, and 3 percent in the Class B State. (Figure 3) The 7 dairy herds under quarantine for brucellosis on August 31, 1993, were located in 3 States: 5 in Texas and 1 each in Kansas, and New Mexico. (Figure 4)

Of the total beef and dairy cattle, 39 percent are in Class Free States, 49 percent in Class A States, and 12 percent in the Class B State. (Figure 5)

There were 601 reactor herds found in FY 1993. This was a decrease of 19 percent from the 744 reactor herds found in 1992. Of the total number of reactor herds in FY 1993, 259 were located in States that held Class A status at the end of the year and the remaining 342 were in the 1 Class B State. Four Class Free States each found a single reactor in a vaccinated herd that had no epidemiological evidence of disease and no probable source of infection. A final diagnosis is still pending in these herds. As a possible aid in resolving the perplexing diagnostic factors in these herds, one of the reactors has been sent to the National Animal Disease Laboratory for further evaluation by scientists of the Agricultural Research Service. (Figure 6)

Of the 601 reactor herds, 97 percent were in 11 States and the remaining 3 percent were in 39 States. Texas, with 342 reactor herds, represented 57 percent of the national total. The States of Kentucky with 26 reactor herds, Oklahoma with 26, Florida with 39, Louisiana with 28, Mississippi with 29, and Kansas with 39, together represented 31 percent of the total for the year. Four States—Missouri, Arkansas, Tennessee and California—with 17, 15, 10, and 11 reactor herds respectively, made
up 9 percent of the total. (Figure 7).

The reactor herd totals on the previous two Figures include herds initially found infected in FY 1993 plus infected herds that were carried over from the previous year in which reactors were disclosed during FY 1993. This traditional way of presenting reactor herd data implies that all of these herds were found during the FY covered by the status report. However, if the herds carried over from FY 1992 are subtracted, the number of newly infected herds actually found in FY 1993 was 353 in 12 States, a 26% reduction from the 487 reported for 1992. (Figure 8) Eleven of the 12 States were successful in reducing their newly infected herds in FY 1993 from the number found the previous year.

The number of herds under quarantine dropped dramatically during the year from 415 on September 30, 1992, to 283 on September 30, 1993, for a reduction of 32 percent. (Figure 9)

Five affected dairy herds were located through brucellosis ring test (BRT) surveillance during the FY. There was a total of 1,219 suspicious BRT laboratory reports which resulted in 757 herd tests for a herd test rate (HTR) of 62 percent (Figure 10). This figure was lower than the FY 1992 HTR of 70 percent and the 1991 HTR of 63 percent, but higher than 1990 and 1989 which were 59 and 54 percent respectively.

The 11.8 million MCI tests conducted in FY 1993 was 100,000 less than the number in FY 1992. Of these, 6.3 million samples (53 percent) were collected at slaughter plants and 5.5 million (47 percent) were collected at stockyards. (Figure 11)

The total number of cattle tested for brucellosis in FY 1993 was 14.4 million, a decrease of 700,000 compared to FY 1992. There were 2.5 million animals sampled through herd tests on farms or ranches and 11.8 million tested under the MCI program. Although the total number of tests decreased by 5 percent, there was a 21 percent increase in the number of reactors found--from 13,300 in FY 1992 to 16,746 in 1993. (Figure 12) This increase occurred in animals tested under the MCI program and may have been due to high levels of vaccination in the past or changes in marketing practices during the period.

There were 7 million calves vaccinated for brucellosis in FY 1993, a decrease of 2.2 million (24 percent) from FY 1992. (Figure 13). The elimination of vaccination as an import requirement by certain States and more selective use of vaccination by owners were contributory factors in this decrease.

All States are currently engaged in the program to eradicate brucellosis from swine. During FY 1993, Missouri and Kansas gained Validated Brucellosis-Free status, and, New Jersey was re-validated after losing its status in 1990, bringing to 42 the number of Validated States. Of the eight remaining non-validated States, Florida and South Carolina were in Stage I and Alabama, Arkansas, Georgia, Louisiana, Oklahoma, and
Texas were in Stage II. (Figure 14)

There are a total of 3,758 validated herds in the United States of which 403 (10.7 percent) are located in non-validated States. The number of Validated herds this year is essentially the same as last year (there were 3,755 validated herds listed during same period in FY 92). This probably is an indication that many owners in validated States are continuing to have their herds validated despite the fact that all herds in Validated States are considered to be validated. (Figure 15)

This graphic shows swine brucellosis (SB) testing during a ten year period. The number of animals tested is virtually the same from FY 1990 to present. (Figure 16)

The total number of swine tested for SB in FY 1993 was 1,601,251 with 54,763 (3.4 percent) tested at markets, 571,140 (35.7 percent) tested at slaughter and 975,348 (60.9 percent) tested on farms. The latter total includes animals tested as a result of MST tracebacks. (Figure 17)

The infection rate for all tests in swine has been remarkably steady for the last 10 years and has not varied from .05 percent since 1990. (Figure 18)

Forty-six newly infected herds were disclosed during FY 1993: 5 in Alabama, 18 in Florida, 3 in Georgia, 1 in Hawaii, 13 in Texas and 2 each in Louisiana, Oklahoma, and South Carolina. (Figure 19)

This chart compares the newly infected herds found by State in FY 92 and PI 93. Texas and Alabama showed substantial declines, Florida had a three-fold increase. The total for all States was down 32 percent (79 vs. 46). (Figure 20)

Purchased swine were the most common source of infection during FY 1993 with exposure to feral swine in second place followed by exposure through community spread. Two herds were in the "other" category which includes exposure by such means as the exchange of boars. The source of infection was not established in 8 herds. (Figure 21)

A total of 83 herds and 3,143 swine in 9 States were depopulated during the fiscal year; at a cost of $149,865.00. (Figure 22)

At the end of the third quarter, 51 swine herds were under quarantine in the United States; 25 in Florida, 16 in Texas, 4 in Georgia, 2 in South Carolina and Oklahoma and 1 in Kentucky and Hawaii. (Figure 23)

The Brucellosis program, in both cattle and swine, is making excellent progress, but the job will not be done until the last infected herd is eliminated from the United States. The Rapid Completion Plan recognized that if we are to succeed we must carry out all of the requirements of the Uniform Methods and Rules to the maximum extent possible. Because the program has been successful we cannot reduce surveillance, as some have suggested, or be less aggressive in advocating depopulation, or assume that MCI reactors cannot be infected because the State hasn't had a case of brucellosis in several years, or divert program funds to other pursuits or
ignore other long proven and accepted tenets of disease eradication. In the vernacular of sports, "we gotta stay with what got us here", to do otherwise is to risk major setbacks from which the program is unlikely to recover.
Brucellosis Eradication
Distribution of Beef Cattle by Brucellosis Status

CLASS A
53%

CLASS B
14%

CLASS FREE
33%

September 1993
Brucellosis Eradication
Distribution of Dairy Cattle by Brucellosis Status

CLASS FREE
69%

CLASS A
28%

CLASS B
3%

September 1993

Figure 3

DAIRY HERDS UNDER QUARANTINE
AUGUST 1993

TOTAL 7

Figure 4
Brucellosis Eradication

Distribution of All Cattle by Brucellosis Status

**CLASS FREE**
- 39%

**CLASS B**
- 12%

**CLASS A**
- 49%

September 1993

**Figure 5**

Brucellosis Eradication

**Number of Reactor Herds Found (According to State Classification)**

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Class Free</th>
<th>Class A</th>
<th>Class B</th>
<th>Class C</th>
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<tbody>
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<td>21</td>
<td>19</td>
<td>8</td>
<td>4</td>
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<tr>
<td>1986</td>
<td>24</td>
<td>18</td>
<td>7</td>
<td>4</td>
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<td>1987*</td>
<td>25</td>
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<td>6</td>
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<td>1988**</td>
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<td>16</td>
<td>7</td>
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<tr>
<td>1992</td>
<td>31</td>
<td>18</td>
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<td>0</td>
</tr>
<tr>
<td>1993</td>
<td>32</td>
<td>17</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**States with dual status:**
- Wyoming-Class Free & Class A
- Montana-Class Free Class A
- Texas & Florida-Class B & Class C
- Texas & Florida-Class B and Class C
- Arizona-Class Free & Class A
- Texas & Florida-Class B & Class C
- Arizona-Class Free & Class A
- Florida-Class B and Class C
- Florida-Class B and Class C

* Estimated

**Figure 6**
Percent of Total Reactor Herds Found

Fiscal Year 1993
Total herds: 601

57.00%
States: 1
Herds: >300
Total reactor herds = 342

3.00%
States: 39
Herds: <10
Total reactor herds = 19

31.00%
States: 6
Herds: 25 < 300
Total reactor herds = 187

9.00%
States: 4
Herds: 10 < 25
Total reactor herds = 53

* Estimated

Figure 7

HERDS QUARANTINED BECAUSE OF BRUCELLOSIS
AS OF AUGUST 31, 1993 - 306 - RATE 0.24
AS OF AUGUST 31, 1992 - 422 - RATE 0.33

Figure 8
Brucellosis Eradication

New Reactor Herds

October 1992 through September 1993 - 356
October 1991 through September 1992 - 487

Figure 9

Brucellosis Eradication

Milk Ring Test Results (BRT)

Thousands

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Total Suspicious BRT Tests</th>
<th>Follow-up Herd Blood Tests</th>
<th>Infected Herds Found</th>
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<tbody>
<tr>
<td>83</td>
<td>3,519</td>
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<tr>
<td>84</td>
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<td>93</td>
<td>1,865</td>
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</table>

Figure 10
Brucellosis Eradication

**Market Cattle Testing Program**

<table>
<thead>
<tr>
<th>Year</th>
<th>At Packing Plants</th>
<th>Other</th>
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<tr>
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<tr>
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</tr>
<tr>
<td>1993</td>
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<td>47.0%</td>
</tr>
</tbody>
</table>

*Estimated

**Blood Testing: Cattle**

**Millions Cattle Tested**

**Thousands Reactors Found**

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>83</th>
<th>84</th>
<th>85</th>
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<tr>
<td>*</td>
<td>19.4</td>
<td>20.3</td>
<td>19.4</td>
<td>17.8</td>
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</tbody>
</table>

*Estimated

Figure 11

Figure 12

148
**Brucellosis Eradication**

**Calves Vaccinated**

![Graph showing calves vaccinated from 1965 to 1993. The graph indicates a decrease in the number of calves vaccinated from 1972 to 1976, followed by an increase from 1976 to 1981, and a peak in 1990 before a decline in 1992.](figure13)

*Estimated Figure 13*

---

**Swine Brucellosis**

**Program Stages – October 1, 1993**

![Map of the United States with states marked for different stages of the program. Legend: Stage 1 (2 States), Stage 2 (6 States), Stage 3 (42 States) (Validated SB-Free).](figure14)
Swine Brucellosis
Validated Herds FY 1993

Total = 3,758

Figure 15

Swine Brucellosis
Animals Blood Tested

Million Animals

Figure 16
Swine Brucellosis
Total Number Swine Tested
October 1992 through June 1993

Total: 1,601,251

Slaughter (35.7%)
571,140

Markets
(First Point)
54,763 (3.4%)

975,348

On Farm* (60.9%)

*Includes reactor MST tracebacks

Figure 17

Swine Brucellosis
Infection Rate

Percent

0.15

0.1

0.05

0.00

83 84 85 86 87 88 89 90 91 92 93*

*October 92 - June 93 Fiscal Year

Total Tests
On-Farm Tests
Market Swine Tests

Figure 18
Swine Brucellosis
Newly Infected Herds

Total = 46

October 1992 through June 1993

Swine Brucellosis
Sources of Newly Infected Herds

Total = 46

October 1992 through June 1993
**Swine Brucellosis**

**Infections Associated with Feral Swine**

October 1992 through June 1993

<table>
<thead>
<tr>
<th>Month</th>
<th>Total New (46)</th>
<th>Assoc. Feral Swine (13)</th>
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<tbody>
<tr>
<td>Oct-Dec</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>Jan-Mar</td>
<td>11</td>
<td>4</td>
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<tr>
<td>Apr-Jun</td>
<td>17</td>
<td>5</td>
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</table>

Figure 21

**Swine Brucellosis**

**Disposition of Infected Herds**

<table>
<thead>
<tr>
<th>State</th>
<th>Herds Depopulated</th>
<th>Swine Depopulated</th>
<th>Indemnity Paid</th>
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</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>2</td>
<td>2</td>
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<tr>
<td>Florida</td>
<td>7</td>
<td>146</td>
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<td>Georgia</td>
<td>8</td>
<td>110</td>
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<tr>
<td>Kentucky</td>
<td>1</td>
<td>123</td>
<td>1,230.00</td>
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<tr>
<td>Louisiana</td>
<td>2</td>
<td>67</td>
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<tr>
<td>Oklahoma</td>
<td>2</td>
<td>31</td>
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<tr>
<td>South Carolina</td>
<td>0</td>
<td>1</td>
<td>10.00</td>
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<tr>
<td>Texas</td>
<td>60</td>
<td>2,215</td>
<td>122,035.00</td>
</tr>
<tr>
<td>Utah</td>
<td>1</td>
<td>448</td>
<td>11,200.00</td>
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</tbody>
</table>

Total: 83 3,143 $149,865.00

Figure 22
Swine Brucellosis
Number of Herds Under Quarantine – June 30, 1993

Total = 51

Figure 23
The meeting was called to order by Committee Chairman John B. Armstrong at 1:25 p.m. Mr. Armstrong opened the meeting by welcoming members and guests. He then commended committee members for their hard work and the progress made in the brucellosis eradication program.

Dr. Granville Frye, USDA-APHIS, Senior Staff Veterinarian, Cattle Diseases and Surveillance Staff, Hyattsville, Maryland, gave the National Brucellosis Program Progress/Status report. He stated that although the total number of MCI reactors had increased, the number of newly infected herds, the number of herds under quarantine, and the number of on farm reactors were less than previous fiscal years. There were 283 cattle herds under quarantine in the U.S. at the end of September 1993. This is the least number of herds under quarantine since the brucellosis eradication program began.

Dr. Mike Dalrymple, Data Analysis, Centers for Epidemiology and Animal Health, Fort Collins, Colorado, presented a paper on the Assessment of the Effect of Brucellosis Calfood Vaccination on the risk of Brucellosis with consideration of associated costs.

A study was conducted to estimate, on a national level for the U.S. the percentage of calves receiving calfood vaccination for brucellosis, to evaluate the effect of calfood vaccination on the probability of infection with brucellosis, and to determine costs of vaccination. Results of the study indicate that over nine million heifers are being vaccinated annually to protect perhaps 15,000 calves that may become exposed to brucellosis. The cost of vaccination nationally is extrapolated to be approximately 52–56 million, or between $11,800–$25,600 to protect each heifer that may actually be exposed.

Dr. Dalrymple indicated the thirteen states used in the study repre-
REPORT OF THE COMMITTEE

presented one-half of the U.S. cattle and one-half of the brucellosis affected herds. Dr. Dalrymple pointed out that no nation requires brucellosis vaccination to import.

Mr. John Lawrence, IDEXX Labs Inc. presented a paper on an ELISA procedure for the detection of \textit{B. abortus} antibodies in milk.

An Enzyme Linked Immunosorbant Assay (ELISA) has been developed for the detection of \textit{B. abortus} antibodies in milk samples. Over 16,000 routine BRT samples were obtained from Texas, Missouri, Michigan, and Maine between November 1991 and March 1993. The IDEXX \textit{B. Abortus} ELISA demonstrated excellent agreements (98.8%, 99.3%, 99.8%, 99.8%), respectively with BRT results. In the Texas Study, utilization of the ELISA resulted in a higher number of tracebacks (80 vs 60) than with the BRT/HIRT test sequence. However, 100% of these tracebacks showed evidence of infection. Conversely, 70% of tracebacks due to positive BRT results would have resulted in tracebacks to negative herds with no evidence of infection or history of quarantine. The IDEXX ELISA also detected two infected herds that tested negative by HIRT. We believe that the IDEXX \textit{B. abortus} Antibody Test Kit is a highly sensitive and specific assay which meets the requirements for official test status.

Dr. Charles E. Massengill, Missouri Department of Agriculture, Animal Health Epidemiologist, presented concerns about Brucellosis UM&R Language and Intent. The committee recommended corrective actions on the three points which Dr. Massengill presented.

1) PQR test for sale of adult vaccinated cattle, 2) Restriction of movement following negative brucellosis CITE test, and 3) Retest of purchased additions in certified brucellosis free herds.

Dr. Mike Gilsdorf, Senior Staff Veterinarian, Cattle Diseases and Surveillance Staff, presented several proposals for improvements in the Brucellosis Program. Six of the proposals were approved by the committee as follows.

1. Problem: Brucellosis Program regulations require loss of Class Free status when the original source of infection for an MCI reactor cannot be identified.

Resolution: Amend the regulations designating a committee to conduct a thorough review the circumstances, obtain input from the State and Federal animal health officials, and recommend actions to the Deputy Administrator. The committee would consist of the APHIS–VS Regional Brucellosis Epidemiologist, and a State designated Epidemiologist from the USAHA Brucellosis Committee.

Do not remove the states Class Free status if:

A. Only one infected animal (culture positive) is found in the herd. (This includes market or on farm animals and indicates there has been no transmission within the herd.)
B. The state responds immediately to the outbreak by testing the
BRUCELLOSIS

herd of origin, all adjacent herds within one mile, and all contact and source herds within 30 days.

C. No spread of the disease has occurred within or outside the herd.

2. Problem: No brucellosis program exists for domestic captive cervidae (deer, elk, moose).

Resolution: Accept the Captive Cervidae UM&R as the minimum requirements for captive cervidae under the brucellosis eradication program with the provision that it be considered a separate program from the cattle and bison program.

3. Problem: Some states are reporting MCI tracebacks to feedlots as successful traces. Feedlot traceback is successful only to a quarantined feedlot/pasture, or when the feedlot/pasture is placed under quarantine and all animals are tested and/or slaughtered.

Resolution: Amend the regulations designating a committee to review the circumstances and recommend actions to the Deputy Administrator when the traceback percentage falls below the requirement to maintain State brucellosis status. The committee would consist of an APHIS VS Regional Brucellosis Epidemiologist and a Designated Brucellosis Epidemiologist from another state.

4. Problem: No regulatory authority exists allowing the return of MCI market reactors to premises of origin.

Resolution: Amend the regulations to allow the return of MCI market reactors to premises of origin for appropriate retesting and milk culturing. The regulations would provide for quarantine of the premises, permanent official identification of the reactor, and isolation of the reactor pending a final classification.

"Reactor" herd classification would require adherence to current regulations governing affected herds, and the herd would be included in the Accumulated Herd Infection Rate.

5. Problem: Under CFR requirements for maintaining State Class status, tracing of MCI reactors, all epidemiology and herd plans, and quarantine or testing must be completed within narrow time restrictions. Many states are unable to comply with these requirements. If the time limits were strictly enforced, many states would be reclassified to a lesser status.

Resolution: Amend the CFR to double the time restrictions for tracing, testing, quarantine and herd plans.


Recommendation: A letter be sent to all AVIC's and State Veterinarians requesting they emphasize to all area herd owners and accredited veterinarians the importance of proper animal identification. Proper identification in vaccinated animals requires a tattoo showing the official shielded "V: and the quarter of the year vaccinated, and an official
vaccination eartag in the right ear. Individual animal registration brands or tattoos can be substituted for official eartags only if they are unique individual numbers. All test eligible animals moving interstate must be identified with an official eartag number or similar individual identification. A reminder should be included that failure to comply with the requirements could result in withdrawal of accreditation.

The proposals which failed were: 1) Increase affected herd quarantine to twelve months, and 2) change recertification test requirements.

Ms. Connie Craig, NCA Animal Health Committee presented the following request for consideration by the committee. The proposal was referred to the scientific committee for study.

Whereas NCA currently recognizes that, at some point, calfhood vaccination for Brucellosis in regions free of the disease is detrimental to an eradication program, and whereas Canada, as well as other brucellosis-free countries prefer not to vaccinate or import vaccinates. We recommend that USAHA appoint a task force to determine if calf-hood vaccination should be required by free states importing cattle from other disease free states and countries. Although we recognize that this is a state-be-state decision, the states look to USAHA for direction. Any recommendation by USAHA should be based upon scientific study which involves 1) the current status of the disease, 2) a risk assessment, 3) an epidemiological study, as well as 4) a cost/benefit analysis of current vaccination requirements and its impact on domestic and foreign trade, 5) a technical review of the criteria used to establish "Free States" in the U.S. compared to the criteria used to define "Free" states in Canada and other countries. 6) Also, an outline of the protocol states use to monitor and control the movement of cattle from Class A and B states should be presented to Canada for review. Such a scientific study should be directed as evaluated by the task force appointed by USAHA.

Mr. Ted Hickerson, Associated Milk Producers, Inc., presented a petition supporting removal of P78.10, 9CFR. A copy of the petition is attached to the minutes. Support of the petition came following a motion by Dr. Alley and a second by Dr. Coats.

Dr. Don Ferlicka, State Veterinarian, Montana, presented a paper on the current brucellosis situation in the Greater Yellowstone Area. He brought information to the committee about actions of the Tri-State Interagency Brucellosis Committee to this committee. This information included a description of three Bison Management Areas, which is the first step to intensive eradication efforts inside the park and is an immediate solution to Montana's emigrating bison conflict.

Subcommittee Report

Dr. Brian Espe, Chairman, Education Subcommittee, indicated that there is a need for materials to be used in the continuing educational efforts for veterinarians, producer groups, and allied organizations. Dr. Espe
presented a related resolution which was accepted by the committee after a motion by Dr. Woods was seconded by Dr. Hartin. Dr. Espe noted the need for additional members on the Education Subcommittee.

Dr. Terry Beals, Chairman, Swine brucellosis subcommittee, presented a report and indicated that 51 swine herds were under quarantine on June 30, 1993. Dr. Beals presented a resolution to require depopulation of brucellosis affected swine herds. The resolution was accepted by the committee after a motion by Dr. Woods was seconded by Dr. Hartin.

Dr. Gary Adams, Chairman, Scientific Advisory Committee, presented four items for consideration by the committee. First, *(the committee agreed to accept the IDEXX *B. abortus* antibody test for milk as an official test if it passes a specific analytical review as described by USAHA in 1987).* The motion was made by Dr. Hinshaw and seconded by Dr. Alley. Second, the HIRT test for *B. abortus* antibody will be expected to follow the same USAHA, 1987 protocol. The motion was made by Dr. Alley and seconded by Dr. Beals. Third, the topic of mandatory OCV was discussed and a conclusion was reached that each state should use official calfhood vaccination strategically as deemed necessary by the state. The motion was made by Dr. Gilsdorf and seconded by Dr. Hinshaw. Fourth, class free states should evaluate their current emergency action plans to contain and eliminate the recurrence of brucellosis in their states. Emphasis should be placed on authority to condemn livestock, fiscal resources to indemnify depopulation, and maintenance of adequate laboratory and epidemiological skills necessary to carry out the emergency plan. The motion was made by Dr. Hinshaw and seconded by Dr. Prichard.

The Committee meeting was attended by 80 members and guests. Four resolutions were passed and forwarded.

**BRUCELLOSIS SUBCOMMITTEE ON EDUCATION**

*Chairman: Dr. Brian H. Espe, Oklahoma City, OK*

W.F. Alexander, OK; J.S. Cargile, TX; T. Conger, UT; J.E. Horne, OK; L.D. Mark, VA; G.W. Wilson, DC

The Subcommittee on Brucellosis Education met on October 25th with 10 participants present. An open discussion was held on the current and future needs for education until brucellosis is eradicated.

The committee discussed and arrived at a consensus on the following needs:
1. Education efforts need to be redirected from the individual herd owner and aimed at fighting complacency and continuation of support for final eradication. These efforts should be directed at the livestock industry in
REPORT OF THE COMMITTEE

each state. The livestock industry, even in Free States, need to be aware that until the disease eliminated the entire industry is at risk.

2. Calfhood vaccination – More emphasis should be placed on proper vaccination for those states which continue to vaccinate a significant number of heifers. This effort should target the veterinarians.

3. Education on the need for continued surveillance for those states and areas which have reached zero prevalence. This is important to insure adequate funding is available to complete total eradication.

4. Total eradication must include the elimination of brucellosis in the bison and elk in the Greater Yellowstone Area. This message must be communicated to the livestock industry.

5. Each individual state must take responsibility for education of groups and individuals.

6. More emphasis should be placed on brucellosis in the Veterinary Accreditation process.

7. The goal of the program for years has been to the finding of disease and its ultimate elimination. This goal will change to efforts to determine the absence of disease by continued active surveillance.

The subcommittee recognized the need for material to be used in the continuing educational efforts for veterinarians, producer groups, and organizations. We therefore offer the following resolution for consideration by the Brucellosis Committee.

REPORT OF THE ADVISORY COMMITTEE ON SWINE BRUCELLOSIS

Chairman: Dr. Terry L. Beals, Austin, TX
Vice Chairman: Mr. Neal Black, Eagan, MN

W.F. Alexander, OK; J.L. Alley, AL; C.C. Black, GA; P.E. Bradshaw, IL; P.B. Doby, IL; B. Lautner, IA; D.M. Lenard, MD; B.D. Marsh, IN; H.F. Moberly, Jr., IL; F.J. Mulhern, MD; T.A. Neuzil, IA; R.A. Schultz, IA; E. Zirkle, NJ

The Swine Brucellosis sub-committee met Oct. 24, 1993 with 11 members of the committee and approximately 25 guests present and Dr. Terry Beals, chairman, presiding.

Dr. Delorias Lenard of APHIS reviewed the current status of the eradication effort. As of Oct. 1, 42 states are validated free with the recent addition of Kansas; six states, Oklahoma, Texas, Arkansas, Louisiana, Alabama and Georgia, are in stage II, and Florida and South Carolina are in Stage I.

During the nine-month period ending June 30, 1993, there were 46 new cases, including 18 in Florida, 13 in Texas and five in Alabama. Major sources of the infection were purchased swine, 18, and feral swine, 13.

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REPORT OF THE ADVISORY COMMITTEE

During the nine months ending in June, a total of 83 herds were depopulated, including 3,143 breeding animals at an indemnity cost of just under $150,000.

As of June 30 there were 51 herds under quarantine for the disease. Dr. Lenard indicated that the prevalence of the disease has apparently stabilized at 50 to 70 cases in the country over the past few years, indicating that more stringent measures are needed to accomplish eradication by the goal of 1996.

Dr. Lenard showed a new videotape produced by VS on feral swine intended for an audience of pork producers and hunters reviewing the hazard of the disease to both groups. Copies will be available through her office in Hyattsville, MD.

Dr. Lenard was asked about her status with APHIS-VS and she said she is leaving to accept a position as AVIC in South Carolina. The committee approved the following motion:

The brucellosis committee of USAHA urges that the position of senior staff veterinarian in APHIS-VS in charge of the swine brucellosis eradication program and swine health protection activities be filled as soon as possible in view of the APHIS goal of eradication of swine brucellosis by 1996 and the importance to swine disease control of swine health protection activities.

Dr. David Stallknecht of the SE Wildlife Cooperative Disease Study reviewed trials on vaccinating a feral swine population on Ossabow Island in Georgia. In the first phase of the trial hogs were vaccinated by hand to determine if prevalence of the target disease, pseudorabies, could be reduced and what proportion of the population could be trapped and vaccinated. Only a small effect in reducing prevalence has been shown to date with 60% of the population vaccinated. A second phase, now underway, is studying the potential of aerial baiting as a means of administering an oral vaccine to a wild pig population.

Dr. Tommy Dees, APHIS epidemiologist, discussed an outbreak of Brucella suis in packing house workers in a plant in North Carolina. The plant kills about 8,000 butcher hogs a day and employes 156 people. After an initial case in a worker in July of 1981, there were more than 12 in 1992. Blood samples of 154 of the workers revealed titers in 129, of which 43 were considered to have significant titers, some with symptoms of the disease. Dees said tracing of sources of the pigs is expected to lead to about 10,000 herds in a number of states. No source for the outbreak has been identified.

Dr. Max Coats of Texas reported on comparisons of the various tests for swine brucellosis conducted on samples from hogs in garbage-feeding complexes in Texas by Richard Ferris, APHIS area epidemiologist. The study with field samples confirmed earlier evaluations of the various tests with laboratory samples, that there is a wide variation in sensitivity and specificity.
SWINE BRUCELLOSIS

of the tests. Coats said 17% of the samples in the study were from culture-positive animals but were negative on all six tests. The results prompted the conclusion that the best combination of tests is the PCFIA in conjunction with the card test.

It was reported that Florida has begun herd testing to identify herds infected with swine brucellosis and pseudorabies in a voluntary program with testing costs paid from public funds. The response from producers has been good and results are apparent in the number of infected herds reported for the state during the current year.

A discussion of modification of the program to meet current needs resulted in the following committee actions:

1. That the requirements for testing for initial validation and revalidation of validated swine brucellosis free herds be changed to conform with the requirements for qualifying and requalifying for pseudorabies qualified-negative herd status.

2. A resolution was approved for forwarding to the resolutions committee calling for amending the eradication program to require mandatory depopulation of all herds found infected with swine brucellosis.

3. That APHIS make it clear that interstate movement controls on swine for swine brucellosis apply to feral swine.

4. APHIS is asked to conduct a survey to identify procedures and status of all animals moving in all markets approved to receive inter-state shipments of swine, with reference to swine brucellosis, pseudorabies and marketing laws and regulations.

5. It is recommended that APHIS develop a plan for first-point testing of breeding animals from Stage I and Stage II states, regardless of where they are marketed, and provide funds to implement such a program.

6. The committee recognized the need for improvement of the major packer surveillance program at plants where sows from states using that form of surveillance are slaughtered.
RATIONAL REGULATION OF THE INTERSTATE TRANSPORTATION OF CAMELIDS

Murray E. Fowler, DVM
University of California
Davis, California

Regulatory agencies have valid concerns about the potential for transmission of infectious and parasitic diseases as animals move across state lines. Legal authority is vested in State Departments of Animal Health (or similar entities) to protect the interests of livestock and poultry industries within each state. When a new alternative livestock industry develops, there is bound to be confusion and lack of factual information about how to categorize such animals and determine whether current regulations are applicable or if new regulations must be drafted.

Twenty years ago, camels, llamas and alpacas were seen only in zoos. Now, private ownership has blossomed, with 60,000 to 70,000 llamas and over 3,000 alpacas in the United States. This burgeoning population of llamas and, to a lesser degree, alpacas in North America is highly mobile. Sales, shows and private treaty negotiations result in these animals moving across state line frequently. The objective of this report is to acquaint regulatory personnel and livestock industry officials with these unique animals so that a logical regulatory policy may be developed.

The taxonomic status of the camelids is listed in table 1. A common misconception is that camelids are ruminants and should be treated like cattle, sheep and goats. Camelids and ruminants have been on separate evolutionary lines for more than 40 million years. Camelids do share some characteristics with ruminants in that both groups have foregut fermentation and ruminate, but digestive anatomy and physiology are different, table 2. The similarities are a result of parallel evolution, not relationship.

Llamas and alpacas are closely related. They were domesticated in the Andes of Peru and Bolivia 6 or 7 thousand years ago. Guanacos and vicuñas are wild species, but guanacos are kept in private ownership in North America. Presently, vicuñas are exhibited only in Canada. Both species of Old World camels are domestic animals. All the camelids began evolutionary development in western North America and migrated over the Bering Straits and Caribbean land bridges that formed during glacial periods in the Pleistocene Era.

What does camelid biology have to do with interstate movement of camelids? Susceptibility or resistance to infectious and parasitic microorganisms are frequently correlated with species relatedness. To further establish the uniqueness of camelids, consider table 2 further. Marked anatomic and physiologic differences between camelids and ruminants exist in many organ systems. More importantly, differences in parasitic and infectious diseases between the two groups are recognized.
REGULATION OF THE TRANSPORTATION OF CAMELIDS

CLASSIFICATION OF LLAMAS/ALPACAS BY STATES

An insight as to the perplexity experienced by state regulatory agencies may be appreciated by a perusal of state regulations, table 3. Further insight may be obtained by considering the diseases thought to be important by each state, table 4. The primary concerns are for brucellosis and tuberculosis, with a small number of states also concerned about bluetongue, anaplasmosis, Johne's disease and leptospirosis. Surely, a state's federal brucellosis and tuberculosis status has a bearing on the regulations promulgated by a state, and rightfully so.

TESTING PROCEDURES

A major factor that has not been given adequate emphasis in the development of regulations is the suitability of testing procedures that are being applied to llamas/alpacas.

Brucellosis

Thirty two states require that llamas/alpacas have a negative test for *B. abortus* prior to entry into the state, table 3. Numerous tests are employed by the states for screening or definitive evaluation, table 4. Table 5 provides an overview of how these tests are used by states to evaluate llamas/alpacas. None of these tests have been verified as valid in camelids. Some of the tests utilize bovine-specific reagents. This would not be tolerated for new tests being suggested for use in cattle.

Furthermore, no documented case of naturally-occurring clinical brucellosis (*Brucella abortus*) in llamas/alpacas has been reported. This includes countries in South America where llamas/alpacas graze in association with cattle in areas where brucellosis (*B. abortus*) is endemic. However, infection and clinical disease caused by *B. melitensis* has been documented.

Tuberculosis

The delayed hypersensitivity response to intradermal tuberculin appears to be different in camelids than in cattle. It is known that there are false positive and false negative reactions. This prompted the Canadian government to halt importation of camelids into the country until a more accurate antemortem test could be developed. Efforts have been made in Canada, Mexico and the United States to develop an acceptable and reliable testing protocol.

A single axillary space intradermal test using 0.1 ml of PPD bovine tuberculin is generally considered to be the most accurate test to date. However, ELISA (including gamma interferon assay), DNA probes, lymphocyte stimulation and other serologic procedures are being evaluated experimentally.
Epidemiologic data collected to date indicate that:

1. Camelids may become infected by *M. bovis, M. avium, M. paratuberculosis* and possibly other mycobacteria.
2. Camelids may be somewhat resistant to infection and spread to naive camelids in association with infected llamas and elk may or may not occur. However, much more information is necessary in order to understand the pathogenesis and epizootiology of tuberculosis in camelids.
3. It is unlikely that camelids pose a serious threat to cattle or other livestock in the spread of tuberculosis.

**FUTURE DIRECTIONS**

It is apparent that further experimental work is necessary to evaluate appropriate testing procedures. Llama and alpaca owners are still greatly concerned about the diversity of regulations and the problems that this may engender. Consider the following true scenario as an example. A female llama was transported to another state for breeding. The state of destination had no requirement for brucellosis testing prior to entry. The female remained at the ranch for a period of time and when preparing documents to return the female to the state of origin, it was determined that a brucellosis test was required for reentry. The female tested positive for *B. abortus*, and reentry was denied. Extensive testing in the herd of destination failed to indicate infection in that herd.

The positive reaction to *B. abortus* may have come about as follows:

1. The reaction is valid and the female had responded to exposure to *B. abortus* in the herd of origin.
2. The reaction was a false positive, caused by any of the following.
   a. The testing method employed was inappropriate for a llama.
   b. The interpretation of the laboratory test was inappropriate for a llama.
   c. The reaction was a cross reaction to another antigen, such as *Yersinia enterocolitica*.
   d. The reaction was a result of a recent vaccination causing a surge in IgG.
   e. Unknown factors.

How is the dilemma to be resolved? Consider the following:

1. Retest, using most appropriate tests.
2. Test the herd of origin to determine its status for brucellosis
3. Culture the blood of the reacting female
4. Evaluate the response, taking into consideration the herd history, as is done in cattle brucellosis herd testing
5. Euthanize the female and culture for *B. abortus*
REGULATION OF THE TRANSPORTATION OF CAMELIDS

6. The state of origin could accept the risk, considering that llamas are not high risk animals
7. The owner of the herd of destination could keep the female isolated on the ranch
8. Establish more precise, definitive tests to rule out *B. abortus* infection in llamas and alpacas when a screening test is positive.
9. The llama could be sold to a party in a state not requiring testing for brucellosis.

The problem might have been avoided, had the owner of the herd of destination required testing for diseases required by the state of origin before accepting the female for breeding. That recommendation is now being made to all llama/alpaca owners. Nonetheless, uniform regulations would help to minimize such problems.

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Table 1. Classification of camelids and other artiodactyls

<table>
<thead>
<tr>
<th>Class</th>
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<tr>
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<td>SUIFORMES</td>
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<tr>
<td>Suborder</td>
<td>TYLOPODA</td>
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<tr>
<td>OLD</td>
<td>Camelus dromedarius -- dromedary camel</td>
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<tr>
<td>WORLD</td>
<td>Camelus bactrianus -- bactrian camel</td>
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<tr>
<td></td>
<td>Lama glama -- llama</td>
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<tr>
<td>NEW</td>
<td>Lama pacos -- alpaca</td>
</tr>
<tr>
<td>WORLD</td>
<td>Lama guanicoe -- guanaco</td>
</tr>
<tr>
<td></td>
<td>Vicugna vicugna -- vicuña</td>
</tr>
</tbody>
</table>

Suborder -- RUMINANTIA -- Cattle, sheep, goats, water buffalo, giraffe, deer, antelope, bison
Table 2. DIFFERENCES BETWEEN LLAMAS & ALPACAS AND RUMINANTS

<table>
<thead>
<tr>
<th>LLAMAS AND ALPACAS</th>
<th>RUMINANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Evolutionary pathways diverged 40 million years ago</strong></td>
<td>Evolutionary pathways diverged 40 million years ago</td>
</tr>
<tr>
<td><strong>Blood</strong></td>
<td></td>
</tr>
<tr>
<td>RRbc elliptical and small (6.5u)</td>
<td>RBCs round and larger</td>
</tr>
<tr>
<td>Predominant WBC is neutrophil</td>
<td>Predominant WBCs lymphocyte</td>
</tr>
<tr>
<td>Leukocytes up to 22,000</td>
<td>Leukocytes up to 12,000</td>
</tr>
<tr>
<td><strong>Foot</strong></td>
<td></td>
</tr>
<tr>
<td>has toenails and soft pad</td>
<td>Foot has hooves and sole</td>
</tr>
<tr>
<td>P-2 &amp; P-3 horizontal, semiplantigrade</td>
<td>P-2 &amp; P-3 vertical, digitigrade</td>
</tr>
<tr>
<td><strong>Digestive system</strong></td>
<td></td>
</tr>
<tr>
<td>Parallel evolution - foregut fermenter</td>
<td>Same</td>
</tr>
<tr>
<td>with regurgitation, rechewing and re-swallowing.</td>
<td>Stomach --- 4 compartments</td>
</tr>
<tr>
<td>Stomach --- 3 compartments</td>
<td>Only abomasum glandular</td>
</tr>
<tr>
<td>All compartments glandular</td>
<td>Motility pattern - front to rearward</td>
</tr>
<tr>
<td>Motility pattern - rear to forward</td>
<td>Ingesta layered</td>
</tr>
<tr>
<td>Ingesta homogeneous</td>
<td>Susceptible to bloat</td>
</tr>
<tr>
<td>Resistant to bloat</td>
<td>Spiral colon, simple -- 2-3 coils</td>
</tr>
<tr>
<td>Spiral colon, complex --- 5 coils</td>
<td>Omental Sling present</td>
</tr>
<tr>
<td>No omental sling</td>
<td>Dental formula I 0/3, C 0/1, PM 3/3, M 3/3</td>
</tr>
<tr>
<td>Dental formula I 1/3, C 1/1, PM 1-2/1-2, M 3/3</td>
<td></td>
</tr>
<tr>
<td>LLAMAS AND ALPACAS</td>
<td>RUMINANTS</td>
</tr>
<tr>
<td>--------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td><strong>Reproduction</strong></td>
<td><strong>Spontaneous ovulation</strong></td>
</tr>
<tr>
<td>Induced ovulator</td>
<td>Luteal phase part of each estrous cycle</td>
</tr>
<tr>
<td>No luteal phase except after ovulation</td>
<td>Has estrous cycle</td>
</tr>
<tr>
<td>No estrous cycle</td>
<td>No follicular wave cycle</td>
</tr>
<tr>
<td>Follicular wave cycle</td>
<td>Copulation in standing position</td>
</tr>
<tr>
<td>Copulation in the prone position</td>
<td>Placenta cotyledonary</td>
</tr>
<tr>
<td>Placenta diffuse</td>
<td>No epidermal membrane on fetus</td>
</tr>
<tr>
<td>Epidermal membrane surrounding fetus</td>
<td>Ejaculation short &amp; intense</td>
</tr>
<tr>
<td>Ejaculation prolonged</td>
<td></td>
</tr>
<tr>
<td><strong>Respiratory system</strong></td>
<td><strong>Lung not lobed</strong></td>
</tr>
<tr>
<td>Lung not lobed</td>
<td>Soft palate short – mouth or nasal breather</td>
</tr>
<tr>
<td>Soft palate elongated, primarily nasal breather</td>
<td></td>
</tr>
<tr>
<td><strong>Urinary system</strong></td>
<td><strong>Kidney smooth and elliptical</strong></td>
</tr>
<tr>
<td>Kidney smooth and elliptical</td>
<td>No suburethral diverticulum</td>
</tr>
<tr>
<td>Suburethral diverticulum in female</td>
<td></td>
</tr>
<tr>
<td><strong>Genital system</strong></td>
<td><strong>No cartilaginous projection on glans</strong></td>
</tr>
<tr>
<td>Cartilaginous projection of tip of glans</td>
<td></td>
</tr>
<tr>
<td><strong>Parasites</strong></td>
<td><strong>Do not share lice or coccidia, but do share GI nematodes</strong></td>
</tr>
<tr>
<td>Have unique lice and coccidia.  Do share GI nematodes</td>
<td></td>
</tr>
<tr>
<td><strong>Infectious diseases</strong></td>
<td><strong>Highly susceptible to M. bovis, B. abortus, and FMD infection. IBR, PI 3 and BVD common.</strong></td>
</tr>
<tr>
<td>Minimally susceptible to <em>M. Bovis</em>. No known natural <em>Brucella abortus</em> infection in llamas of alpacas. Mild susceptibility to FMD</td>
<td></td>
</tr>
</tbody>
</table>
Table 3. Camelid classification by states

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic animals</td>
<td>45</td>
</tr>
<tr>
<td>Regulations specific for camelids</td>
<td>11</td>
</tr>
<tr>
<td>Llamas considered separately</td>
<td>9</td>
</tr>
<tr>
<td>SAC &amp; OW camelids considered together</td>
<td>2</td>
</tr>
<tr>
<td>Regulations same as for cattle</td>
<td>2</td>
</tr>
<tr>
<td>Regulations same as for sheep and goats &amp; cervids</td>
<td>1</td>
</tr>
<tr>
<td>Regulations same as for bison</td>
<td>3</td>
</tr>
<tr>
<td>Regulations same as for cervids</td>
<td>3</td>
</tr>
<tr>
<td>Regulations general for all animals*</td>
<td>23</td>
</tr>
<tr>
<td>No health certificate required</td>
<td>2</td>
</tr>
<tr>
<td>Classified as zoo or wild animals</td>
<td>5</td>
</tr>
<tr>
<td>Regulations for llamas/alpacas being rewritten</td>
<td>8</td>
</tr>
</tbody>
</table>

* Usually based on cattle regulations

Table 4. State required testing for importation of llamas/alpacas

- **ANAPLASMOSIS** --- 6
- **BLUETONGUE** --- 9
- **Brucella abortus** --- 32
- **M. bovis** --- 29

Table 5. *Brucella abortus* -- Laboratory Tests

- STANDARD PLATE AGGLUTINATION
- STANDARD TUBE AGGLUTINATION
- STANDARD CARD TEST
- ROSE/BENGAL CARD TEST
- COMPLEMENT FIXATION
- C.F. TECHNICON AUTOMATED
- BUFFERED ACIDIFIED PLATE ANTIGEN
- PARTICLE CELL FLUORESCENT IMMUNOASSAY
- ELISA
- ELISA --- COMPETITIVE
### Table 6. Brucellosis tests accepted by states for use in llamas and alpacas

<table>
<thead>
<tr>
<th>LABORATORY TEST SCREENING</th>
<th>DEFINITIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD PLATE AGGLUT.</td>
<td>11</td>
</tr>
<tr>
<td>STD TUBE AGGLUT.</td>
<td>15</td>
</tr>
<tr>
<td>STD CARD</td>
<td>19</td>
</tr>
<tr>
<td>R/B CARD</td>
<td>5</td>
</tr>
<tr>
<td>COMPLEMENT FIX.</td>
<td>4</td>
</tr>
<tr>
<td>RIVANOL</td>
<td>6</td>
</tr>
<tr>
<td>BAPA</td>
<td>14</td>
</tr>
<tr>
<td>PCFIA</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 7. FALSE POSITIVE -- CAUSES

- SPECIES SPECIFIC TESTS
- ACCEPTED TITER MAY NOT BE APPROPRIATE
- DISEASE AGENTS MAY SHARE ANTIGENS
- VACCINATION SURGE OF IgG
- LABORATORY VARIATION
- INTERPRETATION OF LABORATORY DATA
- UNKNOWN FACTORS
REPORT OF THE COMMITTEE ON INFECTIOUS DISEASE OF CATTLE, BISON AND LLAMA

Chairperson: Dr. C. S. Card, Harrisburg, PA
Vice Chairperson: Dr. Lynne M. Siegfried, Ames, IA

W.F. Alexander, OK; A.A. Andersen, IA; F.R. Bauer, CA; R.E. Bohlender, NE; T.C. Bunting, IL; H.M. Chaddock, MI; T. F. Conner, IN; R.A. Crandell, CA; G.L. Crenshaw, CA; K. Dowling, SD; D.P. Ferlicka, MT; L.R. Harrison, KY; J.A. Hennessy, MO; D. Hensel, CO; S. Holland, SD; J.A. Jarvinen, IA; A.J. Kennel, MN; A.J. Leudke, CO; D. Mattson, OR; P.L. McDonough, NY; C.A. Mebus, NY; J.M. Miller, IA; P.A. O’Berry, IA; B.I. Osburn, CA; T. Phelps, CA; D.H. Schlafer, NY; J.A. Schmitz, NE; V.A. Seaton, IA; J.E. Strickland, GA; D.E. Suther, CA; R.M.S. Temple, OH; C.O. Thoen, IA; R.D. Walker, KS; R.E. Werdin, MN; L. Woodson, KS; W.B. Wren, KS.

The Committee on Infectious Diseases of Cattle, Bison, and Llama met from 1:30 – 5:30 p.m. on October 26, 1993, and from 1:30 – 5:30 p.m. on October 27, 1993 at the Sahara Hotel in Las Vegas, NV. Chairperson Card and Vice Chairperson Siegfried conducted the meeting.

Committee members present included:
T.C. Bunting, IL; H.M. Chaddock, MI; R.A. Crandell, CA; G.L. Crenshaw, CA; K. Dowling, SD; D.P. Ferlicka, MT; L.R. Harrison, KY; J.A. Hennessy, MO; D. Hensel, CO; S. Holland, SD; J.A. Jarvinen, IA; A.J. Kennel, MN; A.J. Leudke, CO; D. Mattson, OR; P.L. McDonough, NY; C.A. Mebus, NY; J.M. Miller, IA; P.A. O’Berry, IA; B.I. Osburn, CA; T. Phelps, CA; D.H. Schlafer, NY; J.A. Schmitz, NE; V.A. Seaton, IA; J.E. Strickland, GA; D.E. Suther, CA; R.M.S. Temple, OH; C.O. Thoen, IA; R.D. Walker, KS; W.B. Wren, KS.

Dr. Michael David (USDNAPHISVS) discussed a research program recently completed in Argentina investigating FMD transmission and susceptibility in llama and alpaca. The study included:

STUDY A: FIELD SURVEY

Objective: To evaluate the susceptibility of South American camelids (llamas) to FMD by studying llamas at livestock (cattle and sheep) farms where FMD had been known to occur.

The protocol required sampling of llamas, cattle and/or sheep in at least 3 farms where the llamas were associated (in close contact or intermingling) with livestock to determine the exposure rate.

Summary:
A total of nine farms were surveyed. Seven of these farms had cattle and llamas, four also had sheep. One small farm had llamas only, and another had llamas and sheep, but no cattle. Three farms reported no
occurrence of FMD, five reported having had an outbreak at least 12 to 24 months prior to sampling, and one farm reported having a recent outbreak. During the last four months of 1992, serum and oesophageal-pharyngeal (OP) fluid samples were collected from at least ten cattle and/or sheep and from at least 50-60 llamas at each farm. Tests for FMD antibody using the virus infection associated antigen (VIAA) test and the virus neutralization (VN) test (to FMD types A, C, and O), and for FMD virus in OP fluids were conducted at the laboratories of the Instituto Nacional de Tecnologia Agropecuaria in Argentina. Aliquots of the serum and the OP fluids were forwarded to the United States for confirmatory testing.

Results:

All OP samples taken from llamas (0/460) and from a few randomly selected cattle (0/60) and sheep (0/30) were negative for FMD virus. All llamas (0/460) and sheep (0/30) samples were negative to both the VIAA and VN tests. In cattle, however, VIAA (38/120) and VN (103/120) antibodies were detected. These results were confirmed at the U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services' Foreign Animal Disease Diagnostic Laboratory in Plum Island, New York, by a sampling of the positive and negative animals.

STUDY B: CLINICAL TRIAL

Objectives:

1) To determine the susceptibility of llamas to FMD infection when exposed to both actively shedding animals and other exposed animals.

2) To determine the ability of llamas, whether infected by or exposed to livestock actively shedding FMD virus, to become FMD virus carriers.

Summary of Clinical Trial:

1) The entire trial was conducted in a high containment facility at the Instituto Nacional de Tecnologia Agropecuaria in Argentina from October 1992 through January 1993.

2) Six pigs were inoculated with FMD virus; two with type A, two with type C, and two with type O. Each pair of pigs inoculated with the same serotype was placed into separate isolation rooms and served as the source of FMD virus to which the initial group of 30 llamas were exposed.

3) Three days after inoculation of the pigs, ten llamas and one 18-month old susceptible Holstein steer were placed in each of the rooms with the inoculated pigs. This became the first day (day O) of the trial. Each containment unit, therefore, had 10 llamas, two pigs and one steer. The susceptible steers were added to each
group of llamas and pigs as sentinels for FMD virus shedding by the pigs. The llamas and steers were observed for lesions and sampled (serum and OP fluid) at regular intervals.

4) On day 4 following exposure, the pigs and steers were removed from each group and sacrificed. All thirty llamas were then placed into a single containment unit and 30 additional susceptible llamas were added to the group of exposed llamas. Both groups of llamas were observed for the development of lesions and sampled at regular intervals for 90 days.

5) On day 60 of the experiment, 40 susceptible domestic livestock (10 pigs, 10 goats, 10 calves and 10 sheep) were added to the entire group of llamas. These sentinel animals were also observed for lesions and sampled.

6) A control group of 15 llamas and 20 domestic livestock were housed in a separate area to monitor for the possible escape or cross-contamination by FMD virus from the containment area.

All six pigs had developed vesicular lesions by the time the llamas and the steer were placed with them. Two of these pigs, one inoculated with FMD virus type O and one inoculated with FMD virus type C, died within the four day period of introduction to the llamas. The three steers used for monitoring and verifying that FMD virus was being shed by the pigs became viremic and developed vesicular lesions. Virus of the corresponding type used to infect the pigs was isolated from blood and vesicular fluid samples collected from these steers.

None of the llamas that were experimentally exposed to FMD types A or C developed any clinical sign of FMD. None of these llamas developed any VIAA or neutralizing antibody to any of the FMD types used, and no virus was isolated from either the OP fluids or blood collected.

Only two llamas experimentally exposed to FMD virus type O developed lesions. These lesions were barely detectable. Neither of these two llamas ever stopped eating or demonstrated any discomfort as a result of the lesions. These two llamas, as well as a third one, developed both VIAA and neutralizing antibodies to FMD virus type O. Foot-and-mouth disease virus type O was isolated from the blood and OP fluid of these same lesioned animals (Table III).

All 30 llamas added on day 4, all sentinel livestock introduced on day 60 of the trial, and all control animals remained healthy and did not develop any lesion. These animals remained negative on the VIAA and VN tests and no FMD virus was detected in OP fluid or blood.

All positive results and those from a sampling of the negative animals were corroborated by USDA's Veterinary Services, Foreign Animal Disease Diagnostic Laboratory.
REPORT OF THE COMMITTEE

Conclusion:
From the results of the study, we concluded that:

1) The serological tests (VIAA and VN) are adequately sensitive to detect FMD infected llamas,
2) Llamas are very resistant to FMD virus infection, and
3) In contrast to cattle, infected llamas only carry FMD virus in their esophageal–pharyngeal region for a short time.

Following an extensive discussion by committee members and guests, a resolution was presented and was unanimously accepted by the Committee.

Dr. Raul Barletta, Department of Veterinary & Biomedical Sciences and Center for Biotechnology, University of Nebraska, Lincoln, NE 68583-0905, discussed molecular tools for the study of mycobacterial diseases.

Dr. Barletta pointed out that new viral diseases, globalization of the economy, and the abandonment of preventive practices have contributed to the resurgence of mycobacterial infections in both humans and animals. The resurgence of bovine tuberculosis and its potential spread to wildlife is a major concern for US agriculture. Current control measures and diagnostic tests are inadequate. Integrated management measures, effective vaccines, and new diagnostic tools are needed.

Recent developments in the molecular genetics of Mycobacteria provide the basis for a modern approach to disease prevention and control. Electroporation has been used to introduce DNA into Mycobacteria. Broad shuttle plasmid vectors able to replicate in both E. coli and Mycobacteria have been developed. Mycobacterial expression sequences have been cloned and used to express foreign antigens in M. bovis BCG. Genetic manipulation of Mycobacteria has made possible the construction of new attenuated mycobacterial vaccine strains with defined mutations in virulence genes. Deletion of non-essential antigen genes and addition of appropriate genetic markers would result in the development of vaccine strains compatible with diagnostic tests.

For the development of new diagnostic tools, the E. coli β-galactosidase and the firefly luciferase genes have been used. These reporter genes have been cloned into non-essential regions of mycobacterial phages. Reported mycobacteriophages combine the specificity of the phage with the sensitivity of the reporter gene. Luciferase phages have been used as a screening tool to determine the antibiotic susceptibilities of mycobacterial pathogens and could be used to detect Mycobacteria in clinical samples.

Dr. H. Li, USDA/ARS in Pullman, WA, addressed the Committee on the subject of the detection of Malignant Catarrhal Fever virus antibody in sheep, by competitive inhibition ELISA. Dr. Li and co–workers, Dr. T. Shen, D.P. Knowles, J.R. Gorham and T.B. Crawford, described a monoclonal antibody (MAb) to a conserved epitope of Malignant Catarrhal Fever virus.
INFECTIOUS DISEASE OF CATTLE, BISON AND LLAMA

(MCFV) was identified. The MAb immunoprecipitated a glycoprotein complex of 115/110/105/78/45 kd. Serum antibodies from animals naturally or experimentally infected with MCFV also immunoprecipitated the protein complex and competed with the MAb for the epitope. A competitive inhibition enzyme-linked immunosorbent assay (CI–ELISA) based on this competition was developed. The specificity of the MAb was intensively examined. It did not react with 8 sheep/goat viruses (ovine herpesvirus, caprine herpesvirus, ovine respiratory syncytial virus, ovine parainfluenza virus 3, ovine adenovirus types 5 and 6, ovine progressive pneumonia virus, caprine arthritis–encephalitis virus) and 5 bovine viruses (bovine herpesvirus 1, 2, 4, bovine virus diarrhea virus, or bovine respiratory syncytial virus). Polyclonal sera from animals experimentally inoculated with four different isolates of MCFV from diverse geographic areas exhibited significant inhibition in the assay. Among 149 serum samples from sheep associated with MCF outbreaks in 7 states, 55% of the sheep were seropositive by this assay. Preliminary data also suggested a significant association between the age of the sheep and the presence of antibody to MCFV. The assay appears to be highly specific and useful for detection of MCFV antibody in many species.

Dr. Stuart E. Knapp, Montana State University, Bozeman, MT, presented information from a study of a large herd of bison in southwestern Montana. The long–term study is located on a 130,000 acre former cattle ranch, located approximately 20 miles southwest of Bozeman. The ranch is being developed into a commercial bison operation. The ranch has been stocked with bison originating mostly from Wyoming and Utah ranches. Randomly collected fecal samples were taken from each group of animals as they were brought into the herd. All new animals were treated with Ivomec before being shipped to the ranch. Fecal examination results were negative for lungworms and liver flukes, stomach and intestinal nematode ova counts (epg) were negative or low, Nematodirus ova were frequently present and coccidia oocysts were present in most of the fecal samples that were examined. Six species of coccidia were identified: Eimeria bovis, E. auburnensis, E. canadensis, E. brasiliensis, E. ellipsoidalis, E. zuernii. The most prevalent of these were E. bovis, 97% and E. canadensis, 90%. Two species, E. ellipsoidalis and E. zuernii, have not previously been reported from Bison bison.

Parasite burdens, based on routine fecal examinations, have not increased significantly enough to warrant application of anthelmintics. Decoquinate has been used with weaned calves, but no cases of coccidiosis have been observed.

Nematodirus helveticus is present in the herd and could constitute a health problem. A field trial, run on weaned calves, showed that Levisole, injectable and Panacur, drench caused a significant reduction of eggs of this parasite. A drug efficacy study, sponsored by the USDA IR–4 Program, involving Ostertagia ostertagi and Ivomec Pour–on, was done during the
spring of 1993. The drug was effective in eliminating this parasite. This was the first time bison have been experimentally infected with a nematode.

Approximately 2300 elk and 1500 white-tail or mule deer occupy the ranch at various times. The lungworm, Dictyocaulus spp. has been reported present in 35% to 60% of the elk in the Northern Rockies herd. This parasite has also been reported as a parasite of bison. It is possible that the lungworm will become established in the bison herd on this ranch since the bison and the wild cervids use the same range.

Dr. Randall Cutlip, ARS, Ames, IA, reported on the results of his research on transmission of the scrapie agent to cattle. Nin of 9 cattle exposed intracerebrally developed central nervous system signs and positive immunochemical staining of proteinase-resistant prior protein. Oral transmission attempts were negative at two years. Dr. Cutlip also summarized transmission studies of Horrigan and Clark at Mission, TX and Robinson, ARS, Pullman, WA.

**Surveillance for BSE in the United States, including:**

1. **Histopathological Examination of Brains from Cattle Suspected of having BSE and those Testing Negative for Rabies.**
   Conducted by APHIS' National Veterinary Services Laboratory, Center for Disease Control, and other diagnostic laboratories.
   Over a period of several years, 856 brains were examined. All were negative for lesions characteristic of BSE.
   Based on these findings, it was calculated that if BSE does occur in the United States, it could be no more frequent than in 1 per 1 million cattle.

2. **Histopathological Examination of Referrals from Private Practitioners to State Diagnostic Laboratories and Veterinary Schools.**
   Inquiries to these laboratories indicate there are 20–30 such referrals per year per laboratory. With 60 such laboratories, there are approximately 1,500 brains examined per year. None of these have been reported to be positive for BSE.

3. **Foreign Animal Disease Surveillance Program.**
   In 1992, brains from 16 cattle suspected of having a foreign disease were examined.
   None has lesions of BSE.

4. **Rabies–Negative Reports from Public Health and Veterinary Laboratories.**
   These laboratories examine hundreds of brains each year. Since 1980, well before the outbreak of BSE in Great Britain, there has been no increase in diagnosis of rabies–negative cattle brains. An increase would be expected if BSE had become endemic in the United States.
5. Surveillance by Mink.

Another form of surveillance comes from the possibility that outbreaks of transmissible mink encephalopathy (TME) in the United States originated from cattle. TME is a spongiform encephalopathy of mink that has been reported on 5 mink ranches in the United States. The original source of the agent was believed to be from sheep with scrapie that were fed to the mink. Two outbreaks of TME have been reported in which the mink were fed only "downer cows" - no sheep were fed.

Two surveys have studied this possibility of transmission from cattle. One survey was designed to evaluate the number of "downer cows" fed to mink in 7 dairy states since the last outbreak of TME. The conclusion was that as many as 33,000 "downer cows" may have been fed since the last TME outbreak in 1985.

And that if BSE does occur in the United States, it is very rare or it is transmitted to mink only under very unusual conditions. The latter is considered unlikely - mink are believed to be very susceptible to the U.S. agent because in all outbreaks, nearly 100% of the mink have died.

The other survey was conducted only in Wisconsin where the greatest number of TME outbreaks have been reported. The finding was that approximately 27,000 "downer cows" had been fed to mink per outbreak of TME. This equates to approximately 900,000 total cattle per outbreak.

And, again, if BSE does occur in the United States, it is very rare.

Dr. Jack Rhyan, National Veterinary Services laboratory pathologist, reported on new information regarding the pathogenesis of abortions resulting from Tritrichomonas foetus infections in cattle. Using monoclonal antibody and immuno-histochemical stains, the organism could be detected in placenta and fetal lung and intestine. Its apparent invasive characteristics help explain its success as an abortigenic agent.

Dr. Lynn Siegfried, Co-chair of the Committee, USDA/NVSL/VS, AMES, IA discussed the future role of APHIS in pre-harvest food safety programs.

Concerns over the safety of our food supply have increased recently as human health incidences resulting from Salmonella enteritidis and Escherichia Coli 0157H7 have hit the news.

USDA's Animal and Plant Health Inspection Service (APHIS) and Food Safety Inspection Service (FSIS) responded through sponsorship of six regional food safety hearings over the U.S. At these hearings, representatives from consumer groups, industry, and government presented
their concerns and perceptions of food safety issues. These responses have served as a midus for development of an APHIS response.

The APHIS role in food pathogen reduction is at the "pre–harvest" level on the farm and related to livestock movement. An APHIS Pre–harvest Food Safety Management Team was formed. This team is involved in short and long–term pre–harvest food safety planning. Areas of focus include improvements in animal identification for more accurate traceback activities, investigations of food pathogens and resulting monitoring and surveillance programs; risk assessment and management; education of APHIS field staff in food pathogen reduction, and research and development of rapid, reliable diagnostic tests.

Pre–harvest food safety relies upon interactions of USDA, producers, veterinary practitioners, State agricultural officials, and public health agencies. Team efforts of these groups will help provide food products that will meet consumer expectations.

Dr. Arthur Kennel discussed the priorities for llama research, including the process of establishing priorities, funding and the administration of the research sponsored by the ILA and other llama agencies.

HISTORICAL PERSPECTIVE

The history of llama medical research in North America is relatively short. In 1987, the International Llama Association (ILA) reported funding four research projects with funds totaling $7,000. Early projects were funded on a case by case basis in response to proposals by research scientists based on the strength of the appeal and funds available. Some were funded by individual llama breeders and some were funded collaboratively by two or more llama associations or the Registry. An unknown number of projects had no formal funding but were "piggy–backed" unto other projects being carried out by researchers. The need for llama–specific research to provide a sound scientific basis for their medical care and management was gradually recognized by practicing veterinarians and breeders alike.

Eventually llama research proposals became more competitive, more sophisticated, of longer duration, and more expensive. The need for a rational and consistent method of evaluating proposals was recognized. The need for developing priorities, a sort of road map for where we wanted to go, was also recognized. A partnership with the Morris Animal Foundation was formed by the Llama Association of North America (LANA) and by ILA to aid in the solicitation, evaluation, and administration of research projects, and holding recipients of grants accountable.

THE PRIORITY SETTING PROCESS

During 1992, a process for setting llama medical research priorities was initiated by the ILA. The goal of the process was to gather information about the health and diseases of llamas in order to determine their medical
research needs. Another goal was that of developing balance in research, clearly communicating with potential researchers the needs of the llama community, and to provide a rational basis for funding based on relevancy to the needs of the llama community and the likelihood of providing benefits to the llama community by improving the health and welfare of our animals.

Initially, the data was gathered by Kennel as chair of the ILA Research Committee. The task of analyzing the data and setting priorities was completed in the spring of 1993 by the newly formed Llama Medical Research Group also chaired by Kennel. Other members were Lavona Fercho of the Canadian Llama Association, Hank Kauffman of the ILA, Judy Lawson of the Rocky Mountain Llama Association, and Dick Wickum of LANA. Cheryl Buckley of the IIA office provided office support.

Data were gathered from four sources and represented three differing perspectives on the health and diseases of Llamas.

1. Thirty-one veterinarians caring for an estimated 10,530 llamas and alpacas in 22 states and provinces of North America were surveyed. They recalled 1507 deaths of llamas of which 1232 (82%) had some level of post-mortem examination performed. They also reported the reasons for which they received calls from llama farms. They also listed their sense of what the priorities should be for llama medical research. These results were reported at the 1992 meeting of the USAHA.

2. The Wilkins Insurance Company provided data from 271 deaths of llamas with necropsies. Infectious diseases were thought to have caused 34% of the deaths, gastrointestinal diseases 17%, trauma 11%, immune deficiency 7%, heat stress 6% and unknown causes 8%.

3. Health et al reported in the 1992 Proceedings of the Health and Diseases of Small Ruminants on a data base survey of 22 veterinary teaching hospitals. They reported that 14.5% of visits were because of infectious disease, and 11.3% because of reproductive disorders.

4. Dr. B. Smith of Oregon State University provided data indicating that infectious disease accounted for 30% of visits, musculoskeletal problems 19%, reproductive problems 13%, and gastrointestinal problems 13% at their institution.

We concluded that the experience of practicing veterinarians most closely resembled the day to day health services provided to llamas, and accordingly what types of research would be most appropriate. Veterinarians are called for two basic categories of care. On the one hand, they are called for the diagnoses and treatment of disease states (category A). On the other hand, they are seeing llamas for health maintenance and prevention reasons (category B). They recommended that research funds be directed equally to both categories of research. On the basis of the data, their
REPORT OF THE COMMITTEE

recommendations, and other considerations, the group recommends the following priorities for llama medical research.

RECOMMENDATIONS

CATEGORY A. DIAGNOSIS AND TREATMENT OF DISEASE STATES.

1. Infectious diseases including immune disorders. These are closely related and have broad overlap so they are lumped together. We recommend this as the highest priority for several reasons.
   a. The potential health impact of contagious infectious disease spreading both within and between herds.
   b. The growing density of the population increasing the chance of spreading infectious diseases within the llama population.
   c. The frequent movement of llamas across and between countries for showing or sale or breeding.
   d. The potential economic impact of ID both for the individual breeder and the llama community.
   e. Implications for regulatory agencies for the safe movement of llamas across state, provincial, and national borders.
   f. This field of research may be expected to be cost effective.
   g. The existence of experienced research teams at several institutions.
   h. The potential for spread from animal to human, the zoonoses, examples of which include tuberculosis and brucellosis.
   The development of a valid test/s for tuberculosis was affirmed as the highest priority within infectious diseases. Studies of meningeal worm (P. tenuis) are also considered a high priority both for endemic areas but also because of the ripple effect on non–endemic areas and the concerns of regulatory agencies. Studies of immune deficiency states constituted another high priority closely related to infectious disease.

2. Reproductive disorders, firstly female and secondly male, constitute the second broad research priority for several reasons.
   a. The obvious economic impact on the individual breeder.
   b. The existence of several "reproductive centers" across the country.
   c. The reservoir of problem breeders available for study.
   d. The existence of experienced research teams at several institutions.

3. Gastrointestinal disease constitutes the third priority. Most commonly encountered are gastric ulcers and liver diseases. Many GI diseases are difficult to diagnose and to treat.

4. Studies of congenital diseases are important. These may be expensive and prolonged. Large numbers of cases may be needed to achieve statistical significance. There are difficulties
distinguishing between congenital acquired conditions and genetically caused conditions and wide discrepancies in reporting the frequencies of each.

5. Pharmacological studies. These include safety, efficacy and dosing and routes of administration.

6. Several other conditions are of lesser priority but none should be excluded per se. Each should be judged on its particular merits.

CATEGORY B. HEALTH MAINTENANCE AND PREVENTION.
This includes behavior and welfare studies.

1. Nutrition. Studies of nutrition are highly recommended for several reasons.
   a. Nutrition affects the health and welfare of individual and herds of animals in multiple direct and indirect ways including fertility, lactation, cria health, wool production and immune functions.
   b. The development of normal blood and body fluid mineral, vitamin, and other nutrient values facilitates better nutritional studies.
   c. Misconceptions about nutrition need to be dispelled.
   d. While some nutritional variations occur by geographic regions, many others apply widely.

2. Immunizations against infectious diseases.
   a. Studies of safety, efficacy, dosing and timing are needed.
   b. These are widely practiced based on little if any llama specific research.

3. Parasite control.
4. Herd management.
5. Stress and its prevention.
7. Several other areas need research and each should be considered on its own merits.

CONCLUSIONS
Considerable time and effort has gone into the process of gathering and analyzing data to provide a rational basis for setting priorities for llama medical research. It entailed cooperation on the part of many including practicing veterinarians, a major llama insurance company, 23 veterinary teaching hospitals, and representatives of several llama associations. While it is imperfect, we hope that this work will provide useful guidelines for the llama community, for existing and potential research scientists, assure that research funds are wisely used, and improve the health and welfare of our animals.

Dr. Murray Fowler, Davis, CA, presented a discussion of national regulation of interstate transportation of camelids.
REPORT OF THE COMMITTEE

Regulatory agencies have valid concerns about the potential for transmission of infectious and parasitic diseases as animals move across state lines. Legal authority is vested in State Departments of Animal Health (or similar entities) to protect the interests of livestock and poultry industries within each state. When a new alternative livestock industry develops, there is bound to be confusion and lack of factual information about how to categorize such animals and determine whether current regulations are applicable or if new regulations must be drafted.

Twenty years ago, camels, llamas and alpacas were seen only in zoos. Now, private ownership has blossomed, with 60,000 to 70,000 llamas and over 3,000 alpacas in the United States. This burgeoning population of llamas and, to a lesser degree, alpacas in North America is highly mobile. Sales, shows and private treaty negotiations result in these animals moving across state line frequently. The objective of this report is to acquaint regulatory personnel and livestock industry officials with these unique animals so that a logical regulatory policy may be developed. The primary concerns are for brucellosis and tuberculosis, with a small number of states also concerned about bluetongue, anaplasmosis, Johnes' disease and leptospirosis. Surely, a state's federal brucellosis and tuberculosis status has a bearing on the regulations promulgated by a state, and rightfully so.

TESTING PROCEDURES

A major factor that has not been given adequate emphasis in the development of regulations is the suitability of testing procedures that are being applied to llamas/alpacas.

Brucellosis

Thirty-two states require that llamas/alpacas have a negative test for B. abortus prior to entry into the state. Numerous tests are employed by the states for screening or definitive evaluation. None of these tests have been verified as valid in camelids. Some of the tests utilize bovine-specific reagents. This would not be tolerated for new tests being suggested for use in cattle.

Furthermore, no documented case of naturally–occurring clinical brucellosis (Brucella abortus) in llamas/alpacas has been reported. This includes countries in South America where llamas/alpacas graze in association with cattle in areas where brucellosis (B. abortus) is endemic. However, infection and clinical disease caused by B. melitensis has been documented.

Tuberculosis

The delayed hypersensitivity response to intradermal tuberculin appears to be different in camelids than in cattle. It is known that there are false positive and false negative reactions. This prompted the Canadian government to halt importation of camelids into the country until a more
INFECTIOUS DISEASE OF CATTLE, BISON AND LLAMA

accurate antemortem test could be developed. Efforts have been made in Canada, Mexico and the United States to develop an acceptable and reliable testing protocol.

A single axillary space intradermal test using 0.1 mi of PPD bovine tuberculin is generally considered to be the most accurate test to date. However, ELISA (including gamma interferon assay), DNA probes, lymphocyte stimulation and other serologic procedures are being evaluated.

Epidemiologic data collected to date indicate that:

1. Camelids may become infected by M. bovis, M. avium, M. paratuberculosis and possibly other mycobacteria.
2. Camelids may be somewhat resistant to infection and spread to naive camelids in association with infected llamas and elk may or may not occur. However, much more information is necessary in order to understand the pathogenesis and epizootiology of tuberculosis in camelids.
3. It is unlikely that camelids pose a threat to cattle or other livestock in the spread of tuberculosis.

FUTURE DIRECTIONS

It is apparent that further experimental work is necessary to evaluate appropriate testing procedures. Llama and alpaca owners are still greatly concerned about the diversity of regulations and the problems that this may engender. Consider the following true scenario as an example. A female llama was transported to another state for breeding. The state of destination had no requirement for brucellosis testing prior to entry. The female remained at the ranch for a period of time and when preparing documents to return the female to the state of origin, it was determined that a brucellosis test was required for reentry. The female tested positive for B. abortus, and reentry was denied. Extensive testing in the herd of destination failed to indicate infection in that herd.

The positive reaction to B. abortus may have come about as follows:

1. The reaction is valid and the female had responded to exposure to B. abortus in the herd of origin.
2. The reaction was a false positive, caused by any of the following:
   a. The testing method employed was inappropriate for a llama.
   b. The interpretation of the laboratory test was inappropriate for a llama.
   c. The reaction was a cross reaction to another antigen, such as Yersinia enterocolitica.
   d. The reaction was a result of a recent vaccination causing a surge in IgG.
   e. Unknown factors.
REPORT OF THE COMMITTEE

How is the dilemma to be resolved? Consider the following:

1. Retest, using most appropriate tests.
2. Test the herd of origin to determine its status for brucellosis.
3. Culture the blood of the reacting female.
4. Evaluate the response, taking into consideration the herd history, as is done in cattle brucellosis herd testing.
5. Euthanize the female and culture for B. abortus.
6. The state of origin could accept the risk, considering that llamas are not high risk animals.

Rational Regulation of the Interstate Transportation of Camelids.

7. The owner of the herd of destination could keep the female isolated on the ranch.
8. Establish more precise, definitive tests to rule out B. abortus infection in llamas and alpacas when a screening test is positive.
9. The llama could be sold to a party in a state not requiring testing for brucellosis.

The problem might have been avoided, had the owner of the herd of destination required testing for diseases required by the state of origin before accepting the female for breeding. That recommendation is now being made to all llama/alpaca owners. Nonetheless, uniform regulations would help to minimize such problems.

Mr. Robert Frost (ILJ) and Dr. Charles Thoen, Ames, IA briefly discussed the current status of TB testing research results in llamas. The objectives of this research is to find an effective test to protect domestic livestock and wildlife from any threat of TB.

New York state has conducted 300 axillary tests with no reaction. Serological tests are being developed based on PCR, DNA, lymphocyte transfer and ELISA. Collaboration research with USDA, Canada, and other countries is underway.

Dr. Thoen updated the Mexican study, which is now complete. The tailfold and cervical regions are not reliable.

Presently, the axillary skin region is recommended for the intradermal test, but the thickness of the injection site must be measured pre and post injection. The reaction may cause only a small skin thickening or in some cases a major thickening.

Efforts to adopt ELISA are ongoing, but at the present, are in no way definitive.

Dr. Murray Fowler and John Tompkins discussed Dr. Bill Franklin's work using llamas as predator control animals. Castrated llamas work best and adopt a very territorial relationship with sheep. Information may be requested from:

1. Mr. John Tomkins, 1615 Toro Creek Rd, Morrow Bay, CA 93442, or
2. Guard Llamas (publication), Extension Distribution Center, 119
Subcommittee of the USAHA committee on Infectious Diseases of Cattle, Bison and Llama.

The following individuals attended a subcommittee meeting on 26 October 1993, at 7:30 - 10:00 am at the Sahara Hotel in Las Vegas, Nevada. The meeting was conducted by Dr. Seymour Card, Chair of the Committee.

Committee members attending were: Dr. T. F. Bunting, IL; D. Hensel, CO; R.M.S. Temple, OH.

Guests included: W. Bonner (ANC), TX; P. Bradshaw, IL; D. Christ (ILA), OR; Michael Davis, (USDA/APHIS/VS), MD; D. Hull, (IL, D.A.) IL; T. Hunt, (CODI), MI; A. Keating, (AFBF); R. Rissler, (USDA/APHIS/VS), MD, M. Silberman, GA; R. Temple, OH; M. Turner, (USAHA), TX; L. Wilson, (NCA).

The Animal and Plant Health Inspection Service ("APHIS") of the United States Department of Agriculture ("USDA") has proposed removing certain pre-embarkation health certification and quarantine requirements upon arrival in the United States from llamas and alpacas from Chile, Poland, and the Netherlands. APHIS asserts that this proposed "action is warranted to relieve excessively burdensome restriction" 58 Fed. Reg. 41,643 (1993).

Dr. Michael David and Dr. Dick Rissler of USDNAPHISNS discussed the proposed rule change (Docket # 92-107-1) and the research project carried out in Argentina on "susceptibility and transmission of FMD in llamas.

The subcommittee discussed this proposed rule change, and the International Llama Association (ILA) outlined their reasons for opposing the action by APHIS. Further discussion enumerated several considerations of the problem of susceptibility and transmission of FMD in llamas that would require continued, well-controlled research studies by APHIS and ARS. The subcommittee also concurred that llamas and alpacas imported into the United States should continue to undergo strict quarantine at HSTAIC with sentinel animals and all appropriate testing.

The subcommittee also recommended the presentation of a resolution on importation quarantine for llamas and alpacas to the Committee on Infectious Diseases of Cattle, Bison and Llama.
THE ROLE OF STATE DIAGNOSTIC LABORATORIES IN EMERGENCY DISEASE PREPAREDNESS

Willie M. Reed
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Protecting domestic livestock and poultry from the ravages of foreign animal diseases, as well as some of the more lethal domestic diseases, requires constant vigilance by federal and state regulatory officials, including very significant roles played by state veterinary diagnostic laboratories and veterinary practitioners.

Introduction of a foreign animal disease (FAD) to the United States would threaten the vitality of our $80 billion poultry and livestock industries by severely disrupting the foreign markets it has taken the U.S. decades to establish abroad—a vitality achieved through much hard work and a unique partnership between the United States Department of Agriculture and livestock and poultry producers. This partnership has resulted in the healthiest and most productive food and fiber animal populations in the world. In a matter of weeks, if not days, introduction of a FAD would deal a severe blow to U.S. animal agriculture and undoubtedly would lead to higher prices for the consumer.

The general public has little knowledge of the vulnerability of our livestock and poultry industries to the ill effects of foreign animal disease or of the daily efforts required to maintain a constant, affordable, safe food supply. Table 1 illustrates the large scope and diversity of our animal populations. Only by close interaction and effective working relationships between federal and state agencies, producers, and veterinary practitioners can this national resource be maintained.

Table 1. U.S. Livestock and Poultry Population

<table>
<thead>
<tr>
<th>Animal Type</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle and calves (1)</td>
<td>100,110,000</td>
</tr>
<tr>
<td>Hogs and pigs (2)</td>
<td>57,684,000</td>
</tr>
<tr>
<td>Sheep and lambs (3)</td>
<td>10,850,000</td>
</tr>
<tr>
<td>Egg-type chickens (4)</td>
<td>352,621,000</td>
</tr>
<tr>
<td>Broilers (4)</td>
<td>5,864,650,000</td>
</tr>
<tr>
<td>Turkeys (4)</td>
<td>283,000,000</td>
</tr>
</tbody>
</table>

The responsibility for protecting U.S. livestock and poultry from incursions of FADs has been assigned primarily to the Animal and Plant Health Inspection Service (APHIS), in cooperation with other federal agencies and foreign governments. Because of the many ways in which FADs may reach U.S. soil, the capability for rapid detection and response is essential to an effective disease control program.

Emergency disease preparedness, which requires constant planning and training and conducting test exercises, is an essential component of a successful disease control program: within the APHIS, this responsibility is assigned to the Veterinary Services branch. The success of U.S. emergency disease preparedness also rests on the ability of state veterinary diagnostic laboratories and veterinary practitioners to detect and report potential FADs. Veterinary diagnosticians and diagnostic laboratories all across the U.S. are on the front lines of disease detection and surveillance and are likely to be the first to detect possible introduction of FADs.

The well developed U.S. diagnostic laboratory system, staffed by highly trained professionals, is a crucial link in emergency disease preparedness. Most laboratories have pathology, bacteriology, and virology capabilities, which serve as basic requirements for rapid and accurate detection of infectious pathogens. Many of these laboratories also have one or more diagnosticians trained to recognize FADs. Since many FADs can mimic domestic diseases, diagnosticians must be constantly vigilant and astute.

Whenever a FAD is suspected by diagnostic laboratory personnel, it is imperative that federal and state officials be contacted immediately. Because veterinary diagnostic laboratories have specially trained veterinarians and technicians, they may assist in the collection and initial testing of specimens and serve as the initial intermediary between federal officials and livestock or poultry producers. In addition, personnel of diagnostic laboratories may assist personnel of the National Veterinary Services Laboratory in Ames, Iowa, and the Foreign Animal Disease Diagnostic Laboratory at Plum Island, New York, by providing information relative to the disease status of a particular premise, providing specialized reagents and techniques and access to specialized equipment, or helping acquire additional specimens for laboratory testing.

In summary, emergency disease preparedness, an essential component of the strategy to protect U.S. livestock and poultry industries, requires rapid detection and effective response to introduction of FADs. State veterinary diagnostic laboratories play an important role in this effort, in cooperation with livestock and poultry producers and veterinary practitioners.

Reference:
REPORT OF THE COMMITTEE ON EPIZOOTIC ATTACK

Chairman: Dr. Harry M. Chaddock, Lansing, MI
Vice Chairman: Dr. Saul T. Wilson, Jr., Tuskegee, AL

J.B. Anderson, TN; W.W. Buisch, NY; J.J. Callis, NY; A.K. Eugster, TX; W.D. Felker, IA; J.B. Finley, TX; C. French, AA; D.D. Gingerich, IA; P.R. Henry, CO; B.R. Heron, CA; J.P. Huntley, NY; J.L. Hyde, NY; B.R. Jamieson, CAN; U.J. Lane, PA; J.H. Lang, WI; H.M. Loper, AL; D.W. Luchsinger, VA; E.T. Mallinson, MD; J. Mason, MD; R.H. McCapes, CA; H.A. McDaniel, MD; C.A. Mebus, NY; N. Meyer, VA; M.A. Mixson, NC; J.E. Novy, AA; G. Oltmans, MN; R.E. Omohundro, TX; J.S. Orsborn, Jr., CA; B.I. Osburn, CA; E.C. Sharman, GA; A.W. Smith, OR; W.G. Sterritt, CAN; D.L. Thompson, CA; O.H. Timm, CA; M.C. Turner, TX; M.A. Van Buskirk, PA; S.A. Vezey, GA; J.L. Williams, MD; G.W. Wilson, DC; J.H. Wyss, TX

The meeting was held on Thursday, October 28, 1993, and was attended by sixteen members and twenty-one guests. The agenda was divided into three areas: Emergency Disease Preparedness, Disaster Preparedness, and Free Trade Negotiations Issues.

EMERGENCY DISEASE PREPAREDNESS

Dr. Jim Pearson, Chief of the Diagnostic Virology Laboratory, National Veterinary Services Laboratories, Ames, Iowa, gave a presentation titled "Foreign Animal Disease Emergency: What is the Role of the National Veterinary Services Laboratories?" Dr. Pearson outlined the two main roles of the National Veterinary Services Laboratories – Prevention of Disease and Diagnosis of Disease. Disease prevention is accomplished by both the Ames and Plum Island staffs and facilities by training foreign animal disease diagnosticians, state personnel, veterinary school facilities, Canadian officials, APHIS personnel, and veterinary students. The first line of disease prevention is the veterinary practitioner and the second line of prevention is the state diagnostic laboratory. Dr. Pearson raised the question of awareness sufficiency and wondered if organizations such as USAHA, APHIS, and AVMA are doing enough to make practitioners aware of foreign animal diseases.

When the National Veterinary Services Laboratory suspects a foreign animal disease, federal and/or state officials are immediately informed. Trained laboratory foreign animal disease pathologists may be dispatched to the site as part of the on-the-site team. The National Veterinary Services Laboratories must maintain a stock of reagents and test materials at all times. Many times, shifting of staff resources is necessary to respond to disease outbreaks and sample submissions. It is very important that when a foreign animal disease is suspected, samples reach the federal laboratory as quickly as possible so that the possibility of a foreign animal disease can be eliminated before samples are spread around the country to other labor–
Dr. Pearson reported that a technology review of the National Veterinary Services Laboratories had recently been completed and that the following improvements are needed.

1. Improve development and introduction of diagnostic techniques. There is a need for better interaction with other foreign animal disease laboratories.

2. Currently the best methods available for detection of foot and mouth disease are not being used.

3. Development projects need to be prioritized to reflect the needs of APHIS.

4. Research efforts need to be better coordinated with the Agriculture Research Service and the Foreign Animal Disease Diagnostic Laboratory at Plum Island.

5. The ability to respond to some foreign animal diseases need to be improved.

6. Many of the criticisms by the National Research Council in 1983 have not been addressed.

It was noted that all the above deficiencies were related to resource problems and not due to lack of knowledge or desire. The Director of the National Veterinary Services Laboratories will be establishing a strategic planning task force and the USAHA will be asked to appoint a member to the task force. The Committee applauds this evaluation study by the laboratory and looks forward to having a USAHA representative on the strategic planning task force.

Dr. Willie Reed, Director of the Animal Health Diagnostic Laboratory at Michigan State University in East Lansing, Michigan gave a presentation titled "The Role of State Diagnostic laboratories in Emergency Disease Preparedness." Dr. Reed reviewed the mission of a diagnostic laboratory and also the organizational structure of a state laboratory. The impact of an outbreak of a foreign animal disease as far as economics, animal health, and public health were listed and reviewed. Several pathways for the entry of a foreign animal disease into this country were discussed with an emphasis placed on our highly mobile society and that foreign animal diseases can be carried by people, through the mail, and terrorism. Dr. Reed reviewed the principal roles of the diagnostic laboratory including maintenance of animal and public health and production, providing personnel for foreign animal disease investigations, disposal of infected animals, assistance in collecting samples, and most importantly the early detection of disease and the reporting of suspicion of foreign animal diseases.

Dr. Adam Grow, Senior Staff Veterinarian, USDA-APHIS-VS, Emergency Programs reported on emergency program updates. Dr. Grow reported that 299 foreign animal disease investigations were conducted during fiscal year 1993. 24% were vesicular conditions, 11% mucosal
EPIZOOTIC ATTACK

disease conditions, 41% avian diseases, 5% swine septicemic conditions, 10% encephalitic conditions, and 9% screwworm, exotic ticks or other disease conditions. Every geographical area of Veterinary Services had a foreign animal disease investigation, but not each state.

Currently emergency disease eradication guidelines for avian influenza are being reviewed. Several activities in the emergency programs area have taken place this year. Among those are:

1. USDA/industry roundtables on emergency disease preparedness.
2. A cooperative agreement with the American Veterinary Medical Association.
3. A North American Foot and Mouth Disease Vaccine Bank between Mexico, Canada, and the United States has been maintained.
4. A foreign animal disease international test exercise was carried out between the Western Region of USDA-APHIS and Agriculture Canada. The location included Montana and Alberta and a Foot and Mouth Disease Model was used.
5. Two foreign animal disease diagnosticians courses were held.
6. A foreign animal disease threats and implications course was held for managers.
7. A Plum Island foreign animal disease workshop was held.
8. A wildlife diseases and foreign animal disease course in Athens, Georgia was held.

DISASTER PREPAREDNESS

Mr. Eric Sakach, Investigator, West Coast Regional Office, The Humane Society of the United States presented a paper titled "Preparing for Disasters: The New Cooperation Among Human Societies, Animal Control Agencies, and Veterinary Groups." Mr. Sakach explained how historically disaster preparedness plans had not taken companion animals or livestock into consideration. Fortunately irrational fears and presumptions are being replaced by knowledge and experience. The problem of what to do with pets and livestock must be taken seriously and addressed in detail. Mr. Sakach reminded us that the key to dealing with most of these issues is in planning and preparation. While there is no question that human rescue and relief efforts must always come first, it is clear that the evacuation, rescue, confinement, veterinary care, and ultimate disposition of animals are emergency functions that must be an integral part of any disaster planning. Local human societies, veterinarians, and governmental animal control agencies in particular provide services which are deemed essential and, as such, must be prepared to operate even in case of catastrophic emergency or disaster. Each of these groups share common goals and collectively should know more about delivering animal services than anyone else in their jurisdiction. Communication and a spirit of teamwork among all these groups is especially important.
REPORT OF THE COMMITTEE

Dr. Richard E. Breitmeyer, Assistant Director, Division of Animal Industry, State Veterinarian, California Department of Food and Agriculture gave a presentation titled "California's Response to Disaster Preparedness." Dr. Breitmeyer reviewed the resources available to the Division of Animal Industry and stated that their response to emergency disease programs was their most important priority and the reason for their general fund money that supports their division. He stated it was very important to have an excellent working relationship with state and federal regulatory officials along with the animal industries. It is also extremely important to work cooperatively with other state and federal agencies and departments. Dr. Breitmeyer reviewed the newly created disaster preparedness plans established by the California Veterinary Medical Association. He stated this was a grass roots organization with the local veterinary medical associations with each county having a veterinary coordinator. Dr. Breitmeyer stated the California Veterinary Medical Association has developed a disaster response resource guide that would be beneficial for any state establishing a disaster preparedness program. The Committee encourages other states to obtain this guide for their use.

Dr. Arthur V. Tennyson, Director, Membership and Field Services, American Veterinary Medical Association, gave an overview of the American Veterinary Medical Association's Emergency Preparedness Plan and discussed how it will be implemented. The American Veterinary Medical Association has prepared an emergency preparedness plan in cooperation with the U.S. Department of Health and Human Services and the U.S. Department of Agriculture. The plan provides for the use of veterinarians' skills and knowledge in response to major and minor disasters and emergencies in concert with cooperating agencies and organizations. A Memorandum of Understanding has been signed between the American Veterinary Medical Association and the U.S. Public Health Service and a similar agreement is now undergoing administrative and legal review in the Department of Agriculture.

The agreement with the Public Health Service will integrate veterinary relief efforts into the National Disaster Medical System, part of the Federal Response Plan for disaster relief. Trained veterinarians, veterinary technicians, and support personnel will function as Veterinary Medical Assistance Teams that are component parts of the National Disaster Medical System. They will operate in the field in the same manner as the Disaster Medical Assistance Teams that are comprised of physicians, nurses, dentists, and other human health professionals to care for human medical needs. The American Veterinary Medical Association Emergency Preparedness Plan provides a structured basis for integrating veterinarians into disaster relief plans at the federal level that can be adapted to the state level organizations to provide continuity of operations as relief efforts evolve. It is flexible and responsive. The American Veterinary Medical Association
EPIZOOTIC ATTACK

is preparing an emergency response guide that will describe the plan and provide resource information for participants.

Dr. John L. Williams, Senior Staff Veterinarian, USDA, APHIS, VS gave a presentation on Animal Health Emergency Preparedness. Dr. Williams stated there are two animal health emergency preparedness concerns – Exotic Animal Diseases and Technological or Natural Disasters. There are currently approximately 250 foreign animal disease diagnosticians stationed throughout the United States. If an exotic animal disease is diagnosed, a Regional Emergency Animal Disease Eradication Organization (READEO) is activated. Dr. Williams described the current READEO structure and stated that several Memorandums of Understanding between USDA and other agencies and departments are in existence to provide resources, if needed, in the event of an emergency. Dr. Williams explained how the Federal Emergency Management Agency (FEMA) has the responsibility for developing and maintaining the federal response plan and implementing the federal response at the national level for technological or national disasters.

Dr. Walter D. Felker, State Veterinarian, Iowa discussed the livestock and animal problems associated with the 1993 Iowa flood. Estimates of losses of livestock directly associated with the flood has not been a large figure; however, he was not aware that an accurate figure has been determined. Damage estimates and other losses are still being submitted and evaluated. In most cases the flooding was predicted and livestock producers were given sufficient notice to remove livestock from potential problem areas. There were losses due to prolonged and inefficient feeding of cattle, swine, and sheep because of wet and muddy yards, interrupted feeding schedules, and poor quality feedstuffs. The bottom line that the death of livestock due to the flooding was not great; however, there were substantial losses due to the abnormally cool and wet weather.

FREE TRADE NEGOTIATION ISSUES

Dr. Dan J. Sheesley, Director, Trade Support Team, USDA, APHIS, International Services presented an overview of USDA, APHIS, International Services' need to devote specialized individuals to the agency's International Services Group. APHIS formed the trade support team which is a small group but with each individual having an area of expertise. The trade support team was established in order for APHIS to defend import regulations in effect to protect animal health. Dr. Sheesley reviewed the purpose of the North American Free Trade Agreement which is to eliminate tariff and non-tariff barriers to trade and provided attendees with a handout titled "NAFTA Dispute Settlement Procedures" and a second handout describing and discussing regionalization.
REPORT OF THE COMMITTEE

RESOLUTIONS

The Committee received a proposed resolution from the Foreign Animal Disease Committee concerning APHIS Foreign Animal Disease Program. A motion was made to co-sponsor adoption of the resolution with the Foreign Animal Disease Committee. After discussion, the resolution was adopted with minor technical amendments and sent back to the foreign Animal Disease Committee which will present the resolution to the Resolution Committee.

EMERGENCY PROGRAMS REPORT
Dr. Adam Grow, USDA, APHIS, VS, EP

Foreign Animal Disease Surveillance and Laboratory Coordination

During fiscal year (FY) 1993, October 1, 1992, through September 30, 1993, veterinarians from the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) and the States conducted 299 investigations for suspected foreign animal diseases (FAD). These actions are part of the Emergency Programs approach to foreign animal disease surveillance to insure that exotic diseases do not become established in the United States or it's territories. The investigations included 72 (24%) vesicular conditions, 33 (11%) mucosal disease conditions, 124 (41%) avian diseases, 14 (5%) swine septicemic conditions, 29 (10%) encephalitic conditions, and 27 (9%) screwworm, exotic ticks, or other disease conditions.

Emergency Preparedness and Response

State Emergency Boards and APHIS Emergency Preparedness: Emergency Programs, Veterinary Services is the designated Animal and Plant Health Inspection Service (APHIS) representative to the United States Department of Agriculture's (USDA) Emergency Preparedness Program for defense and natural disasters with the Federal Emergency Management Administration (FEMA). Emergency Programs coordinates with all APHIS Units to insure that emergencies and disasters are responded to promptly. The roster of APHIS representatives to USDA State Emergency Boards and State Food and Agriculture councils was updated. In addition, Emergency Programs supported the USDA Emergency Coordinator and participated in four Regional training conferences in 1993. The purpose of the conferences was to update the State Emergency Boards (SEB) members and to emphasize their emergency preparedness responsibilities. The SEB is a group of trained USDA Agency emergency personnel in each State prepared to respond to any emergency or disaster in their respective State. Emergency Programs met with all APHIS personnel attending the conferences to ensure that they were aware of, and understood their responsibilities as a member of the SEB. The interim edition of the
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Emergency Operations Handbook for USDA Emergency Personnel and the Departmental Emergency Programs Responsibilities Manual were also reviewed.

The USDA–Industry Roundtable met December, 1992, in Washington, D.C. and in Hyattsville, Maryland in June, 1993. Major areas discussed were ways to enhance livestock industry emergency preparedness, the organization of the READEOs and how the livestock industry will function in these units.

An agreement has been made with the American Veterinary Medical Association (AVMA) for a Memorandum of Understanding to establish a mechanism for cooperation during an animal health emergency. The AVMA can provide veterinarians and animal health technicians during an emergency to assist APHIS.

North American Foot-and-Mouth Disease Vaccine Bank (NAFMDB): Only one meeting of NAFMDB was held in FY 1993, and this was done in conjunction with the USAHA annual meeting in Louisville, Kentucky. The representatives from Canada, Mexico and the United States discussed the procurement of additional types of FMD antigen and potential sources of other exotic animal disease vaccines.

Regional Emergency Animal Disease Eradication Organization (READEO): Federal and State animal health officials participated in a week-long READEO workshop held in Englewood, Colorado. READEO officers reviewed rosters for all officers and the field personnel assigned to each section. The new READ1 System 3 and the revised Veterinary Services Form 12–27 were also reviewed.

READEO Exercise: Emergency Programs and Agriculture Canada conducted an 6-day international READEO exercise that simulated a foot-and-mouth disease outbreak in Montana and Alberta, Canada, during August. The VS Western READEO and the Alberta Regional Emergency Response Team were activated simultaneously with task forces being located at Great Falls, MT and Lethbridge, Alberta. The cattle, swine, and livestock marketing industry were actively involved in the planning and execution of the exercise. This was the first international and the third consecutive national exercise which Emergency Programs has conducted to test and strengthen APHIS’s response capabilities to potential outbreaks of emergency animal disease in the United States.

Advisory Committee on Foreign Animal and Poultry Diseases: One Committee meeting was held June 29–July 1, 1993, in Laurel, Maryland, and attended by 18 members. This Committee advises the Secretary on the means to prevent, suppress, control, or eradicate an outbreak of foot-and-mouth disease (FMD) or other destructive foreign animal or poultry diseases should such diseases enter the United States. Committee duties involve advising and counseling on policy and regulatory action pertaining to dealing with an outbreak, changing practices in the production and marketing of
animals, the importation of animals and animal products, and the handling and treatment of unusual, suspicious animal or poultry disease problems. Sixteen comments or recommendations were made by the Committee. At least one meeting of the Committee will be held in fiscal year 1994.

Emergency Field Operations and Resource Planning

Representatives from various units of APHIS participated in meetings with the Mid-Atlantic Cooperative Extension. The main topic was understanding emergency poultry diseases. The purpose was to acquaint non-commercial poultry industry with emergency diseases, bio-security to reduce incidence of these diseases, and to express concerns, raise issues, and make recommendations to State and Federal regulatory officials.

Biosecurity and Foreign Animal Disease Threats Exhibits: Emergency Programs Staffed the Veterinary Services Biosecurity and Foreign Animal Diseases Awareness exhibit at the 1993 the International Poultry Exposition in Atlanta, Georgia. These exhibit included printed information brochures about many foreign animal disease, videos on "Farm and Ranch Bio-security," and the video program, "Foreign Animal Diseases You can Make a Difference." The latter video was prepared to inform visitors to the United States of methods by which foreign animal diseases may be introduced and procedures to follow to prevent their introduction.

Exotic Newcastle Disease Awareness: Regional APHIS press releases were issued warning the bird-owning public of the dangers of buying or selling smuggled birds. Emergency Programs is continuing efforts to use alternative initiatives to get this important information to bird owners, dealers, and the public in order to maintain and increase their awareness on the threat of exotic Newcastle disease in pet birds and poultry.

Dr. Dale Boyle, COL, U.S. Army, Veterinary Medical Corps, was designated the Military Liaison Officer for Emergency Programs on June 24, 1993. COL Boyle replaced COL Phillip Debok who retired in June.

Foreign and Exotic Animal Disease Information Technology

Foreign Animal Disease Diagnosticians Training: Two Foreign Animal Disease Diagnosticians (FADD) training courses were conducted in 1993. The first course was held in March and the other in May, with each course being two weeks in length. The first week is at the National Veterinary Services Laboratories, Ames, Iowa, and focuses on, bio-security procedures, exotic avian diseases and disease investigation techniques. The second week is at the Foreign Animal Disease Diagnostic Laboratory, Plum Island Animal Disease Center, Orient Point, New York. It centers on in–depth information about exotic animal diseases in ruminants, equine and swine. Forty Federal, State, and International Veterinary Medical Officers achieve FADD status from this training.

Emergency Programs Military Training: In September, military
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Veterinarians participated in a program to enhance APHIS's response to emergency animal disease outbreaks. This program is part of a memorandum of understanding that was consummated in 1965 between the United States Department of Agriculture and the Department of Defense. If there were an incursion of an emergency disease, these military veterinarians would be available to aid in eliminating outbreaks of exotic or emergency animal diseases.

Foreign Animal Disease, Threats and Implications Course: The course entitled Foreign Animal Disease, Threats and Implications was held in Laurel, Maryland, during June. The course is designed to provide Federal and State animal health officials, Staff officers, veterinarians, and other interested persons with specific information about exotic animal diseases, disease control concepts, and the potential economic treats to the U.S. poultry, livestock, and wildlife populations. A second course was held in Houston, Texas during the last week in August. This course was a special course for Texas State Veterinary Medical Officers.

Foreign Animal Disease Workshop for Professors and Diagnosticians: Emergency Programs and the Foreign Animal Disease Diagnostic Laboratory (FADDL) at Plum Island, New York, presented this annual workshop for teachers of infectious diseases and veterinary laboratory diagnosticians in November, 1992. This program provides participants with the opportunity to observe clinical signs and pathology for many of the exotic diseases found outside the U.S. The goal of the course are to enhance awareness of exotic diseases and increase the reporting of specific disease conditions for VS foreign animal disease surveillance activities. Twenty veterinarians attended the workshop.

Wildlife Seminar for FADD: The Wildlife Seminar for FADD's was held during July at the University of Georgia, Athens, Georgia. This annual seminar is sponsored by the Southeastern Cooperative Wildlife Disease Study in collaboration with Emergency Programs. The program familiarizes participants with wildlife management concepts and reviews diseases of wildlife in North America that have the potential to involve domestic livestock and poultry. Thirty Federal and State FADD's attended this course.

Special Lectures on FAD: Emergency Programs Staff Veterinarians presented lectures on foreign animal diseases to students and faculty at the Colleges of Veterinary Medicine at the University of California – Davis, University of Minnesota, and Michigan State University.

Animal Disease Management Information Center (ADMIC)

ADMIC, which is an entity of the Emergency Programs Information Center, was established in 1972. It provides a high-speed information system for the delivery of up-to-date scientific and technical information. Information Center services are primarily for use by Federal and State personnel who are engaged in the control and eradication of emergency...
animal diseases in the United States. ADMIC literature files are comprised of more than 72,000 articles on microfilm and 3,000 articles on optical disk in English. The literature resource articles pertain to 44 diseases and 6 other items concerning entomology and non–disease subjects.

Three issues of the Foreign Animal Disease Report (FADR) were published in 1993, and over 25,000 copies of each issue were distributed worldwide. The quarterly publication regularly features articles on field investigations of suspected exotic disease incursions into the United States and outbreaks of foreign animal disease elsewhere in the world. This year the FADR featured articles on regionalization and risk analysis, foot-and-mouth disease in Italy and Hong Kong, swine vesicular disease in Spain, Venezuelan equine encephalomyelitis in Mexico, duck plague, avian influenza in ratites, bovine spongiform encephalopathy, screwworm, velogenic neurotropic Newcastle disease, viral hemorrhagic disease in rabbits, Amblyomma variegatum in the Caribbean, and significant diseases of Somalia, East Africa. The FADR enables Emergency Programs to economically maintain current awareness of more than 250 FADDs, other veterinary diagnosticians, regulatory officials, and the animal owning public, of the threat of foreign animal diseases to American livestock, poultry, and wildlife.

UPDATE ON NORTH AMERICAN FREE TRADE AGREEMENT (NAFTA) AND TRADE RELATED ANIMAL HEALTH ISSUES

Dr. Dan Sheesly
Trade Support Team
USDA, APHIS, International Services

TRADE IN LIVESTOCK/ANIMAL PRODUCTS

Trade Increases With or Without NAFTA

Over the past five years there has been a steady increase in the trade of agricultural products with other countries. Consumers in many countries are demanding that fresh fruits, vegetables, meats and other products be available year round. Foreign livestock industries seek to develop hardy livestock breeds through imported genetic stock, semen and embryos.

From a regulatory standpoint, NAFTA does not change the health of agricultural commodities of their enterability into the U.S. These products that have not or do not meet our health requirements will not be allowed entry because of NAFTA. The basis for regulating or prohibiting agricultural commodities remains the same with or without NAFTA.

We do not predict an immediate surge of imports because quotas and tariffs are eliminated gradually over time. Furthermore, we already have
been managing an increasing trend in Mexican agricultural commodities coming into the U.S. over the past 5 years and have already made many of our adjustments to this new level of trade. We are not concerned that in January if NAFTA is passed that we will be inundated with produce or other agricultural commodities that will stress our inspection capabilities.

Any increase of new agricultural commodities will be linked to new regulations that have been developed and which determine the safety for such entry. It is in the development of new regulations, allowing for new products, previously restricted for health reasons, where APHIS begins to consider the question of inspection issues and needs.

APHIS' inspection resources are mobile. We are prepared to shift our resources to areas we believe, on empirical and scientific grounds, present high risk areas of entry or crucial pest pathways. We have systems in place that give us solid information on pest interceptions (such as where these are occurring and associated with what commodities) and changes in import flows and patterns. We are prepared to move our inspectors to the high risk border points.

NORTH AMERICAN FREE TRADE AGREEMENT (NAFTA)

Key NAFTA Sanitary Provisions

• In general, APHIS is satisfied that NAFTA provisions will advance U.S. export interests as well as preserve our ability to maintain import standards and requirements essential for protecting the health of U.S. agriculture. APHIS has always tried to promote transparent, scientifically based regulations. This agreement finally commits the United States, Mexico, and Canada to such principles.

• A common misperception of the agreement is that it will open the borders and allow the free movement of commodities between our countries including agricultural pests and diseases. This is a fallacious perception. The language in the agreement clearly preserves our right, as well as Canada's and Mexico's, to maintain and implement measures necessary to protect the health of our livestock and crops as long as these requirements have a scientific basis.

• APHIS has for a long time promoted the use of sound science as the only reasonable basis for prohibiting or restricting the entry of high risk agricultural commodities. Regulations based on scientific risk assessments will ensure against arbitrary trade disruptions caused by unfair requirements. NAFTA enshrines these principles.

• Dispute Settlement Mechanisms: Importing countries occasionally
REPORT OF THE COMMITTEE

institute disruptive changes in their animal or plant health requirements. These regulatory changes are not always transparent, often with minimal advance notice, and often unclear as to how and why they are being implemented. This sometimes causes major disruptions for U.S. exporters. APHIS has spent a great deal of time and energy in trying to negotiate through some of these sudden, arbitrary changes in other countries' import policies and requirements. NAFTA will allow us to more effectively challenge these unjustified restrictions.

- Regionalization: NAFTA puts us squarely on a path toward implementing regionalization, or recognizing pest and disease free areas. APHIS believes that large countries, such as the United States, where there is a great differences in climatic and pest and disease conditions will benefit greatly from the regionalization of pest or diseases.

APHIS is currently working through international standards organizations, such as the OIE, to develop an approach for effectively and safely implementing concepts such as regionalization, risk assessment, surveillance, and monitoring systems. In particular, we intend to work with the OIE to develop internationally accepted standards for assessing another country's animal health infrastructure. We need detailed criteria for assessing other countries' veterinary services in order to verify disease free area claims and assure importing countries that the integrity of those areas is adequately maintained. Similar issues in the plant health area are being addressed through NAPPO, our relevant regional plant health organization.

Current Status of Agreement

In September, the Administration reached agreement with Mexico and Canada on NAFTA side agreements which address environmental, labor, and import surge issues.

The Administration hopes to present the entire NAFTA package, including the main agreement (signed 12–17–92 by the Presidents), Statement of Administrative Action, and the Implementing Legislation to Congress by November 1. Under the Fast Track provisions, Congress can only vote up or down. If the agreement reaches Congress by the 1st of November and Congress approves it, NAFTA could go into effect by January 1994.

Most if not all of the current negotiations regarding NAFTA are focused on the Implementing Legislation portion of the package. Various agencies are looking existing statutes and deciding how they must be changed to fit the NAFTA.
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The Statement of Administrative Action is an interpretive guide to the agreement. It outlines the Administration's intent with regard to each of the points within the agreement.

GENERAL AGREEMENT ON TARIFFS AND TRADE (GATT)

Background

The traditional aim of the General Agreement on Tariffs and Trade (GATT), since its inception in 1947, has been to reduce tariffs. New rounds of negotiations have taken place over the years in which member countries have tried to strengthen GATT guidelines. The current round of negotiations, begun in 1986 and known as the Uruguay Round, is seeking to extend international rules to cover agricultural trade, services, textile trade, intellectual property rights, dispute settlement, enforcement measures, and other global trade concerns.

From the start of the current Round, the United States and the European Community (EC) have disagreed about the manner and extent to which agricultural trade should be liberalized. A basic disagreement has been over the pace and depth of phasing out government subsidies that distort agricultural trade. The U.S. position, supported by a number of other major trading countries, has been to seek, on a mutual basis, large cuts in government farm supports which affect trade. The EC position, driven by the vocal and powerful demands of the French farming block, has been to resist such reform. This difference led to the temporary suspension of negotiations in 1991 and continues to be a sore point in current trade disputes with the EC.

The EC has also been insistent on the inclusion of a non-scientific factor to the S&P text, such as animal welfare, consumer concerns, etc.

Current Status

The Administration has stated that completing the current GATT round is a top priority. In July, Congress granted the President a 6-month renewal of his "fast track" authority--necessary to complete GATT negotiations. Under fast track authority, the Congress can only vote up or down on the entire agreement, under a certain timeframe, and not add amendments. Under the current 6-month fast track authority, the President would be required to submit a draft of the GATT agreement to Congress by December 15. Congress would have 90 days to review it. The President would have until April 15, 1994 to submit a final GATT text complete with implementing legislation.

GATT negotiations over the next few months are likely to continue at an accelerated pace. U.S. negotiators intend to discuss tariff reduction offers and schedules with the EC. During this time, USDA negotiators have and will continue to meet with representatives from and several countries to
discuss various GATT texts and ways to revise them to make them "greener" or more sensitive to consumer and environmental groups.

Some trade experts believe that failure at GATT may boost the emergence of regional, inward looking trade blocs in which members lower trade barriers for one another but not for anyone else. Although the EC and the still unratified NAFTA are not structured as protectionist blocs, without a functioning GATT system they could become more exclusionary. Other countries may respond by forming their own blocs or attach themselves to the existing ones (e.g., Asian trade block and an EC–North Africa trade agreement).

REGIONALIZATION

NAFTA and the GATT, when ratified, commit signatory countries to recognizing disease- and pest-free zones and regions within and across countries. For the United States, this means that countries will no longer be able to justify banning U.S.–wide agricultural imports into their country, due to an isolated U.S. disease or pest outbreak. Similarly, signatory countries previously banned from U.S. markets due to the presence of diseases or pests within their country will be allowed to export to the U.S. market from areas designated as being disease-free.

Benefits to U.S. Livestock Trade

- Regionalization presents significant trade opportunities for countries, like the United States, with great ecological and disease variations. It will be particularly helpful in promoting and maintaining a country's exports when isolated, containable disease or pest outbreaks occur.

- Regionalization is likely to create new opportunities for the United States and other countries to export from areas which are demonstrated to be free of particular diseases or pests even though those diseases of concern may exist elsewhere within its national territory. The greatest benefit of regionalization to U.S. livestock (including meat) trade may be in preserving existing foreign markets and softening the adverse trade impacts when a disease outbreak does occur in the United States.

- While the trade opportunities created by regionalization will be available to all countries which are a party to the GATT or NAFTA agreements, our advanced animal and plant health infrastructure, including our surveillance systems and quarantine and regulatory controls, give the United States a decided advantages in establishing trustworthy and effective disease-free zones.
The reliability of the U.S. agricultural health infrastructure increases the likelihood that countries will accept USDA assurances that specific areas or regions in the United States continue to be safe from sanitary standpoint even though a particular industry may be experiencing a certain disease outbreak in another part of the country.

**Update on APHIS' Regionalization Strategy**

Basic to APHIS' regionalization strategy is the development of risk factors such as pest and disease status and the adequacy of other countries' animal and plant health infrastructure. Quality and credibility of systems used to collect and substantiate that health information will be crucial for determining the success of a country's export trade.

Health data and information must be trustworthy. However, trust can only be established and maintained through verification. Assessments of infrastructure and ongoing pest and disease monitoring activities will be crucial for the verification process.

Over the past year, APHIS has made great strides in developing draft criteria and standards for assessing disease free areas. These standards include standards for assessing an exporting country's veterinary infrastructure, surveillance systems, and other risk factors necessary for determining the risk profile of a given area or zone.

APHIS draft regionalization/risk assessment criteria are still in a developmental stage. Action will be required on a number of other fronts before these becomes an acceptable and operationally feasible. The following action will be required:

**Need for Internationally Accepted Standards**

The Agency is working through the Office of International Epizootics (OIE) to develop internationally consistent regionalization principles, particularly risk assessment, veterinary services, surveillance, and monitoring systems. APHIS believes that trading countries need to harmonize their regionalization principles to ensure consistency, fairness, and credibility.

To this end, in May 1993 the OIE Commission approved and codified the following interconnected concepts:

- Regionalization
- Risk Assessment
- Assessment of Veterinary Services

Even though the OIE swiftly approved and adopted these far reaching concepts, the more difficult task of converting these concepts into detailed criteria and building consensus still remains. Also, there remains a fourth concept which needs further elaboration---surveillance and monitoring
standards (criteria is needed for assessing and ranking the quality of these activities). APHIS has agreed to draft and present to the OIE this fourth element.

USDA Commitments with the EC

As a result of a December 1992 agreement between USDA and the EC, USDA committed itself to recognizing and eventually implementing the concept of regionalization in the animal health area. According to language in the agreement, APHIS must demonstrate good faith efforts in amending its regulations and legislation and taking other actions necessary for adopting regionalization into policy and practice. According to the agreement, these activities should be underway by December 1993.

Until the 1930 Tariff Act is changed, APHIS is limited in its ability to recognize disease-free zones within countries. Amendments to the 1930 Tariff Act had been drafted as part of the process of preparing implementing legislation for NAFTA. As drafted, the amended Act would allow for recognition of free zones within FMD or rinderpest infected countries. However, it is unclear whether the NAFTA implementing legislation will be broad enough to allow for the recognition of disease free areas in countries other than Mexico and Canada.

If the opportunity of using the NAFTA process for amending the 1930 Tariff Act—in a way to meet our obligations—diminishes, the Agency will explore other options. It is clear, however, that failure to actively pursue and make changes to the 1930 Tariff Act could threaten USDA's December 1992 agreement in which the U.S. wrought important meat export concessions from the EC.

NAFTA Dispute Settlement Procedures

1. Consultations at a technical level occur first between disputing countries.

2. If no resolution at technical consultation level is achieved with 30, 45, or 15 days (depends on issue), complaining party requests the Free Trade Commission (a trilateral cabinet level group) to address issue.

   Commission may call on technical experts or organizations with relevant input on which to base its evaluation of the issue and to make recommendations.

3. If matter is not resolved by Commission within 30 days, complaining party may request establishment of "arbitral panel."

   Panelist are chosen from existing rosters. Roster includes 30 individuals placed on roster for 3 year terms by mutual agreement of parties.

   Panel shall include 5 members.

   Parties agree on panel chair, could be individual from non-NAFTA country if agreeable to Parties.
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Panelists are chosen from roster by consensus or by lot if necessary.

Commission will establish rules of procedures in accordance with principles (e.g., right of parties to hearings and rebuttals) already outlined in the Agreement.

4. Panels can (a) make findings of fact, (b) make determinations, and (c) make recommendations.

5. Panels can seek technical advice from any person or body (including OIE, IPPC, or other expert or scientific organization) as long as Parties agree.

6. Panel can form "scientific board" of independent experts on subject.

7. Disputing Parties will have opportunity and right to comment to the Panel on matters of fact.

8. Panel will take into account report from the scientific board as well as comments from the Parties.

9. Panel will present final report to Parties within 90 days. Report can include:
   a. findings
   b. determination of whether measure subject to dispute is consistent or not with agreement
   c. recommendations

10. Panel will present final report within 30 days to Parties.

11. Disputing Parties will present Panel's final report (plus any report from the scientific board) to the Commission.

12. Commission will publish report.

13. Based on Panel report, Parties will try to agree on a resolution. Whenever possible, such resolution shall be non-implementation or removal of measure found to be inconsistent or in violation of the Agreement.

14. If resolution is not reached by the disputing Parties, complaining party may suspend some benefit to the violating Party (in same sector). This would be an opportunity for retaliation in kind.

Source: Distilled from NAFTA Chapter 20: Institutional Arrangements and Dispute Settlement Procedures
INTRODUCTION

Risk assessment has become an important discipline in the last 20 years. Risks are a naturally occurring feature of life. Modern technology has managed to reduce some risks while creating other risks. Regulatory officials in many government agencies have been forced to assume increasing responsibilities for managing highly complex situations involving risk. The field of risk assessment originated from the need to effectively evaluate and manage risk.

Risk assessment has been a rapidly developing applied scientific field that has become well established and documented in the United States during the past decade. In 1983, the National Research Council of the National Academy of Sciences (NAS) produced an excellent summary text entitled Risk Assessment in the Federal Government: Managing the Process which effectively described risk assessment. This important publication states the value of risk assessment and describes the necessary components of risk assessments. The NAS publication addresses risk assessment for chemicals and has become a vital foundation document in the field of risk assessment.

Risk assessment has greatly expanded the scope of its application to many fields over the past two decades. It has been used in many different applied scientific areas including environmental health, occupational health, and engineering. Federal agencies have effectively used risk assessment in different regulatory applications. For example, an effective use for risk assessment in the public sector has been for the assessment of the human health risk associated with exposure to various chemicals in the environment.

Risk assessment is a complex formal process which organizes and interprets scientific information. It includes the acknowledgment and documentation of uncertainties; the estimation of the risk for specific scenarios; and the presentation of findings in concise, organized formats to facilitate informed decision making. This formal scientific process provides a sound foundation for management decisions. In addition, risk assessment provides a strong basis for effective communication about regulatory decisions to the parties interested in the risk estimates and the techniques employed to produce the estimates.
AN OVERVIEW OF RISK ASSESSMENT

DEFINITION OF TERMS

Risk assessment techniques have been widely adapted for use in many fields and the discipline is dynamic. The terminology is not standardized at the present time. Nevertheless, it is necessary to understand the meaning of some general terms. The Food Safety and Inspection Service (FSIS) of the United States Department of Agriculture is currently in the process of adapting certain common terms used in the field of risk assessment and risk analysis for use in the FSIS. These definitions have not been finalized. The FSIS and many of the other agencies that are actively developing and using risk analysis have chosen to follow the general usage of terms as defined in the NAS risk analysis publications and adapt them to their application areas. The following definitions were provided in the 1989 NAS book *Improving Risk Communication.*

**Hazard:**
"An act or phenomenon posing potential harm to some person(s) or thing(s); the magnitude of the hazard is the amount of harm that might result, including the seriousness and the number of people exposed."

**Risk:**
"Adds to the hazard and its magnitude the probability that the potential harm or undesirable consequence will be realized."

**Risk Assessment:**
"The characterization of potential adverse effects of exposures to hazards; includes estimates of risk and of uncertainties in measurements, analytical techniques, and interpretive models; quantitative risk assessment characterizes the risk in numerical representations."

**Risk Management:**
"The evaluation of alternative risk control actions, selection among them (including doing nothing), and their implementation; the responsible individual or office (risk manager) sometimes oversees preparation of risk assessments, risk control assessments, and risk messages."

**Risk Communication:**
"An interactive process of exchange of information and opinion among individuals, groups, and institutions; often involves multiple messages about the nature of risk or expressing concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management."
In the FSIS, the term Risk Analysis is used as an inclusive term for three components: risk assessment, risk management, and risk communication. Risk assessment is the scientific process of gathering and interpreting data and information and then preparing detailed risk characterizations with estimations of risk. Risk management is the phase which includes the consideration of the scientific risk assessment with information about the related social, economic, and political factors. It includes the selection and the implementation of an appropriate management option. Risk communication is the process of sharing information about the scientific risk assessment, the management decision, and related concerns with interested parties in open two-way communication. Although risk management and risk communication are vital components of the complete risk analysis picture, we will now focus on risk assessment, the foundation for risk analysis.

RISK ASSESSMENT

Risk assessment is a specific scientific approach for interpreting data and information to characterize and estimate potential adverse effects from exposure to a hazard. The NAS firmly established that a risk assessment includes four definitive components. These components are: hazard identification, dose-response assessment, exposure assessment, and risk characterization. The following descriptions of the components were provided in the 1983 NAS book about chemical risk assessment:

Hazard Identification:
"The determination of whether a particular chemical is or is not causally linked to particular health effects."

Dose-Response Assessment:
"The determination of the relation between the magnitude of exposure and the probability of occurrence of the health effects in question."

Exposure Assessment:
"The determination of the extent of human exposure before or after application of regulatory controls."

Risk Characterization:
"The description of the nature and often the magnitude of human risk, including attendant uncertainty."

Although these definitions address risk assessment for chemical hazards, the four components of risk assessment are readily applicable to other types of hazards.

The NAS stressed the importance of conducting risk assessment separately from making risk management decisions. In the 1983 text, the NAS stated that "scientific findings and policy judgements embodied in risk
AN OVERVIEW OF RISK ASSESSMENT

assessments should be explicitly distinguished from the political, economic, and technical considerations that influence the design and choice of regulatory strategies." Risk assessment should be performed independently from regulatory decision making to maintain high standards of scientific integrity in the risk assessment process. The division between risk assessment and risk management enhances the credibility of the individual risk assessments.

THE PERFORMANCE OF RISK ASSESSMENTS

Risk assessments are performed for specific described scenarios. First, the topics for the risk assessments must be clearly delineated. The topics must be quite specific, rather than global, to permit risk assessments to be performed. Then detailed scenarios appropriate for the specific potential hazards are developed. The described situations or scenarios must be both specific and comprehensive. If not, then the completed risk assessments will be inadequate for the proper estimation of the risks. Scientific data and other appropriate information are obtained, analyzed, and interpreted to produce estimates of the potential risk in each part of the risk scenarios.

Information is limited and sometimes continually increasing for any given hazard; therefore, there are unknowns and/or uncertainties in risk assessments. It is crucial that uncertainties related to each part of the scenarios be expressed in the risk estimates.

Finally, after the hazard identification, dose–response assessment, and exposure assessment phases are completed, then characterizations of the risk are prepared for each described situation. The completed risk assessments include both estimates of the risk and expressions of the associated uncertainties and unknowns.

Risk assessment should be a transparent and understandable process that is reflected in the resulting risk assessment documents. The data and information used in each risk assessment should be selected based on scientific acceptability and applicability to the particular risk scenario. The analysis and interpretation of the data and information must be performed by knowledgeable scientific professionals using high standards to produce credible risk assessments. The completed risk assessments should include references for the scientific data and information considered in the risk assessment, descriptions of the methodology employed, and explanations and justifications for the assumptions incorporated in the assessment.

CONCLUSION

The techniques of risk assessment are well established and have been successfully applied to assess the risk related to various hazards. However, the field of risk assessment has traditionally been applied to static
hazards such as chemicals. The application of the principles of risk assessment to biologic hazards that interact and multiply presents a new and interesting challenge. The field of risk assessment can significantly contribute in this arena. Risk assessment needs to be performed for many different types of scenarios and processes that include living organisms.

In the future, we should expect the development of the capability to perform credible scientific risk assessments for a wide spectrum of biologic, chemical, and physical hazards. The techniques of risk assessment should contribute new information that will be used in important management decisions to protect the environment, promote animal health, and enhance human health.

REFERENCES


Introduction

Food safety agencies face substantial regulatory challenges in the late 20th century. The public we serve frequently has unreachable expectations of food safety through regulatory action. Consumers sometimes desire a guarantee of absolute safety for food products. It is unfortunate that, given the current state of scientific knowledge, it is not possible to guarantee that a given food product is 100% free of biological, chemical, and physical hazards.

Some degree of risk is an inherent aspect of all elements of life. This basic biological principle applies to the consumption of food and water as well as to other activities. A major component of the job of food regulators is the regulation of food harvesting and processing to minimize the risks associated with foods. One of the challenges in food regulation is the estimation of risk. The recognition and estimation of risks are crucial to the ability to monitor changes and to recognize effective regulatory interventions.

One effective scientific method of estimating risk is risk assessment. The field of risk assessment has evolved from the need to effectively evaluate and manage risk.

The term Risk Analysis is an inclusive term for the components Risk Assessment, Risk Management, and Risk Communication. Risk assessment is the scientific component of compiling and interpreting data and information into detailed estimations of risk, including attached uncertainties. Risk management is the consideration of the risk assessment with information about associated social, economic, and political factors, and the selection and implementation of an appropriate management option. Risk communication is the process of sharing the scientific information, the management decision, and concerns with interested parties in open communication.

Definitions and Principles

It is vital to review the meaning of some basic risk analysis terms. The following definitions were provided in the 1989 book, Improving Risk Communication, published by the National Research Council of the National Academy of Sciences (NAS):
RISK ANALYSIS PRINCIPLES

Risk Assessment:
"The characterization of potential adverse effects of exposures to hazards; includes estimates of risk and of uncertainties in measurements, analytical techniques, and interpretive models; quantitative risk assessment characterizes the risk in numerical representations."

Risk Management:
"The evaluation of alternative risk control actions, selection among them (including doing nothing), and their implementation; the responsible individual or office (risk manager) sometimes oversees preparation of risk assessments, risk control assessments, and risk messages."

Risk Communication:
"An interactive process of exchange of information and opinion among individuals, groups, and institutions; often involves multiple messages about the nature of risk or expressing concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management."

To initiate risk analysis activities, regulators must begin with the performance of risk assessments. Risk assessments are performed for specific risks in specifically described scenarios. The risk situations must be detailed and clear in nature to allow the performance of the four steps of risk assessment: Hazard Identification, Dose–response Assessment, Exposure Assessment, and Risk Characterization. The process of scientific risk assessment is performed independently from regulatory decision making to maintain high standards of scientific integrity in the risk assessment process. Risk assessments are completed and documented to characterize and estimate the risks and the attached uncertainties.

The completed risk assessments become a major driving force in the risk management process. The challenge of risk management is to determine the optimal regulatory decisions for action, or inaction, based upon the scientific estimates of the risk and uncertainties in conjunction with the associated social, political, and resource constraints on the regulatory decision. Risk communication is the final but important component of the entire process of risk analysis. Scientists and managers use risk communication to acquire and share information and concerns about the risks and about the regulatory efforts related to the risks.

Food Safety Applications
Regulators have informally assessed the risks to human health associated with food products throughout the history of food regulation. Informal qualitative assessments of risks have always assisted managers in
making decisions. Recently, however, various components of formal risk assessment have been used by many of the Federal Agencies that regulate foods to protect public health in the United States.

Several agencies play important roles in protecting our food supply. The Food Safety and Inspection Service (FSIS) is responsible for the safety of red meat and poultry meat products. The FSIS has an extensive inspection system including carcass inspections, establishment inspections, and testing programs for residues and bacteria in products. The Agricultural Marketing Service (AMS) is responsible for egg grading. In addition, it performs residue testing for some produce. The Animal and Plant Health Inspection Service (APHIS) protects the health of animals and plants from diseases in its mission to protect American agriculture. The National Marine Fisheries Service (NMFS) conducts a limited voluntary inspection program for fish and shellfish. The Food and Drug Administration (FDA) is responsible for the safety of dairy products, produce, and other food products.

The use of risk assessment has gradually expanded to the field of food safety. Some of the components of risk assessment have been used by some food regulatory agencies to perform partial risk assessments. This relatively new application for the techniques of risk assessment has built upon the firm foundation developed from its application in other areas of public health.

EPA

The Environmental Protection Agency (EPA) regulates the use of pesticides in the United States. In addition, the EPA determines the amounts of pesticide residues that are allowed to remain in both animal feeds and in human foods (including meat and poultry). The Agency utilizes some of the traditional components of risk assessment in making these decisions.

Information about a pesticide is evaluated to determine its toxicity to humans. Potency is then evaluated by performing a dose–response assessment. Management policy for carcinogen regulation is based on "negligible risk" under the assumption that all exposures involve risk (i.e. no threshold). A "safety factor" management approach is used for non–carcinogens. The highest dosage is determined for which no significant adverse effect in animals was observed. This dose is called the No Observable Effect Level (NOEL). An uncertainty factor, often 100, is incorporated in establishing the Reference Dose because extrapolations have been made from animal toxicity to human toxicity. The dose–response assessment and exposure assessment are then used to characterize the risk. The EPA approaches incorporate risk policies in the risk assessment process.
RISK ANALYSIS PRINCIPLES

FDA
The FDA is the agency responsible for the safety of a broad spectrum of foods and food additives including dairy products, produce, food and color additives, and various other food products. The Agency also determines the violative level of residues (thus in converse, the allowable residue levels) for animal drugs and recommends actionable levels for environmental contaminants in foods of animal origin. The FDA has utilized some of the components of risk assessment in its food safety program. The Agency uses risk assessment techniques for compounds that are not covered by the Delaney Clause. Thus, the FDA utilizes some components of risk assessment for contaminants, impurities, and animal drug residues. The FDA extrapolates from toxicity data for compounds in animals to make inferences about the potential toxicity of these compounds to humans.

APHIS
The APHIS is responsible for the protection of animals and plants from exotic diseases. Some of these animal diseases are caused by zoonotic, and potentially foodborne, pathogens. Although the APHIS does not currently perform direct food safety regulatory functions, it indirectly assists in human food safety by protecting our animal populations from disease. For example, the APHIS has become the lead agency in the preharvest control of *Salmonella enteritidis* (a zoonotic pathogen) in laying chickens.

The APHIS has been actively developing a risk assessment/ risk analysis program for approximately three years. Risk assessment is beginning to be utilized to assess the risk to agriculture in the United States of the importation of animals, plants, and their products. The Agency has also applied some components of the techniques of risk analysis to assist in the management of the food safety concern of *Salmonella enteritidis* in layers.

FSIS
The FSIS is responsible for the safety of most of the foods of animal origin. These include red meat and poultry meat in addition to a broad array of processed products and convenience foods which contain meat as approximately 2% or more of their ingredients. Foods of animal origin are a special public health concern as a result of both zoonotic pathogens and the administration of approved compounds to animals which may leave unsafe residues in meat products.

The Agency informally assesses risk and makes management decisions about the efficacy of procedures to control risks. On occasion, the FSIS has used the results of quantitative risk assessments that were requested by the Agency for certain chemical contaminants. The FSIS has been utilizing some components of qualitative risk assessment in its National
Residue Program for many years. The Agency conducts an extensive multi-
million dollar program to test for pesticides and drugs in meats. The
Compound Evaluation System was developed in 1985 to provide a
systematic method for qualitatively ranking compounds for residue health
risks. A compound is evaluated to determine whether it may cause a meat
residue or residues. If the potential for a residue exists, then the compound
is categorized and a qualitative compound assessment and ranking is
performed.

FSIS Risk Assessment Initiative

The FSIS has initiated the development and implementation of a risk
assessment/risk analysis program. In 1985, the NAS recommended that the
FSIS adopt formal quantitative risk assessment in Agency decision making
to increase the scientific basis of FSIS programs. Today, with the
increasing industry volume and complexity of meat and poultry products to
be inspected, the FSIS recognizes the need to have the capability to
systematically evaluate and characterize risk. The foundation of the new risk
analysis program will be the development and implementation of risk
assessment. The program will include a risk assessment group in the
Science and Technology Program which will interact with the risk
management activities of the Policy Evaluation and Planning Staff and the
risk communication activities of Information and Legislative Affairs.
Individuals involved in all aspects of the initiative will interact with other FSIS
program areas. In addition, the risk analysis program will share information
with other agencies, industry, public and consumer groups, academia, and
international food safety organizations.

The FSIS expects to develop quantitative risk assessment
techniques appropriate for use in assessing the various types of human
health risks associated with meat and poultry products. Ultimately, it will
need to develop the capability to perform risk assessments for biologic,
chemical, and physical hazards.

The development of effective risk assessment procedures and
methodologies will present a significant challenge for the Agency. The field
of risk assessment has historically been applied to static hazards such as
chemicals. The application of risk assessment to biologic hazards that can
multiply during production, handling, storage, and preparation will present a
substantial challenge.

In the future, the FSIS hopes to have the capability to perform formal
scientific risk assessments for the broad spectrum of biologic, chemical, and
physical health hazards that may be associated with meat and poultry
products. The Agency expects to perform risk assessments for many
different types of scenarios and processes. Gradually, the Agency will shift
from the current informal qualitative assessment of risks to the use of formal
RISK ANALYSIS PRINCIPLES

quantitative risk assessment. The FSIS expects risk assessment to contribute new information that will be used in management decisions to protect the public from foodborne hazards.

REFERENCES


Chairman: Dr. J. L. Blair, Annandale, VA

B. F. Barnum, OK; G. W. Beran, IA; D. L. Berndt, DC; J. P. Beveridge, UT; L. G. Billingsley, CA; R. E. Breitmeyer, CA; L. M. Brooks, GA; B. Buntain, DC; C. W. Carraway, NC; W. J. Charminski, WV; G. W. Dimmick, IN; W. H. Dubbert, DC; M. Floyd, IL; W. Godwin, FL; C. W. Gross, KY; J. Haslam, DC; L. Jan, TX; W. E. Ketter, MD; C. C. King, SC; R. W. Laslocky, VT; M. M. Mamminga, IA; A. P. Marquez, NM; D. T. Marshall, NC; E. L. Menning, DC; E. E. Mortensen, MT; L. D. Nordyke, DC; F. C. Okino, IL; R. Peterson, OK; J. R. Priester, AL; J. P. Quigley, GA; R. D. Ragland, VA; W. W. Rosser, TX; W. Thomas, ME; L. D. Woodson, KS.

The Food Animal Hygiene Committee was called to order by Chairman, Dr. Joe Blair at 1:35 p.m., October 25, 1993. Seventy-one (71) persons including twenty-five (25) Committee members were in attendance.

Dr. Tari Kindred spoke on "Risk Analysis Principles and Food Safety Applications." The term "risk analysis" is used as an umbrella term for three main subject areas: risk assessment -- a complex formal process which characterizes potential adverse effects of exposure to hazards; risk management -- the evaluation, selection and implementation of alternative risk control actions; and risk communication -- an interactive process of exchange of information and opinion among individuals, groups and institutions. Dr. Kindred discussed the food safety applications of risk analysis in various agencies and described the new FSIS risk analysis program. Dr. Kindred's paper will be published in the USAHA Proceedings.

Dr. George Beran spoke on "Food Safety Consortium - Overview and Update." He highlighted a number of food safety research projects currently underway at the three universities which comprise The Food Safety Consortium: University of Arkansas (poultry); Iowa State University (swine); and Kansas State University (beef). Dr. Beran outlined the probability of foodborne illness per meal consumed in the United States for five common foodborne pathogens. Campylobacter jejuni, Salmonella spp., and Staphylococcus aureus had the highest probability with 1:125,000, 1:137,000 and 1:174,000 respectively. Clostridium perfringens was at the lowest end of the probability scale with one case per 26,280,000 meals consumed. Trichinosis occurred in one case per 2,628,000 meals consumed. The public is willing to pay some additional amount for safer meats. One study translated this willingness into $0.42 to $0.82 per meal for pathogen free meat items.

Dr. Beran reported that there are a number of studies underway on Escherichia coli O157:H7 following the foodborne illness outbreak in the western U.S. last winter. The studies include:

1. Evaluation of the speed of cooking on the resistance to inactivation by the organism.
2. Biocidic action of phenolic antioxidants.
3. Biocidic action of bacteriocins (proteins produced by the multiplication of meat spoilage organisms). The bacteriocins appear to have a positive effect by reducing multiplication of undesirable microorganisms.
4. The use of irradiation for inactivation of *E. coli* O157:H7 appears to hold a lot of promise. The study utilized a radioactive beam which is not radioactive when it is turned off and does not produce any radioactive residue.
5. The use of acid washes for carcasses appears to be moderately effective. Their effectiveness is through the delay of the logarithmic growth phase of the bacteria rather than a reduction in actual numbers of organisms. These washes do increase shelf life of product.

Dr. Beran discussed the antibiotic resistance patterns for *E. coli* which differ depending on their recovery location. The resistance is increased in the lower digestive tract during stress and during periods of increased intestinal motility. Another study found that the normal liver in healthy swine is capable of removing 96% of salmonellae within 3 hours. However in stressed swine the liver's function is altered, thus enhancing salmonellae survival. These studies strongly indicate that animals should be handled in a manner that minimizes stress and be butchered as soon as possible after leaving the farm.

Dr. Beran reported on additional studies on the prevalence of pathogenic organisms and the stability of selected viruses on pork carcasses. Natural contaminants such as salmonellae are the highest following slaughter but decrease in numbers during subsequent processing operations. However, contaminants resulting from human handling, such as, *Staphylococcus aureus* reacts just the opposite and the numbers increase during operations following slaughter.

Dr. Beran discussed advancements in rapid testing for the identification of *Campylobacter, Listeria and Salmonella*; the effects of poultry scald water temperature on salmonellae contamination; and the latex agglutination test for identifying fecal bacteria.

A more in-depth coverage of the research being conducted by the Food Safety Consortium will be presented during a joint meeting of the American Association of Food Hygiene Veterinarians and the National Association of Meat and Food Inspection Directors on Thursday October 28, 1993.

The American Veterinary Medical Association's (AVMA) food safety policy was presented to the committee. The policy is as follows:

"Veterinarians traditionally have a vital role in the advancement and maintenance of food safety for the benefit of society. The veterinary
FOOD SAFETY

profession is the only health profession that is actively involved in all aspects of the food chain from farm production of food animals to the consumption of food products that derive from those animals."

"It is the policy of the American Veterinary Medical Association to help assure that the supply of foods of animal origin, including meat, poultry, fish, and dairy products shall be wholesome in nature and free of harmful chemical, parasitic, microbiological, or pharmaceutical contaminants. The AVMA shall encourage its members to promote responsible animal production and husbandry to assist in all matters related to increasing the safety and quality of meat, milk, fish and other seafood, poultry, and related products. The AVMA shall actively pursue appropriate educational, legislative, and regulatory measures to meet those goals."

There was a discussion of the AVMA's more detailed food safety proposals that are currently in draft form. Vice President Gore's September 9, 1993 appearance on the Phil Donahue show was discussed with particular concern over his apparent lack of understanding of basic animal health and food safety issues. Letters to the Vice President from the AVMA and the National Association of Federal Veterinarians were made available to the committee. The Food Safety Committee voted to prepare a letter from the USAHA to Mr. Gore outlining our concerns and recommendations relating to food safety.

Dr. Daniel LaFontaine briefed the committee on recent hearings held around the country by FSIS. These hearings were seeking broad based input on possible changes in FSIS programs. Several members of the committee had testified at various hearings and shared their experiences with the committee. Dr. LaFontaine has been invited to participate in the FSIS sponsored Conference on Regulatory Progress in the Future, scheduled for November, 1993.

The meeting concluded at 5:15 p.m.
African swine fever (ASF) is a highly contagious peracute disease of domestic swine characterized by fever, areas of cyanosis of the skin, severe hemorrhages in lymph nodes, kidneys and the alimentary tract, and a mortality rate of almost 100%. The disease can be transmitted by tick vectors of the *Ornithodoros* genus.

The causative agent, African swine fever virus (ASFV), is the sole member of an unnamed family of animal viruses, a large icosahedral virus with a double-stranded DNA genome of 170–190 kb that shares many characteristics with poxviruses. The virus infects and replicates in cells of the mononuclear–phagocytic system.

Persistent infection with ASFV is reported to occur in warthogs and in some domestic pigs surviving acute viral infection; however, the real incidence and the duration of viral persistence are unknown. Apart from the observation that virus can in some cases be detected after the acute stage of the disease in lymphoid tissues and peripheral blood using animal inoculation assays, little is known about the nature of persistent ASFV infection.

To study viral persistence, a polymerase chain reaction (PCR) assay was developed using as a target the P72 gene, which was selected because it is a structural protein with a high degree of conservation among diverse ASFV isolates. The PCR was performed for 35 cycles of thermal denaturation at 96°C for 30s, reannealing at 50°C for 30s, and extension for 1 min at 72°C. Primers used for amplification were: 5' AITITAAGCCTTATGTTCCAG 3', 5' CTCTAAAAGGTGTITGGTTGTC, representing nucleotides 187 and 452 respectively.

The specificity of the amplified product was assessed by either, cleavage into two fragments of 77 and 189 bp following digestion with restriction enzyme Hind III and, hybridization with a cloned p72 probe (clone L09U724A.E) representing a 238 bp fragment contained within the amplified p72 gene region.

To estimate the sensitivity of the PCR assay, serial dilutions of purified viral DNA were mixed with a constant amount (1 ug) of DNA from peripheral blood mononuclear lymphocytes (PBML), amplified by PCR, visualized in a 3% agarose gel, transferred to a nylon membrane and hybridized with the 32P labelled p72 gene probe. In 10 independent assays, between 10 and 100 fg of ASFV DNA could be detected, which corresponds to between 55 and 550 ASFV genome equivalents.
DNA extracted from Ficoll–Hypaque purified PBML from 19 pigs that had recovered from acute infection, were examined for evidence of viral persistence using the PCR assay described above. Pigs used in these experiments (Groups I–III) were treated with anti–ASF Ig or infected with ASW and subsequently challenged with virus as described below.

<table>
<thead>
<tr>
<th>Group I (n=6)</th>
<th>Anti–ASFV IgG</th>
<th>E75–L7 (2 dpi) 10^2HA_{so} intramuscular</th>
<th>E75–L7 (48 dpi) 10^2HA_{so} intramuscular</th>
<th>E75–L7 (187 dpi) 10^2HA_{so} intramuscular</th>
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<tbody>
<tr>
<td>II (n=4)</td>
<td>E75–CV1 10^4HA_{so} via oronasal</td>
<td>E75–L7 (2 dpi) 10^2HA_{so} intramuscular</td>
<td>E75–L7 (187 dpi) 10^2HA_{so} intramuscular</td>
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</tr>
<tr>
<td>III(n=9)</td>
<td>E75–CV1 10^4HA_{so} via oronasal</td>
<td>E75–L7 (60 dpi) 10^2HA_{so} intramuscular</td>
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During a period of 4 months (195–319 dpi), blood samples from animals in Group I were tested for detection of ASW by virus isolation in monocyte/macrophages cell cultures and PCR. Virus isolation was performed by inoculating 1 ml of whole blood onto pig macrophage cultures and observing them for cytopathic effect and hemadsorption for 5 to 7 days. Negative cultures were passaged 2 or 3 additional times onto fresh macrophage cultures before samples were considered negative for virus isolation. For PCR analysis, the PBML fraction was isolated from Ficoll–Hypaque gradients. Recovered cells were washed 3 times in DMEM and approximately 10^6 cells were resuspended in 100 ul of digestion buffer and incubated for 45 minutes at 56°C, followed by 10 minutes at 90°C to inactivate the protease. The PCR assay was performed as described above, with 10 ul of the sample (1 ug DNA) in a total reaction volume of 100 ul.

ASFV DNA was detected in PBML from all pigs at least once during the monitoring period (Table I). Infectious virus was not however recovered from any of these samples.

To further characterize the persistently infected cell population, PBML from blood samples in Group II were fractionated into adherent and non–adherent cell populations by culturing Ficoll–Hypaque purified mononuclear cells overnight in DMEM, 10% FCS at 37°C and 5% CO₂. The non–adherent cells were removed and the adherent cells were extensively washed with DMEM and harvested by scraping. The cells were digested 45
min at 56°C in 100 μl of digestion buffer (50 mM KCl, 15 mM Tris-Cl, 2.5 mM MgCl₂, 0.5% Tween 20, 100 ug/ml of proteinase K) and, both fractions, assayed for ASFV DNA by PCR.

ASFV DNA was detected in all Group II (Table II) and Group III pigs (data not shown). The detection rates in total PBML and non-adherent fractions were lower than those for the adherent cells, indicating that elimination of the non-adherent cells results in an enrichment of the persistently infected cell population. Using swine cell type specific monoclonal antibodies against cell surface markers (HB 8371 [5C9], anti-swine Ig,¹⁷ HB142.1 [74.22.15A], anti–monocyte/macrophage¹⁸ and MSA–4, anti pan T–cell,¹¹) for immunofluorescence, adherent cell populations were found to contain approximately 98% monocytes/macrophages with contaminating T and B cells present at 3.3% and 3.6%, respectively.

TABLE I. Detection of ASFV in Peripheral Blood Mononuclear Cells of Pigs at Times Post–Inoculation.

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<tr>
<th>Pig No.</th>
<th>Days Post Inoculation</th>
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<tr>
<td></td>
<td>195</td>
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<tr>
<td>206 VI⁺</td>
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<td>207 VI</td>
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<td>214 VI</td>
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<td>PCR</td>
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*VI: Virus isolation on pig macrophage cultures. PCR: Polymerase chain reaction. +: Positive assay result. -: Negative assay result.
PERSISTENT INFECTION WITH AFRICAN SWINE FEVER VIRUS

Group II

TABLE II.  PCR Detection of ASFV DNA in Swine Peripheral Blood Mononuclear Cells at Times Post-Inoculation.

<table>
<thead>
<tr>
<th>Pig No.</th>
<th>Days Post Inoculation</th>
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<tr>
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<td>342</td>
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<td>88 T</td>
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<tr>
<td>NA</td>
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<td>90 T</td>
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<td>A</td>
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<td>NA</td>
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<td>91 T</td>
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<td>A</td>
<td></td>
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<tr>
<td>NA</td>
<td></td>
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<tr>
<td>92 T</td>
<td></td>
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<td>A</td>
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Positive selection cell sorting of PBML from Group II pigs was performed using sheep–anti mouse IgG coated immuno-magnetic beads and the monoclonal antibodies for swine leukocyte cell surface markers described above to confirm the role of the monocyte/macrophage populations in ASFV persistent infection. The PBML (approximately 10⁶ cells) were incubated with each monoclonal antibody for 1 hour at 4°C, washed three times with DMEM, 10% FCS and incubated with the immunobeads for 1 h. at 4°C, washed extensively to eliminate the nonattached cells, and resuspended in 100 ul of digestion buffer, or released from the immunobeads, by incubation overnight at 37°C to assess the purity of the population by indirect immunofluorescence. In all cases, the selected population had less than 5% contamination with the other two cell types.

In all experiments ASFV DNA was detected by PCR in the monocyte/macrophage fraction. Occasionally, weak positive signals were detected in the T-cell and B-cell fractions, probably resulting from the contamination of these fractions with monocytes/macrophages. These results directly support the observations made for, adherent and non-adherent PBML, indicating that monocytes/macrophages are persistently
infected with ASFV and that this cell population represents the primary source of viral DNA in PBML of persistently infected animals.

In summary, we have shown under experimental conditions that long-term persistent infection is the natural sequel to infection with ASFV in most if not all animals. The finding that monocytes/macrophages, major targets for lytic virus replication both in vivo and in vitro,2−6,9,20,21 are also persistently infected in vivo suggests that ASFV–swine monocyte–macrophage interactions can result in either lytic or persistent infection.

The PCR assay described here for ASFV DNA is clearly more sensitive than cell culture virus isolation procedures13,14 and it appears to be equally or more sensitive than earlier attempts to detect persistent virus using direct animal inoculation.6,7 Thus, the assay could have significant diagnostic applicability for detecting ASFV.

References

PERSISTENT INFECTION WITH AFRICAN SWINE FEVER VIRUS


APPLICATION OF THE DOUBLE ANTIBODY SANDWICH ELISA FOR THE DIAGNOSIS OF VESICULAR DISEASES VIRUSES

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INTRODUCTION

Foot-and-mouth disease (FMD) is the most contagious disease of cloven-hoofed animals. The FMD virus (FMDV) spreads to susceptible species directly by contact with infected animals, or indirectly via contact with infected animal products and fomites. It will also transmit readily over some distances as aerosols under favourable environmental conditions, particularly when pigs are involved as a source of virus (Gloster et al, 1982).

In countries having a policy of eradication and a pre-established eradication plan, action toward disease control is initiated following evidence of clinical disease with confirmation by laboratory diagnosis. It is therefore very important to have rapid, sensitive and accurate diagnostic procedures to support the Animal Health Authorities responsible for activating emergency measures in the face of a FMD outbreak. A swift and appropriate response is likely to significantly limit the severity of an eventual outbreak.

For the last several decades, the complement fixation test (CFT) has been used as the primary laboratory assay for FMD diagnosis. The CFT is capable of detecting FMDV antigens directly in epithelial tissues submitted from the field (Brooksby 1952). The test, however, requires a large amount of antigen in tissues to provide a positive result, and hence not all true FMD and other vesicular diseases specimens such as vesicular stomatitis and swine vesicular disease can be diagnosed directly with the CFT from field submission. In cases where insufficient amount of vesicular disease antigen is present in tissues, time consuming viral amplification is needed before confirmation of a diagnosis becomes possible.

NOTE: All work involving live foot-and-mouth disease virus was conducted either at the FADDL or the EWRL.
APPLICATION OF THE DOUBLE ANTIBODY SANDWICH

Several years of development at the European and World Reference Laboratory for Foot-and-Mouth Disease (EWRL) have culminated in extensive validation studies by Ferris and Dawson, 1988, which led to the replacement of the CFT by the double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) for the primary diagnosis of FMD from animal tissues. The forthcoming lack of CFT support from the EWRL prompted the Animal Diseases Research Institute (ADRI) to purchase the DAS-ELISA reagents for the primary diagnosis of FMD.

The purpose of this presentation is to report on the validation studies which led Agriculture Canada to adopt the DAS-ELISA for primary diagnosis of FMD and other vesicular diseases. Further validation of the test with archival strains of FMD, which was carried out in cooperation with the Foreign Animal Disease Diagnostic Laboratory, Plum Island Animal Disease Center (FADDL) along with the preliminary evaluation of ELISA reagents from the Pan American Foot-and-Mouth Disease Center (PAFMDC) will also be reported.

MATERIAL AND METHODS

Positive specimens

Foot-and-mouth and Swine Vesicular disease: The FMD and Swine Vesicular Disease (SVD) specimens were obtained either from the FADDL or from the EWRL repositories.

Vesicular stomatitis: Twenty one bovine and four equine samples of vesicular stomatitis virus, New Jersey type (VSV-NJ) were obtained from Dr. J. E. Pearson, National Veterinary Services Laboratory, Ames Iowa. The specimens were first cell culture passage from the 1982 VS-NJ outbreak and were passaged once in secondary bovine kidney cells at ADRI. Three VSV-NJ were provided by the EWRL while the VSV Indiana subtypes 1, 2 and 3 and Piry were obtained from the FADDL.

Negative specimens

Canadian field samples: Sixty epithelial samples of Canadian origin (cattle, sheep, horses, pigs, goats and camels) were collected in glycerinated phosphate buffer, pH 7.6, (French and Geering, 1978), and were tested in the DAS-ELISA test. These samples were tested to ascertain the positive threshold values with tissues collected from native animals which were either normal or were affected with buccal lesions resembling vesicular diseases.

Reagents: Rabbit and guinea pig antisera for the seven FMDV types were purchased from the EWRL and antisera to FMDV types O, A, and C, were provided by Dr. Vincente Astudillo, PAFMDC. The EWRL reagents were produced as described by Roeder and Le Blanc Smith, (1987), while the PAFMDC antisera were prepared as described by Alonso Fernández et al., (1992).
The VSV subtypes Indiana 2 (VSV-Ind-2) and Indiana 3 (VSV-Ind-3) antisera were provided by EWRL, Pirbright, U.K. The VSV-NJ and the VSV-Ind-1 antisera were prepared at the ADRI, according to the procedure described by Ferris and Donaldson, (1988), using the Ogden strain of VSV-NJ and the San Juan strain of VSV-Ind 1 viruses.

ELISA procedure: The DAS-ELISA was based on methods previously described (Afshar et al, 1986; Ferris and Dawson, 1988). In brief, flat-bottom 96-well immunoplates were optimally coated with anti-FMDV rabbit sera, diluted in 0.06 M carbonate buffer, pH 9.6, for 1 hour at 37°C on a rotary shaker and then 18 hours at room temperature (RT). A 10% suspension of epithelium, chorioallantoic membrane samples diluted 1:50 or undiluted clarified cell culture supernatant fluids were applied in triplicate according to a sample placement pattern described by Roeder and Le Blanc Smith, 1987, (Fig 1). Following an incubation period of 1 hour, the plates were filled, 100 μl / well, with the corresponding anti-FMDV guinea pig sera, pre-blocked with fetal bovine serum (FBS) and optimally diluted in phosphate buffered saline (PBS) containing 0.05% Tween 20 (T) and 3% bovine serum albumin (BSA). The plates were incubated for 30 minutes and were filled with FBS-blocked horseradish peroxidase labelled rabbit anti-guinea-pig immunoglobulin G (H/L chain), optimally diluted in PBST BSA and incubated for 30 minutes. All incubations were at 37°C and the plates were held on a rotary shaker. Between each incubation step, wells were washed five times with PBST. The plates were finally filled with substrate solution containing 1 mM ABTS [2, 2' azinobis (3-ethylbenzthiazoline sulfonic acid)] and 4 mM hydrogen peroxide in 0.05 M citrate buffer, pH 5.0 ± 0.05, and the plates were then shaken continuously for 15 minutes at RT. In each testing session, optimally diluted inactivated antigens were used as quality controls. Chromogen conversion was measured at 414 nm with a Multiskan Mark II microplate photometer, which had been previously blanked with the substrate solution. Data were captured by means of a custom computer program and the results were expressed as the mean optical density (OD) values of three replicates, minus the OD reading in the "no antigen" well.

CFT procedure: A microtitre technique based on the method described by Darbyshire et al. (1972) was used. Briefly, a 10% epithelium suspension was tested as constant undiluted antigen against serial dilutions of both complement and antisera of the seven types of FMD. Fixation was allowed for 1 hour at 37°C before adding the hemolytic system.

RESULTS AND DISCUSSION

1. Preliminary Assessment Of The DAS-ELISA At The FADDL
Tests were considered valid when the positive control antigens for each virus type resulted in OD values of 0.8 ± .2. Test samples giving OD values ≥ 0.1 were considered positive.
APPLICATION OF THE DOUBLE ANTIBODY SANDWICH

A preliminary validation of the DAS–ELISA test was conducted in cooperation with the FADDL, in February 1990. Sixteen epithelium samples were provided from cattle experimentally infected with FMD virus, one type O, two type A, four type C, two type SAT 1, four type SAT 2, two type SAT 3 and one type Asia 1. The DAS–ELISA results obtained with a 10% suspension of the epithelium material (original suspension; OS), correlated perfectly with the ADRI CFT results, which were performed with the EWRL reagents, and the FADDL CFT results, which utilized FADDL CFT reagents (Table 1).

The successful completion of the preliminary testing at the FADDL suggested that the DAS–ELISA had good potential as a primary diagnostic tool. The possibility that experimental material would not represent adequately the field situation had to be investigated further. It was decided to expand the validation studies with a greater number of field specimens made available by the EWRL, Pirbright, UK in April 1991.

2. Validation Exercise At The EWRL

The objective of the exercise was to ascertain the suitability of the ADRI modifications of the DAS–ELISA test on field specimens of known FMDV types, which had been submitted to the EWRL from various world locations between 1980 to 1991. The samples were tested in parallel by the EWRL and the ADRI ELISA test and their respective staff and the results were compared. Limited comparisons were also made between the ADRI CFT and the DAS–ELISA.

For this exercise, 73 FMD field samples of epithelium and five FMDV in cell culture were provided. They represented 43 FMDV type O viruses, 9 type A, 3 type C, 2 type SAT 1, 2 type, SAT 2, 5 type, SAT type 3 and 9 type Asia 1. In addition, 8 pig foot epithelium samples of SVD from the 1974 outbreak in the UK and 3 VSV–NJ from Central America were provided.

Initially, ten samples having moderate amount of antigen (OD 0.4 - 0.6) as suggested by previous EWRL–ELISA results were selected. Specimens having low amount of antigen were eliminated because most would not have reacted in the CFT. Conversely, the high reactor specimens were also excluded because they were likely to react positively in the CFT. The selected submissions were tested in parallel with the ADRI CFT and the EWRL and the ADRI ELISA tests.

Of the ten samples selected, nine were correctly identified with the ADRI DAS–ELISA while only five were identified with the ADRI CFT. One sample was anticomplementary and three were negative. One sample was negative by all tests including that of the EWRL. This sample remained negative after one passage in primary bovine thyroid cells (BTY), suggesting that virus had decayed between the time of its submission in 1989 to testing in April 1991. This specimen had previously been identified as a type C virus from the Philippines. These results were consistent with those published
Figure 1. Layout of two ELISA plates for foot-and-mouth disease (FMD) types O, A, C, SAT 1, SAT 2, SAT 3, ASIA 1, Swine Vesicular Disease (SVD), and Vesicular Stomatitis New Jersey (VSV–NJ) and Indiana 1 to 3 (VSV–IND 1 to 3)


Effort was then concentrated in evaluating the ADRI DAS–ELISA relative to the EWRL DAS–ELISA with the remaining specimens (Table 2).

Of the 43 type O specimens available, 36 and 37 were confirmed in 1991 by the EWRL and the ADRI DAS–ELISA respectively. Six specimens were negative in both ELISA systems and one was negative by the EWRL ELISA procedures performed in 1991. Six of the seven negative samples were passaged once in BTY cells; four were identified as type O by both ELISAs and two samples remained negative. One specimen was not amplified for lack of original tissue.

Of the nine type A viruses, seven were correctly identified by both ELISA procedures and two were negative before amplification. After one passage of the OS in BTY cells, one sample became positive while the other
remained negative. Among the three type C specimens, only one was confirmed with both ELISAs while the other two remained negative even after one passage in BTY cells. Eight of the 9 type Asia 1 samples were correctly identified by both ELISAs and one was negative after one passage in primary BTY cells. All of the type SAT 1 and SAT 2 samples were correctly identified with both ELISAs. The 5 cell culture derived type SAT 3 viruses were tested only with the ADRI ELISA test and identified correctly. Seven of the eight SVDV specimens were identified correctly with the ADRI ELISA. The eighth sample was cornified and had little usable epithelial tissue. The OD readings obtained with the homologous SVDV reagents were high and no cross reactions were detected with the heterologous reagents for FMDV and VSV-NJ and VSV-Ind 1 serotypes. The three VSV-NJ specimens reacted strongly with the homologous VSV-NJ reagents and did not cross react with the VSV-Ind or the seven FMDV reagents.

As a result of this more extensive validation study with a larger number of FMD field specimens acquired from several parts of the world, the Canadian Animal Health Authorities endorsed the ADRI DAS-ELISA as their

### Table 1. Number of known positive foot-and-mouth disease samples confirmed with the Animal Diseases Research Institute (ADRI) double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) and the complement fixation test (CFT) in the preliminary assessment at FADDL.

<table>
<thead>
<tr>
<th>FMD TYPE</th>
<th>NO. TESTED</th>
<th>NUMBER CONFIRMED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DAS-ELISA</td>
</tr>
<tr>
<td>O</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>SAT 1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>SAT 2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>SAT 3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>ASIA 1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 2. Number of known positive vesicular disease samples confirmed with the Animal Diseases Research Institute (ADRI) double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) and the European and World Reference Laboratory for FMD (EWRL) DAS-ELISA at EWRL in April 1991.

<table>
<thead>
<tr>
<th>VIRUS TYPE</th>
<th>NO SAMPLES</th>
<th>CONFIRMED POSITIVE BY DAS-ELISA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>ADRI</td>
</tr>
<tr>
<td>FMD</td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>O</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>A</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>SAT 1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>SAT 2</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>SAT 3</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>ASIA 1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SVD</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

their official antigen detection assay for FMDV in field tissues in May 1991. It was noted, however that South American strains of FMDV had not been tested either at the FADDL or at the EWRL.

3. Further Evaluation Of The ADRI DAS-ELISA Test With Experimental Specimens At The FADDL

To further evaluate the DAS-ELISA, a second series of tests were performed with the cooperation of the FADDL in September 1992. In this latter series, the objective was to evaluate the EWRL reagents with strains of FMDV from South America and to test cell culture preparations, oropharyngeal material (probang) and epithelial samples on hand at the FADDL repository.

For this exercise, 38 specimens were available. Nine samples were bovine tongue epithelium, 3 were pig foot epithelium, 2 were bovine vesicular fluids, 3 were oropharyngeal fluids, 6 were oropharyngeal fluids passaged once in lamb kidney cells, 14 were cell culture fluids. In addition, 5 were chorioallantoic membranes infected with VSV-NJ, Ind-1, Ind-2, Ind-3 and Piry.
APPLICATION OF THE DOUBLE ANTIBODY SANDWICH

The DAS-ELISA identified correctly all but two of the FMDV type 0 specimens either directly or following one passage in secondary lamb kidney cell monolayers as long as the infectious titer levels were above $1 \times 10^4$ median cell culture infectious units/ml (TCID$_{50}$/ml). Two type A specimens, namely A$_{81}$ /Argentina / 87 and A Sabana / 85, were repeatedly negative with the available EWRL reagents while type A Venceslau was marginally positive. These two recent South American isolates and the European isolate had good infectious titers, i.e. $10^{6.5}$, $10^{6.8}$ and to $10^{7.6}$ TCID$_{50}$/ml, respectively, and should have been readily identified (Table 3). No difficulties were encountered with VSV-NJ, VSV-Ind 1 and SVD. Reagents for VSV-Ind 2 and 3 and Piry were not available.

An updated set of FMD type A antisera, which contained an additional South American strain (A$_{5222}$/COL 85) were purchased from the EWRL in December 1992 and these new reagents were evaluated with archival and contemporary strains of FMDV at the FADDL in February 1993. In this latter series, several South American FMDV samples were included. In addition, DAS-ELISA reagents from the PAFMDC were evaluated in parallel with the EWRL reagents.

4. Evaluation Of The 1992 EWRL Reagents In Parallel With Previous Reagents

In this series of evaluations of the DAS-ELISA tests, the EWRL reagents received at FADDL in 1988 were tested in parallel with another EWRL set of reagents received at ADRI in 1989 and the updated antisera of December 1992. For this experiment, 10 FMDV type A were selected and tested against the reagents for FMDV types O, A and C. As expected, the two South American FMDV type A, which had been found negative previously with the 1989 ADRI reagents were either marginally positive or negative with the 1988 FADDL reagents, but were clearly identified with the updated EWRL reagents. All the other type A viruses were easily identified with the three sets of reagents, and no cross reactions were detected with the other FMDV types.
Table 3. Number of known positive vesicular disease samples tested and confirmed with the Animal Diseases Research Institute (ADRI) double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) at the Plum Island Animal Disease Center, in September 1992.

<table>
<thead>
<tr>
<th>VIRUS TYPES</th>
<th>NO. TESTED</th>
<th>NO. CONFIRMED POSITIVE BY ADRI DAS-ELISA</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>A</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>ASIA-1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VS-NJ</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VS-IND-1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VS-IND-2</td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>VS-IND-3</td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>VSV-PIRY</td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>SVD</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

* Reagents not available at the time

5. Evaluation Of The Updated EWRL Reagents In Parallel With The PAFMDC Reagents

A series of tests were also undertaken to evaluate the updated EWRL reagents and the PAFMDC antisera with archival and contemporary strains of FMDV kept in the FADDL repository. Detection of FMDV type A was emphasized, but other FMDV types and VSV specimens were also included. A total of 68 FMDV samples were tested; 21 FMDV type O, 40 type A, 7 type C viruses, 1 VSV-NJ and one of each VSV-Ind 1,2, and 3. All FMDV samples were cell culture material and the VSV samples were chorio-allantoic membranes suspensions.
APPLICATION OF THE DOUBLE ANTIBODY SANDWICH

Table 4. Number of known positive vesicular disease samples confirmed with the Animal Diseases Research Institute (ADRI) double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA) using the European and World Reference Laboratory for FMD (EWRL) or the Pan American Foot-and-Mouth Disease Center (PAFMDC) reagents.

<table>
<thead>
<tr>
<th>VIRUS TYPE</th>
<th>NO. TESTED</th>
<th>NO. CONFIRMED POSITIVE BY DAS-ELISA WITH REAGENTS FROM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EWRL</td>
</tr>
<tr>
<td>FMD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>A</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>C</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>VS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VSV-NJ</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VSV-IND-1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VSV-IND-2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>VSV-IND-3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

ND – Not done

After having established that the PAFMDC reagents performed adequately with the ADRI DAS-ELISA protocol and after defining their optimal dilutions, a series of tests were performed to compare the updated EWRL and the PAFMDC reagents. Both sets of reagents identified correctly all FMD samples tested, except one type A virus. The PAFMDC reagents identified this archival strain of FMD, A_{16} / Belem / Brazil/ 59, which was negative with the EWRL reagents. The new EWRL reagents to VSV-Ind types 2 and 3 readily identified their homologous viruses prepared in chorioallantoic membranes (Table 4).
Of the 25 VSV specimens tested, twenty bovine and 3 equine samples were identified as VSV-NJ with the DAS-ELISA. No cross reactions occurred with the VSV-Ind 1 reagents or with any of the seven FMDV type reagents.

CONCLUSIONS

The extensive validation studies conducted since the fall of 1989 at ADRI, Nepean, Ont., the FADDL, Greenport, NY and the EWRL, Pirbright, UK have demonstrated conclusively that the DAS-ELISA test, performed according to a standard protocol with EWRL reagents can effectively demonstrate the presence of vesicular disease viral antigens in epithelial tissues of animals, in oro-pharyngeal samples, in cell culture fluids and in chorioallantoic membrane suspensions.

The original DAS-ELISA antisera, which were supplied by the EWRL and prepared with non-South American FMDV strains, were unable to detect at least two South American type A viral strains prepared in cell cultures and having high infectious titers. It was not determined if these antisera would have been more effective in detecting the same viral strains in epithelium, a tissue known to produce more antigen at the height of disease per unit of mass than cell culture. This observation shows the importance of international cooperation in monitoring of FMD to ensure that diagnostic antisera contain antibodies to all the determinants relevant to contemporary isolates. Regardless of the diagnostic test used, constant vigilance will always be required to monitor for the emergence of new strains of FMDV which may escape detection with current reagents.

The comparison of the EWRL and the PAFMDC reagents in this study has confirmed the high quality of the South American reagents for diagnosing FMDV types O, A and C. This finding is to the advantage of the FMD diagnostician who now has two excellent sources of reagents for performing the DAS-ELISA on FMDV types O, A and C specimens.

Retrospectively, the decision of adapting the EWRL DAS-ELISA procedure for the diagnosis of FMDV to an existing ELISA format provided several operational advantages to the ADRI laboratory. This approach allowed immediate capitalization of technical staff already trained in the ELISA procedure. It also took maximum advantage of the constant availability of the essential elements of the ELISA, such as quality controlled buffers, substrates and equipment. It made possible an easy integration of the DAS-ELISA into the already established Canadian quality assurance program. This option of adapting the EWRL DAS-ELISA to the ADRI DAS-ELISA allowed a relatively small laboratory, which is not allowed to work with live FMDV, to provide a rapid, accurate diagnostic capability for FMD which
APPLICATION OF THE DOUBLE ANTIBODY SANDWICH

is so vital to the field staff.

As the number of laboratories performing the DAS-ELISA for FMDV increases, it will become important to standardize the results from different laboratories and creation of an international panel of inactivated and safety tested FMDV antigens may become desirable. The development of such a panel will undoubtedly be complex, but nevertheless important for future livestock trade.

REFERENCES

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assay: a sensitive, rapid and reliable technique for primary diagnosis.

ACKNOWLEDGEMENTS

The helpful assistance of Dr. R. Yedloustschinig and his staff (FADDL) in the initial evaluation of the ELISA for FMD is greatly appreciated. The technical assistance of Mr. A. Tremblay, Mr. R. McLaurin and Mr. J. Ferguson of Agriculture Canada and Ms. M.E. Llewellyn of FADDL made this work possible. Thanks to Dr. J.E. Pearson, National Veterinary Services Laboratory, Ames, Iowa, for providing the VSV specimens and to the diagnosticians in the Canadian provincial laboratories who supplied field specimens and to Mrs. Lynda Gravel for preparing the final version of the manuscript. Special thanks to Mr. Walter Kelly for developing and maintaining the computer software and to Mr. David Gall for preparing the figures.
The meeting of the Foreign Animal Diseases Committee opened with remarks by W. W. Buisch including a welcome and reference to the availability of additional copies of the revised 1992 USAHA Foreign Animal Diseases book. Our sympathy to Dr. John Mare, Committee Chairman, was expressed due to the recent loss of his mother. Dr. Charles Mebus agreed to assist as co-chairman in Dr. Mare's absence. Papers presented include the following:

**Fine Mapping of a Neutralizing Epitope on p 72 of African Swine Fever Virus.** M. Borca, P. Irusta, C. Carillo, C. Afonso, D. Rock

The authors reported that monoclonal antibody 135.D4, which recognizes an epitope on viral protein 72 located on the surface of the virus, neutralized ASF virus infectivity.

**Detection of African Horsesickness virus by reverse transcription-polymerase chain reaction.** M. Stone-Marschat, A. Carville, A. Skowronek, W.W. Laegreid

Reverse transcription-polymerase chain reaction (RT–PCR) was used to detect African horsesickness virus (AHSV). A single primer pair was identified which amplified a 423 base pair fragment of the S8 gene which encodes the NS2 protein of AHSV. Amplification of this fragment from all nine serotypes of AHS was achieved using these primers. Less than $10^2$ AHSV genomes could be detected by RT–PCR followed by agarose gel
electrophoresis and ethidium bromide staining. Application of RT-PCR to blood samples from AHSV-infected horses resulted in earlier detection of viremia than virus isolation. AHSV was also detected by RT-PCR in samples of spleen and lung from horses which died of AHSV infection. These results indicate that RT-PCR is a rapid and sensitive method for the identification of horses infected with AHSV.

Antigen Chimeras of FMDV type A 12 expressing immunodominant sites of types 0 or C. – E. Rieder, B. Baxt, P. Mason

Existing vaccines to FMD are based on immune – inactivated whole virus particle. Extensive information of the immune response to these vaccines as well as the response to synthetic peptides and proteins expressed in E. coli or other systems have identified an immunodominant epitope on the VP1 capsid protein. The dominance of this epitope in the immune response is responsible for the serotype specificity of the vaccines and permits the evolution of antigenic variants that can cause disease in vaccinated animals. The development of vaccines that give a more balanced immune response, could provide a broader immune response to the subtypes and serotypes of FMDV now circulating. To investigate the immune response to this immunodominant epitope relative to the dominant loop, a new virus was generated from infectious cDNA of FMDV type A. These new viruses contained the gene for the immunodominant epitopes of FMDV types O or C. These viruses, which were genetic chimeras, expressed the immunodominant epitopes of type O or C, and animals inoculated with vaccines prepared with these chimeras produced neutralizing antibodies to types O or C and type A. These studies demonstrate that new viruses can be generated using genetic engineering and suggest that vaccines can be developed which will have broader immune responses.


Three neutralizing monoclonal antibodies (MAbs) (SA6, OH3 and ME11) all directed towards VP2 of African horsesickness virus (AHSV/4) were used to study the epitopes responsible for neutralization. These antibodies recognize three related epitopes as determined by competitive binding to immobilized or soluble antigen. Escape mutants were generated to confirm basis for competition and tested by crossneutralization. For purified virions, the epitopes appear to overlap closely, while solubilized VP2 has 2 and possibly 3 binding sites. Cross–neutralization studies with some of the escape mutants confirm the existence of at least 2 sites. Neutralization studies with variants using homotypic and heterotypic AHS antisera suggest that the MAbs identify an immunodominant region on VP2 with multiple interacting sites.
FOREIGN ANIMAL DISEASES

Blocking/Competitive ELISA using Monoclonal Antibodies for Detection of Subgroup Reactive Antibodies  James A. House, Jeffrey L. Stott

Twenty three monoclonal antibodies, specific for AHSV, were developed, characterized and applied to improvement of diagnostics. The majority of antibodies were specific for VP5 (a major coat protein) and the remainder had specificities for VP1 (minor structural protein), VP2 (major coat protein), VP7 (major core protein) and NS2 and NS3 (nonstructural proteins). All antibodies were AHSV serogroup reactive with a few exceptions; 3 antibodies specific for VP5 did not react with AHSV serotypes 1 or 5, and 1 antibody specific for NS2 reacted with Umatilla virus, a related orbivirus. The multiple antibodies specific for VP5 and NS3 were clustered by multiple techniques and used to identify 7 epitopes on VP5 and 2 on NS3. All antibodies were tested for the ability of AHSV-specific equine antibody to block their binding in ELISA. One antibody, F9H (specific for VP7), was selected to developed a blocking ELISA. Two antigen preparations are being tested in the ELISA and include a crude cell culture antigen and a recombinant (yeast-expressed) VP7. Preliminary data that includes 300 normal equine serum and 100 AHSV-convalescent serum indicate the blocking ELISA to be highly sensitive and specific.

Update on the Eradication of Screwworm of Screwworm (SW) in Mexico. Armando Mateos

In January of 1992, an outbreak of SW was detected in the Mexican State of Campeche. From there, the problem disseminated to four other states. The strategy for control included permanent surveillance and public information plus the field operations which included diagnoses and sterile fly dispersion and monitoring. During 1992, 61 cases were detected out of 1439 samples. From January to September 1993, 5 cases were diagnosed, the last one was June 17, 1993. Most of the field activities will continue for a year after the last case before declaring the fly eradicated.

Progress of the Screwworm Eradication Program in Central America. Thomas J. Galvin

Progress of the Screwworm Program in Central America has been delayed by the 1992 – 1993 outbreak in Mexico. Nevertheless, significant advances have been, and are being made. No screwworm infections have occurred in Belize since 12 October 1991. Dispersal of sterile flies in Belize ceased on 31 December 1992.

No autochthonous screwworm infestations have occurred in Guatemala since 10 May 1992. The 10 infestations found since that date were imported from Honduras and detected at one inspection station near the Honduras border. Only 2 of the 10 cases occurred in 1993, 1 in February and 1 in April.

No autochthonous cases have occurred in El Salvador since 4 March
REPORT OF THE COMMITTEE

1993. The cases found since that date were imported from Honduras. Much of the Western half of Honduras is now free of infestations. Dispersal of sterile flies commenced in July 1993, in the western 25% of Nicaragua.

In addition to the economic benefits gained by screwworm eradication, there are other advantages. These include prevention of human infestations. An estimated 350 human case occurred in El Salvador in 1990. A total of 151 confirmed human cases occurred in El Salvador in 1991, and only 29 in 1992. No human cases has occurred in El Salvador since September 1992. A total of 104 human cases was reported in Nicaragua during the first 16 months of surveillance.

Bovine Spongiform Encephalopathy (BSE) – The Reflecting Uncertainty. A Reversion to Scientific Rationale. Don A. Franco

Dr. Franco reported that Bovine Spongiform Encephalopathy (BSE), a complex and fatal degenerative neuropathology of cattle, characterized by a long incubation period was first recognized in Great Britain in 1986. The prevailing hypothesis is that the disease resulted from the consumption by cattle of meat and bone meal containing a scrapie–like infectious agent. A comparative analysis of the production profile of rendered proteins of bovine origin in the United States for the years 1990–1992 inclusive is presented to contrast any epidemiologic parallel to the rendering risk factors of the United Kingdom. According to Dr. Franco, inferences from the raw data indicate marked variables between the United States and the United Kingdom and will not support a meat and bone meal causation hypothesis for the United States. Nonetheless, the complexities surrounding the transmissible encephalopathies heighten the imperative for longitudinal studies and the continued evaluation/analysis of potential risk factors. Anecdotal conclusions promote the possibility of inexactitudes, thus confounding the science. Planned research initiatives remain important regimen to attain answers to this challenging disease.

Continental Vesicular Disease Surveillance and Information System

Vicente Astudillo

The continental surveillance system for foot–and–mouth disease (FMD) and other vesicular diseases, is composed by a network of national systems submitting information to the Pan American Foot–and–Mouth Disease Center (PAFMDC). During the development of its structure, emphasis has been given to the geographical aspect, based on the close relationships existing amongst the spacial behavior of FMD, the animal production and commerce regional patterns and the geographical distribution of the animal health care structures. The outcomes of the system are: characterization of the regional endemicity of the disease, regionalization of the animal production systems and the commercialization flows of animals, demarcation of the FMD ecosystems, definition of the risk areas and the
choice of selective regional strategies for the eradication of FMD.

**Long-Term Persistent Infection of Swine Monocytes and Macrophages with African Swine Fever Virus.** C. Carillo, M. Borca, C. Afonso, D. Onisk, D. Rock

This paper was discussed as presented in the General Session and is included in the proceedings in the full text.

**Application of the Double Antibody Sandwich ELISA Test to the Diagnosis of Contemporary and Archival Strains of Foot and Mouth Disease Virus.** G. C. Dulac, R. Heckert, A. Torres, W. White, J. A. House, A. Alonso, N. Ferris

This paper was discussed as presented in the General Session and is included in the proceedings in full text.

**Overview of Animal Health Activities in Israel.** Arnon Shimshony

Several list A and B diseases were discussed in detail. The national FMD vaccination scheme has been revised. PPR was diagnosed for the first time in Israel. The disease was characterized by 65% abortion rate in Assaf dairy sheep and a high mortality rate in lambs. Sheep-pox vaccine strain 0240 was found to cause, in Holstein dairy cattle, temporary non-contagious signs resembling Lumpy Skin Disease. Regional *B. melitensis* control program in sheep and goats commenced: 10.3% of 44 tested flocks were found infected; test and slaughter policy was applied. *Salmonella enteritidis* (SE) is now present in local broiler and layer breeds. Slaughter of SE infected flocks and hatching eggs has cost from January - September 1993, approximately 1.2 million dollars. Simultaneous incubation of layer and broiler hatching eggs has been prohibited. The SE control program is being reevaluated. Anticipated possible developments due to political changes in the region were briefly discussed.

**Australia Disease Status.** Jack Haslan

Bluetongue is the only OIE List "A" disease reported in Australia (Serotypes 1, 3, 9, 15, 16, 20, 21, 23). Monitoring for Brucellosis (bovine) ceases at the end of this year marking a successful conclusion to the eradication campaign. Australia believes they are about free. Traceback is maintained through application of tailtags. There are State control programs for footrot and lice in sheep. Emerging problems include anthelmintic resistance, acaricide resistance, and hydatid in feral swine. They are doing an Arbovirus survey.

Foreign Disease planning includes control plans, training of stakeholders, strong quarantine strategy, and development of diagnostic capability. The North Australia Quarantine Strategy includes a coastal surveillance program; bilateral agreements with Indonesia and Papua, New
Guinea for mutually beneficial surveillance programs; and a MOU with Malaysia for an old world Screwworm fly control program.

Emerging challenges include the structure of the veterinary profession, new industries, and ratite, crocodile and camelid raising and processing.

**Update on Canada's New High Security Animal Virus Laboratory.**
W. G. Sterritt

The construction of Canada's new high security animal virus laboratory continues on track on budget. Its location in the City of Winnipeg, population 600,000 in the mid-western part of the country caused the review of traditional concepts for locating such facilities including the need for a buffer zone and/or an island location. Like a number of other countries we, concluded that, with modern containment design and technology, such a facility can unquestionably be safely located on the mainland.

The 290,000 square foot building will be shared with our national health department, Health Canada. Agriculture Canada will occupy about one third of the floor space with BSL 2, 3 and 4 laboratories, 5 animal rooms with BSL 3 containment and one BSL 4 animal room. The facility will be used for the diagnosis of viral diseases, research on the development of diagnostic tests, reagent production and our foreign animal disease schools.

The laboratory will be in operation early in 1997.

**Emergency Operation for the Outbreak of VEE in Mexico**
Armando Mateos

After 21 years without a clinical case of VEE, on June 1993, cases of CNS signs in horses were reported and by July 15, a VEE virus was isolated and later confirmed and typed as VEE-IE. From July 10 to August 25, a quarantine was imposed in 8 municipalities in the southern state of Chiapas, an intensive vaccination campaign was established, 38,660 horses were immunized and there was a vector control program.

A total of 133 horses were clinically affected and 61 died, the last one on July 25, 1993.

Even though the quarantine was lifted, there are some requirements for horses leaving the affected area: vaccination certificate, clinical inspection, dipping, and vehicle disinfection. Trucks carrying horses to slaughter are sealed.

**Emergency Operation for an Outbreak of Classical Swine Fever (CSF) in a Free Area of Mexico.** Amando Mateos

From January to June 1993, five outbreaks of CSF have been diagnosed in Mexico. One of the outbreaks occurred in the free area.

On May 6, 1993, the State Federal Veterinarian received a report of mortality in pigs in Baja Sur, California. Samples were taken and diagnosed
positive by FA test. An animal health emergency was declared and an official quarantine was imposed. Field operations included tracing back of all animal movements as well as a swine census in the focal and perifocal areas.

The stamping out operation included the depopulation of 202 premises with 2062 hogs killed and buried. There was compensation. The focal area was completely depopulated by the end of May 1993. After five months of intensive serological surveillance in the perifocal area 1047 samples have tested negative.

**Rift Valley Fever in Egypt. Ali Moussa**

Between 1977 and 1980, Rift Valley Fever was in Egypt and caused abortion storms in sheep, goats and cattle. Again, in the summer of 1993, Rift Valley Fever was isolated from a buffalo fetus in the Aswan Area. In this outbreak there was abortion in over 30% of the cattle. In addition, positive RVF serology was noted in 22 sheep sera, and 2 of 4 goats, and 2 of 6 cows. Human infection of Rift Valley Fever was also noted. Another foci was identified about 40 km to the south. Symptoms in affected people included fever, headaches, joint aches, and impaired vision. No case in either location has been noted since July 23, 1993.

Five possible theories of origin include, emerging mosquito (Transovarian Transmission); use of incompletely inactivated vaccine; importation of camels from the Sudan with a possible aborted fetus in quarantine; transport of vectors from the south; or arrival of viremic humans from the Sudan or elsewhere in Africa. Egypt produces a killed vaccine and a National vaccination campaign is scheduled to begin in November or December 1993 using the attenuated Smithburn vaccine.

**Regionalization of FMD: An Evaluation of Virological and Serological Epidemiological Indicators. Paul Sutmoller, Paulo Auge de Mello**

The liberalization of global trade in animals and animal by-products requires an internationally accepted system of risk assessment, including regionalization of countries or groups of countries with regard to FMD.

For FMD the most important epidemiological indicators are the number of outbreaks and the morbidity rates. Such indicators are provided by the Continental Vesicular Disease and Information System, coordinated by the Pan American FMD Center in Rio de Janeiro, Brazil.

Virological or serological surveys have been used to provide additional indicators to determine if FMD virus is circulating in the livestock populations. Serological surveys are also used to assess the effectiveness of the FMD vaccination program by determining antibody levels of the cattle population. However, it was concluded that, although virologicalserological surveys could play a role under certain conditions, the most important basis for the regionalization of FMD is an effective vesicular disease surveillance
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system, including access to a well functioning diagnostic laboratory service, able to type, subtype and characterize any vesicular disease agent in the region.

Update on Foreign Animal Disease Programs of APHIS. Kelly Preston

The mission statement for the International Services Unit of the Animal and Plant Health Inspection Service was discussed. In addition, Dr. Preston outlined the organizational structure of their Unit. He also noted that a review group recommended 11 major areas that need emphasis. Currently, International Services is placing more emphasis on their advisory role less emphasis on their operational role.

Highlights on the World Status of Foreign Animal Diseases.
Kelly Preston

FOOT-AND-MOUTH DISEASES

Foot-and-Mouth Disease:

There have been several recent Foot-and-Mouth Disease (FMD) outbreaks that are of interest. In February–April 1993, Italy experienced over 50 outbreaks of Type 0-1 Middle Eastern Strain. Nearly 8,000 animals were on the affected premises and destroyed. The EEC provided approximately 70% of the indemnity funds. The source appeared to be cattle dealers moving infected animals from Croatia—part of the former Republic of Yugoslavia.

The Middle East is now considered the major endemic area. A formal barrier program funded by the EEC continues in Turkey. The northern African countries of Morocco and Egypt with FMD Type 0-1 continue to be high risk for Europe. In the Americas, southern Peru and southern Argentina are experiencing outbreaks. Chile and the PANAFRITOSA Center are assisting Peru, which with limited resources, apparently had a slow start in combating their summer outbreaks. The October outbreak in Argentina appears to be controlled. The local emergency response in both cases has been quarantines and depopulations.

VESICULAR DISEASES

Swine Vesicular Disease:

Isolated outbreaks in Spain and Italy were presumed to be related to feeder pig imports from the Netherlands. The EEC response was strict quarantine and depopulation.

Hog Cholera:

Hog cholera was reported on a single premise in Baja, California
FOREIGN ANIMAL DISEASES

Mexico, this spring. Strict quarantine and depopulation measures quickly controlled the outbreak. It was not near any large commercial swine production areas.

African Swine Fever:
Both hog cholera or classical swine fever and African swine fever (ASF) cases are declining in Europe. ASF is confined to southwestern Spain, southern Portugal, and the Island of Sardinia in Italy. Hog cholera or classical swine fever were confined to Italy and eastern Europe until the recent outbreaks in Germany where over 80 outbreaks have been identified. Several large premises have been depopulated—the largest had 3,300 swine.

Porcine Reproductive and Respiratory Syndrome:
Porcine reproductive and respiratory syndrome (PRRS) continues to spread in Europe, particularly in areas of high density, intense swine production. Additionally, it was first reported in August 1993 in Japan.

EQUINE DISEASES

Venezuelan Equine Encephalomyelitis:
The classic 1-C epizootic strain of Venezuelan Equine Encephalomyelitis (VEE) was confirmed by the Yale Arbovirus Research Unit this year from a clinical outbreak of VEE in late 1992 in Venezuela. This was the first isolation or reoccurrence of the epizootic strain of the virus in Venezuela since 1973. The outbreak in Venezuela was limited to the State of Trujillo on approximately (14) premises where (31) animals were affected and (11) died. The first signs were observed on December 10, 1992, and the last clinical case was on January 30, 1993. Strict quarantine measures with vector control and massive vaccination campaigns were conducted by local animal health officials. The equine census was reported to be 300–400 animals in the immediate area and approximately 1,500–2,000 in the surrounding areas.

African Horse Sickness:
African horse sickness (AHS) risks from Morocco remain due to its proximity to Europe and the Iberian Peninsula. (The last reported outbreak was in October 1991 that involved 177 cases with nearly 50 percent mortality. This prompted a massive vaccination campaign with 2 million animals or approximately 85 percent of the population vaccinated.) The EEC continues to assist and monitor Morocco’s efforts.

Europe experienced its latest case of AHS in October 1990 in Spain. AHS vaccination was suspended in July 1991, when they perceived that the major threat had passed. The 1992 Olympics in Barcelona were held with
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no incident of AHS. Neighboring Portugal last reported AHS in late 1989. Portugal has now made a formal request to APHIS to be officially declared free of AHS.

Contagious Bovine Pleuropneumonia:
Contagious bovine pleuropneumonia was reported in Portugal where (270) outbreaks occurred in the previously affected northwest area of the country. Additionally, Spain and Italy reported the disease.

Rift Valley Fever:
Southern Egypt experienced Rift Valley Fever outbreaks which the World Health Organization feels has alarming potential for spread due to the unusually high (mosquito) vector populations this year.

Foreign Animal Disease Surveillance. Adam Grow
Suspected FAD Field Investigations: For fiscal year (FY) 1993 (October 1, 1992, through September 30, 1993) veterinarians from the United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) and the States conducted 299 investigations for suspected foreign animal diseases (FAD). These actions are part of the Emergency Programs approach to foreign animal disease surveillance to insure that exotic diseases do not become established in the United States or it's territories. The investigations included 72 (24%) vesicular conditions, 33 (11%) mucosal disease conditions, 124 (41%) avian diseases, 14 (5%) swine septicemic conditions, 29 (10%) encephalitic conditions, and 27 (09%) screwworm, exotic ticks, or other disease conditions.

Hog Cholera/African Swine Fever Surveillance
The VS surveillance program for classical swine fever (hog cholera) and African swine fever was continued in 1993. Swine blood specimens are regularly collected at slaughter from abattoirs located in Maine, Massachusetts, New Hampshire, New Jersey, Arizona, Texas, and Puerto Rico. Additional samples were sent from Arkansas, California, Florida, Hawaii, Illinois, Kentucky, Rhode Island, Vermont, and Washington. The National Veterinary Services Laboratories (NVSL) in Ames, Iowa tested 9,035 samples and all were determined to be negative for the two diseases.

Velogenic Viscerotropic Newcastle Disease (VVND) Surveillance
On April 8, NVSL isolated VVND virus from yellow nape parrots which were seized from smugglers as they crossed into the U.S. The birds were placed in quarantine where they were specimens were collected. A large number of the yellow napes subsequently died of the disease while in quarantine. There was no outbreak of VVND in caged pet birds or domestic

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poultry in the U.S. in FY 1993.

Avian Influenza Surveillance

The avian influenza surveillance program for live-bird markets was continued for Pennsylvania, New York City, New York, New Jersey and the New England area. In December, 1992, diagnostic specimens from a turkey flock north of Philadelphia, Pennsylvania was found to have antibodies for AI H5N2 virus. No virus was found in the turkey flock, but upon further investigations in the area, the virus was recovered from a live-poultry market in the city of Philadelphia. Studies at NVSL demonstrated the virus was nonpathogenic to chickens. Additional studies conducted at the St. Jude's Children's Research Hospital in Memphis, Tennessee, showed that the isolates were different than the 1983–84 AI outbreak virus. However, it was similar to a virus found in the United Kingdom in 1991–92 and it was identical to the AI virus isolated for shore birds on the Chesapeake Bay.

Since January, the virus has been isolated from 5 live-bird markets in New Jersey, 11 live-bird markets in New York, and 1 live-bird market each in Pennsylvania and Florida. In addition, the virus was isolated from a small backyard flock in Pennsylvania and New Jersey. Serological evidence of the virus was identified in one turkey flock in Pennsylvania and a total of 11 backyard flocks in Pennsylvania, Delaware, Maryland, New Jersey, and Michigan, and three live-bird markets in Florida. Surveillance indicated the virus was confined solely to small backyard flocks and live-bird markets. Tracebacks to numerous associated premises showed negative results. Evidence indicates that this nonpathogenic H5N2 AI strain may be endemic in migrating waterfowl and shore birds in the Chesapeake Bay area and can be readily identified wherever routine surveillance is carried out. This large reservoir of virus may be responsible for the maintenance of nonpathogenic H5N2 AI in nature.

On July 6, due to the ongoing surveillance activities for AI, NVSL classified AI subtypes H5N2 and H7N1 viruses in emu and rhea specimens submitted by the Texas Veterinary Medical Diagnostic Laboratory from 2 separate samples submitted by private veterinarians; and AI subtype H7N1 virus from a rhea submitted by Rollins Veterinary Diagnostic Laboratory in North Carolina. On July 20, as a result of epidemiological investigations, NVSL isolated a fourth virus, AI subtype H7N1, from an emu in Texas. There is no published report in the scientific literature about AI disease in rheas or emus.

The NVSL did AI virus pathogenicity determination studies in chickens during July 7–16, and because some of the rhea premises were in close proximity to commercial turkey flocks, further virus studies were conducted utilizing turkey pouls from on July 21–29. The results for both studies indicated that none of the AI viruses were pathogenic to poultry. Samples of the H5N2 and H7N1 AI viruses were sent to the Department of
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Virology and Molecular Biology at Saint Jude Children's Research Hospital in Memphis, Tennessee, for gene molecular characterization. Researchers at St. Jude reported the AI subtype H₉N₂ virus was similar to the AI virus recovered earlier in the year from the live-poultry markets in the Northeast and the one recovered from sentinel chickens in Miami, Florida. The AI subtype H₉N₂ virus had not been identified before, but was determined to be non-pathogenic.

Epidemiological investigation of the North Carolina infected premise revealed that the rhea originated from an exotics sale in Harper, Texas. Other rheas in the flock had serological titers for subtype H₇N₁, but no further evidence of the Al virus was found in other rhea or turkey flocks in North Carolina. In Texas it was found that all of the infected ratites had been purchased though either the Castleberry Exotic Sale in Lampasas, Texas on May 12–14, 1993, or the Raz Exotic Auction in Harper, Texas on May 22, 1993. One infected rhea was part of a consignment that went through both the Castleberry and Raz auctions. The affected rhea in North Carolina was purchased at the Raz auction. Sale records indicated the Raz Exotic Auction had 23 in-state buyers and 2 out-of-state buyers; the Castleberry Exotic Sale had 86 in-state buyers, 32 out-of-state buyers, and one buyer from Ontario, Canada. As a result, fourteen states received ratites from the two auctions. These states include: Arizona, Georgia, Illinois, Louisiana, Michigan, Mississippi, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Tennessee, Texas, and Wisconsin.

State and Federal veterinarians contacted the ratite buyers associated with either of the two auctions and discovered that many of the birds had changed ownership several times since the sale dates in May. All purchased ratites remaining in the buyer's care, along with any other birds on their premises, were inspected and tested for AI. Additionally, any ratites that had been in contact with the auction birds were also inspected and tested. The full results of NVSL's testing revealed serological evidence for exposure to many AI subtypes, including: H₃, H₅, H₆, H₇, H₉, N₁, N₂, N₄, N₅, and N₆ antibody subtypes. This indicates there is a wide variety of AI subtypes circulating in the environment. Many of the ratites also had titers for Chlamydia psittaci and some were culture positive for bacteria that included salmonella and streptococcus. Several owners who purchased the birds reported that some young emus and rheas died shortly after being transported to their premises. Others reported that the ratites arrived sick but responded antibiotic treatment and recovered. There has not, however, been any unequivocal evidence of specific disease due to AI in the ratite flocks.

Due to VS actions with the AI surveillance program for ratites, 31 states have added requirements for ratites to enter the state. These requirements all demand a pre-movement inspection and a health permit and most demand permanent identification and pre-testing for AI exposure.
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There is always a potential for any AI virus to change its degree of pathogenicity. Therefore, extensive surveillance and research efforts with regards to AI are precautionary. The USDA, APHIS will continue to conduct surveillance measures in order to prevent the potential spread of any avian diseases and to maintain a healthy and prosperous poultry-export market. There has been no highly pathogenic AI in the United States since 1984.

Bovine Spongiform Encephalopathy (BSE) Surveillance

The BSE surveillance program which started in May 1990, is continuing. Pathologists at NVSL and Iowa State University are continuing to examine bovine brains submitted to NVSL from the following sources: 1.) foreign animal disease investigations where suspected encephalitic conditions in cattle are reported, 2.) bovine cases confirmed negative for rabies by the Centers for Disease Control in Atlanta, Georgia, 3.) brain specimens collected at slaughter from abattoirs in selected potential high risk States, and 4.) brain tissues submitted by veterinary diagnostic laboratories in the United States. To enhance the surveillance process, visits have been made by State or USDA personnel to state public health and university diagnostic laboratories to arrange for the submission of suspicious specimens NVSL in Ames, Iowa. Contacts with practicing veterinarians have also been made to increase reporting and the submission of brains from suspicious cattle. As of September 30, 1993, a total of 1215 bovine brains have been examined; none of these specimens contained any characteristic lesion for BSE. Additionally, none of the traced cattle, (393 out of 459), that were imported from the United Kingdom since 1981, have showed any clinical signs of BSE. There has been no case of BSE diagnosed in the United States.

On September 89 a BSE Symposium was held at the University of Wisconsin to assess the possible occurrence of BSE in this country. Participants included university scientists, USDA officials, and representatives of the rendering industry.

Emergency Programs Epidemiology and Risk Assessment

In May, International Services, APHIS, reported screwworm, Cochliomyia hominivoras had been identified in a cow near Veracruz, Mexico. This case was approximately 300 miles south of the United States–Mexico border. A team was sent to investigate the case, a quarantine was placed, and emergency operations initiated. An update fact sheet on screwworm was prepared and distributed by VS in states along the U.S. Border. The outbreaks appears to now be eradicated and sterile fly release has stopped.

International Services, APHIS, also reported an outbreak of hog cholera in Baja California, Mexico, in May. This Mexican State had previously been free of hog cholera for the last 10 years. An updated fact
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sheet on hog cholera was prepared and distributed by VS in States along the U.S. Border.

In July, NVSL isolated Venezuelan Equine Encephalitis (VEE), subtype 1E, virus from horses in Chiapas, Mexico. This was an unknown variant on an endemic strain that seems to have drifted genetically such that it became pathogenic and produced morbidity and mortality in equids. As a result of this VEE epizootic, in late July, movement of equidae from Mexico into the United States was restricted. Equidae were only allowed to cross the Mexico–United States land border ports after they are quarantined in vector proof facilities for 7 days prior to entry. Equine from Mexico could enter the country via airplane through animal import centers in New York, Florida, and California, and be quarantined there for 7 days while being monitored for VEE. All veterinarians in the border States of California, Arizona, New Mexico, and Texas were contacted and informed about this new situation. Emergency Programs encouraged veterinarians to report any suspected case of encephalitis in horses. All reports of central nervous system disorders in equine located in these States were investigated by VS personnel. Furthermore, it is recommended that equidae in the States near the Mexican border be vaccinated with the currently available trivalent equine encephalitis vaccine (EEE, VEE, and WEE).

On August 24, NVSL received and identified a single larva of the hairy maggot blow fly, Chrysomya rufifacies, collected from a lesion on a dog in San German, Puerto Rico. This is the third interception of this Austral–Asian blow fly on the island, and it probably represents a new introduction from recently established populations in Florida, Texas, and Central America. Follow–up surveys in Puerto Rico were negative after previous collections in Yauco (1974) and Juncos (1991).

Duck virus enteritis was diagnosed in flocks of wild ducks in South Carolina, Maryland, and California during the spring of 1993. Veterinarians form APHIS, the Southeastern Cooperative Wildlife Disease Study, South Carolina, and California worked on the outbreaks. Diagnostic specimens were sent to the National Wildlife Health Research Center in Madison, Wisconsin, and to the California Department of Fish and Game in Sacramento.

In mid–September, 1993, the Centers for Disease Control and Prevention (CDC), in conjunction with the El Paso City–County Health District and the Texas State Department of Health investigated an outbreak of salmonellosis in humans in El Paso, Texas. The etiologic agent in the outbreak was Salmonella enteritidis phage–type 4 (SEPT4). Based on the epidemiological evidence, improperly cooked egg rolls served at a single fast–food Chinese restaurant were implicated as the responsible vehicle. It was also demonstrated that an egg batter, made with shell eggs, was used to coat the egg rolls, and this was the most likely source of salmonella. The shell eggs were traced to a large egg producer in Texas with over 2.5 million

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chickens. Extensive environmental and poultry testing by Federal and Texas State Veterinarians has shown the chickens are not infected with SEPT4. In Mexico, human salmonella infections has demonstrated that SEPT4 is widespread in the population. APHIS veterinary epidemiologist are continuing to study and work on this problem.
CONSERVED RECOMBINANT ANTIGENS OF ANAPLASMA MARGINALE AND BABESIA EQUI FOR SEROLOGIC DIAGNOSIS

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SUMMARY

The Competitive Inhibition ELISA (CI–ELISA) format overcomes problems associated with antigen purity since the specificity of the CI–ELISA depends solely on the monoclonal antibody (mAb) used. Therefore, the CI–ELISA format is well suited for use with recombinant antigens. Molecular clones expressing a conserved 19 kDa protein of Anaplasma marginale and a 34 kDa protein of Babesia equi were derived and characterized. The 19 kDa A. marginale protein, conserved in all recognized Anaplasma species, and present in the infected tick salivary gland, was reactive with all bovine immune sera tested. The 34 kDa B. equi protein contains a protein epitope bound by antibody in equine immune sera from 19 countries. Monoclonal antibodies reactive with these proteins were derived and applied with recombinant copies of the 19 kDa A. marginale and 34 kDa B. equi proteins in a CI ELISA format.

DIAGNOSIS OF A. MARGINALE & B. EQUI

Anaplasmosis, a vector–borne rickettsial disease of cattle, is caused by Anaplasma marginale¹ and A. centrale². Clinical disease is characterized by anemia, weight loss, abortion and death³. Survivors are lifelong carriers of the rickettsia⁴. The tick–borne hemoprotozoan Babesia equi causes disease that affects horses worldwide⁵–⁷. Infection followed by fever, anemia and icterus can occur when uninfected horses are moved into endemic areas or infected horses are moved into nonendemic areas in which an appropriate tick vector is present⁸. Horses that survive initial infection are lifelong carriers of B. equi⁹.

Eventual control of A. marginale infection will require both an effective vaccine and identification of carrier cattle¹⁰. Two possible methods
CONSERVED RECOMBINANT ANTIGENS

for routine carrier identification are a nucleic acid probe for hybridization of infected cattle blood or the detection of *A. marginale*–specific antibody in serum. Hybridization of DNA extracted from blood with an *A. marginale*–specific nucleic acid probe does not always detect known carriers, because of cyclic changes in rickettsemia levels. Carrier identification by antibody requires that infected cattle never clear the rickettsia. Indefinite persistence of *A. marginale* in infected cattle has been documented. Current serologic tests for anaplasmosis are not widely used, primarily because the error rate is high. One problem with current tests is false positive results caused by erythrocyte contamination of the *A. marginale* antigen used in the tests, and the presence of anti-erythrocyte antibody in the sera of some cattle.

Infection with *B. equi* is a problem for the importation and exportation of horses. Many countries, including the United States, do not allow importation of *B. equi*–infected horses. Since 1969, the U.S. Department of Agriculture has used the complement fixation test (CFT) to identify *B. equi* infected horses. The limitations associated with the CFT, including the inability to evaluate sera with anticomplement activity, have been described. Also, since it has not been possible to continuously cultivate *B. equi* in vitro, antigen for CFT must be produced by the infection of splenectomized horses.

First described for use in detecting anti–bluetongue virus antibody, the CI–ELISA format has also been used to detect antibodies to *Cowdria ruminantium*, *A. marginale* and *B. equi*. Components of the CI–ELISA include a mAb and corresponding epitope. The mAb must possess an appropriate binding affinity such that polyclonal antibody can replace it in the competitive reaction. Desirable epitope characteristics include a linear peptide composition, immunodominance, and conservation among isolates. The former is an important characteristic in cases where production of the epitope by molecular cloning and expression in bacteria is necessary. Since the specificity of the CI–ELISA depends entirely on the mAb used, the test is well suited for use with recombinant antigens. If the recombinant antigen is expressed in sufficient quantity to provide an appropriate signal:noise ratio after application to the ELISA plate as a bacterial lysate, additional purification of the recombinant antigen is not necessary.

In an effort to improve the serological detection of *A. marginale* and *B. equi*, recombinant antigens with the above described characteristics and corresponding mAbs were derived. A 19 kDa *A. marginale* surface protein, conserved in all recognized *Anaplasma* species, and present in the infected tick salivary gland, was shown to be reactive with all bovine immune sera tested. A 34 kDa *B. equi* protein that contains a surface protein epitope recognized by antibody in equine immune sera from 19 countries, has demonstrated utility in the CI–ELISA format.

In parasitic infections that are persistent, the CI–ELISA format can
be used to serologically detect carriers. An important attribute of the ClELISA format is the ease with which it can be used with recombinant antigens. This is especially important in those parasitic diseases for which diagnostic antigen cannot be produced in cell culture. Furthermore, the production of recombinant antigen in *E. coli* precludes the necessity of infecting animals for antigen production.

**REFERENCES**

2. Theiler, A. (1911) In First report of the Director of Veterinary Research, Union of South Africa, 7-76.
CONSERVED RECOMBINANT ANTIGENS


The Hemoparasitic Diseases Committee met on Thursday, October 28, 1993, at 1:30 pm in Room 5. There were 7 members and 5 guests present. Seven presentations were made to the committee.

Dr. Gale Wagner, Texas A & M University, reported on the use of in vitro cultivation of *Anaplasma marginale* to obtain a more efficacious and economical method as antigen source for vaccine production. He used the reported short-term *in vitro* cultivation to define growth conditions such as media, pH, packed cell volume, culture volume and gaseous conditions in their attempts to grow *A. marginale* in a continuous culture system. It was found that Glasgow's MEM with either fetal calf or adult bovine serum was best for the maintenance of *A. marginale*. They were able to maintain *A. marginale* in a primary culture for a maximum of 16 weeks if hemolysis was avoided. Following splitting, increase in the percent rickettsiemia in passages has ranged from 2–4.5% (equivalent to between 17–23% change of infected cells). However, they were unable to maintain the organism at rickettsiemia greater than 3% for more than 4 passages. Electronmicrographs taken at various time points indicate dividing initial bodies in the erythrocytes at 10 days in passage 1. Electronmicrographs of the co–cultured endothelial cells in 30 day old primary cultures of *A. marginale* infected erythrocytes show multiple initial bodies which may be related to the phagocytic activity of these cells rather than supporting the growth of the rickettsia.

Dr. Wagner also reported on a cell culture derived vaccine for babesiosis. Vaccine was prepared from erythrocyte cultures of Mexican strains of attenuated *Babesia bovis* and avirulent *B. bigemina*. Established, low passage cultures of *B. bovis* at high parasitemias were rapidly subcultured to achieve attenuation. Aliquots of cultures were cryopreserved at various passage (or subculture) levels. Attenuation of pathogenicity was tested in cattle using known numbers of infected erythrocytes. The experimental vaccine was formulated and cryopreserved at passage 75 for *B. bovis* and passage 50 for *B. bigemina*. An intramuscular dose (1.0ml) of $10^7$ infected erythrocytes of each organism was administered. Control animals received vaccine diluent. Cattle were observed for post–vaccinal reactions for 30 days. Field challenge of immunity was conducted on various
ranches in Mexico. Presence of *Babesia*-infected *Boophilus* ticks was determined prior to vaccination. The immunity to field infection was determined by clinical, parasitological, and serological observations over a 30 day period.

Dr. D. P. Knowles, Animal Disease Research Unit, Agricultural Research Service, U.S. Department of Agriculture, Pullman, Washington, reported on infection of severe combined immunodeficient foals with *Babesia equi*. Two severe combined immunodeficient foals (SCID) and two age matched normal foals were infected with *Babesia equi*. Although SCID foals lack mature T- and B-lymphocytes, they do possess complement, macrophages, neutrophils, natural killer cells, and are spleen intact. The normal foals controlled parasitemia by 10 days post infection; however, both SCID foals were unable to control parasitemia and were in extremis by 10 days post infection. Concomitant with increasing parasitemia, the SCID foals had marked decreases in erythrocyte parameters including PCV, hemoglobin concentration and total erythrocytes. The conclusions were: (1) specific immunity is necessary to control *B. equi* parasitemia; (2) specific immunity is not required for erythrocyte lysis; and (3) in the absence of specific immunity the spleen is not able to control *B. equi* parasitemia.

Dr. G. M. Buening, University of Missouri, Columbia, Missouri, reported on Nucleic Acid Probes as a Diagnostic Method for Tick-borne Hemoparasites of Veterinary Importance. By using recombinant DNA techniques, selected clones containing inserts of *Anaplasma*, *Babesia*, *Cowdria* or *Theileria* genomic DNA sequences were obtained, and they are now available to be utilized as specific, highly sensitive DNA or RNA probes to detect the presence of the hemoparasite DNA in an infected animal. Either in an isotopic or non-isotopic detection system, their use will allow scientists to test for, originally in samples collected from experimentally infected animals and later on in samples collected in the field, the presence of hemoparasites during the prepatent, patent, convalescent, and chronic periods of the infection in the host. Nucleic acid probes have given researchers the opportunity to carry out genomic analysis of parasite DNA to differentiate hemoparasite species and to identify genetically distinct populations among and within isolates, strains and clonal populations. Prevalence of parasite infection in the tick vector can now be accomplished more specifically with the nucleic acid probes. Lately, with the advent of the polymerase chain reaction, small numbers of hemoparasites can be positively identified in the vertebrate host and tick vector. These techniques can be used to assess the veterinary epidemiological situation in a particular geographical region for the planning of control measures.

Dr. Buening also gave a summary of the FAO Expert Consultation on the Use of Applicable Biotechnological Methods for Diagnosing Hemoparasites held in Merida, Mexico. Experts representing at least 12 different countries participated. The group considered the four major tick-
HEMOPARASITIC DISEASES

borne diseases of ruminants. Presentations and working papers were submitted on topics relevant to anaplasmosis, babesiosis, theileriosis and cowdriosis. The participants developed a list of recommendations. A list of preliminary recommendations were as follows: (1) training in the use of diagnostic techniques should preferably be carried out in the country or region where the techniques are to be applied; (2) a list of available and potential diagnostic tests, including protocols and reagents such as monoclonal antibodies, probes and primers, should be compiled; (3) a rapid diagnostic test for cowdriosis needs to be developed; (4) diagnostic tests for epidemiological surveys should only be applied after laboratories have defined the aims and strategies for the surveys; (5) FAO and other international organizations should assist in the establishment of networks for the purpose of promoting free flow of information between existing regional and global networks on tick–borne hemoparasitic diseases and their diagnosis.

Dr. W. L. Goff, Animal Disease Research Unit, Agricultural Research Service, U.S. Department of Agriculture, Pullman, Washington, reported on studies that indicated products of activated macrophages were babesiacidal in vitro. Researchers in his group employed an in vitro system which allows for continuous growth of Babesia bovis to investigate the effects of products of macrophage activation on parasite viability. Polyamine oxidases, which degrade polyamines (spermine, spermidine, and putrescine), are present at high levels in bovine serum and are secreted at elevated levels by activated macrophages. Polyamine oxidation leads to the production of the reactive oxygen intermediates hydrogen peroxide, hydroxyl radical, singlet oxygen, and ammonia. These products also result from the oxidative burst that occurs at higher levels in activated macrophages. The addition of polyamines to B. bovis cultures, as well as addition of xanthine oxidase, an enzyme which produces these same reactive oxygen intermediates when it acts on the substrate xanthine, caused a drop in the percent parasitized erythrocytes (PPE) and led to degeneration of intraerythrocytic parasites (aka "crisis forms"). Using a dual chamber system in which splenic leukocytes were maintained in a lower chamber and separated from B. bovis cultures grown in an upper chamber by a 0.45 μm membrane, they have demonstrated that activation results in a decrease in PPE and an increase in crisis forms.

Dr. Goff also gave a summary of the Ninth International Veterinary Hemoparasite Disease Conference held in Merida, Yucatan, Mexico. This conference, the ninth in a series organized by the U.S. Veterinary Hemoparasite Research Workers (VHRW), was the first held outside the continental United States. It is the intention of VHRW to move the conference to a different geographic region of the world each 3 to 4 years, so that tick–borne hemoparasitic diseases can be highlighted in a different and in some aspects, unique regional context. At the same time, the con-
The conference remains a global event. This conference had over 100 participants representing all continents and 23 countries. The conference was co-organized by the Instituto Nacional de Investigaciones Forestales Y Agropecuaria (INIFAP), Asociacion Mexicana de Parasitologia Veterinaria, and Universidad Autonoma de Yucatan. Major sponsors were the Food and Agriculture Organization of the United Nations and the U.S. Agency for International Development. Eight to ten papers were presented in each of the six scientific sections covering the topics: Molecular Biology, Recent Developments in Diagnostics, Epidemiology and Animal Health Informatics, Tick Vector Biology and Control Strategies, Immunology and Pathogenesis, and New and Conventional Vaccine Strategies, and eighteen posters were attended covering similar topics.
ANTIGENIC CHIMERAS OF FMDV
Foot-and-mouth disease virus chimeras expressing intertypic antigenic sites

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Plum Island Animal Disease Center, Agricultural Research Service, United States Department of Agriculture, Greenport, NY 11944 USA

SUMMARY
We have developed a method to engineer genetically defined foot-and-mouth disease viruses (FMDV) which will have wide-spread applications in the study of FMD. Production of these genetically defined viruses has been made possible by our ability to assemble a full-length cDNA molecule corresponding the entire genome of the virus, and propagate this genome in *E. coli*. This full-length genome is used to produce RNA molecules *in vitro*, which when introduced into animal cells produce new viruses. By specifically altering the nucleotide sequences in the full-length cDNA we have been able to produce unnatural viral RNAs and FMDVs. Characterization of these novel viruses has allowed us to investigate several important aspects of FMDV biology. In this report, we describe the production and characterization of intertypic chimeras of FMDV.

INTRODUCTION
Foot-and-mouth disease virus, an aphthovirus of the family Picornaviridae, causes a devastating disease of domestic animals\(^1,2\). Despite the successful application of inactivated vaccines in controlling the disease, there are some risks associated with the use of these products. In particular, the escape of virus from vaccine production plants and failure to completely inactivate the vaccine have led to outbreaks. As a result, FMD vaccines are not produced in the USA and vaccination is not permitted. Further problems in successful control of FMD stem from the fact that the virus can undergo extensive variation, and antigenic variants often arise which cause disease in vaccinated animals. Understanding these problems and production of new vaccines will be greatly assisted by the ability to genetically engineer FMD viruses to test theories on antigenic variation, immunogenicity, and pathogenicity.

FMDV contains a single-stranded positive sense RNA genome of 8,500 nucleotides that is polyadenylated at the 3' terminus and encapsidated in a shell composed of 60 copies of each of four coat proteins, VP1–4. VP4 is located inside the virus particle, while VP1, VP2, and VP3 are exposed on the outer surface of the capsid\(^3\).

An immunodominant site of FMDV has been identified in the loop between the G and H beta strands of VP1 (site 1)\(^3\), but monoclonal antibody (MAb) studies have identified other immunogenic sites on the virion\(^4\). Although epitopes from the immunodominant site can be expressed in the
form of peptides comprising the G–H loop, vaccines based on these immunogens alone may lack practical application since they would theoretically be more susceptible to antigenic variation than existing whole–virus vaccines.

Aside from its immunodominance, the G–H loop of VP1 has other important biological properties. For example, it is altered in many antigenic variants, yet it contains a conserved arginine–glycine–aspartic acid (RGD) sequence which has been implicated as the virion receptor.

Construction of an infectious cDNA of FMDV A12 has allowed us to directly examine the relative importance of the immunodominant G–H loop of VP1 in the protective immune response. Specifically, we have designed and produced chimeric viruses in which the immunodominant G–H loop of serotype A12 has been replaced by the corresponding loops from serotypes C3 or O1. In this paper we show that sequential epitopes contained within the G–H loops of FMDV serotypes O and C can be successfully transferred onto the A12 backbone producing viable viruses that are useful in probing the immunogenic properties of FMDV.

MATERIALS AND METHODS

Cell lines, viruses, and plasmids

Baby hamster kidney (BHK) cells were propagated as described previously. FMDV types included the O1 British field strain (O1 BFS) and C3 Resende (C3RES) and A12 derived from the infectious clone pRMC35 (A12IC). All plasmids used to produce chimeric viruses were derivatives of pRMC35.

Construction of chimeric cDNAs and recovery of chimeric viruses

Two new restriction endonuclease sites (MscI and Nhel) bordering the G–H loop of VP1 were inserted into plasmid p44 using standard polymerase chain reaction (PCR) techniques (Fig.1). Double–strand oligonucleotides containing these restriction sites and the G–H loops of O1 BFS or C3RES were synthesized, and ligated into the new restriction sites in p44. Chimeric A/O and A/C VP1 cDNA molecules were then excised from the p44 derivatives and inserted into the full length infectious cDNA pRMC35 via a shuttle vector containing a 4,260–base pair EcoRI restriction endonuclease fragment extending from within the leader protease coding region into 3A (Fig.1). The full–length cDNA containing plasmids were then re–sequenced through the G–H loop to confirm the proper insertions.

In vitro RNAs were produced from NotI–linearized, full–length cDNA plasmids using T7 RNA polymerase, and transfected into BHK cells using Lipofectin (GIBCO–BRL; Gaithersburg, MD).
Monoclonal Antibodies

Neutralizing MAbs against FMDV type A12 (2PD11, 6EE2, 7SF3) and O1 Brugge (12FE9, 10GA4) have been characterized previously\textsuperscript{13-15}. The FMDV C3 Indiana–specific MAbs (7AB5 7EE6 7CF12 7CA11) were kindly provided by Drs. F. Osorio and V. Astudillo (Centro Panamericano de Fiebre Aftosa, Rio de Janeiro, Brazil). Plaque reduction neutralization tests were performed as previously described\textsuperscript{13}, and values reported are titers giving 70% reduction in plaque number (PRN–70).

Virus purification and BE1 inactivation

Viruses were purified in sucrose gradients\textsuperscript{13}, and inactivated with binary ethylene imine (BE1) as described by Bahnemann\textsuperscript{16}.

RESULTS

Production of chimeric viruses

Chimeric full–length FMDV type A12 cDNA molecules containing the G–H loops of FMDV O1 BFS and C3RES were generated as shown in Fig. 1. The exact coding sequences inserted in these full–length cDNA plasmids, designated PRM–A/O and PRM–A/C are shown in Fig. 2. Junction points between the G–H loop and the body of the virion were selected based on alignments of the sequences of the A, C, and O viruses\textsuperscript{17-19}, and the crystal structure of the type O virion\textsuperscript{20}.

T7 RNA transcripts derived from pRMC35, pRM–A/O, and pRM–A/C displayed indistinguishable specific infectivities in BHK cells, indicating that all three transcripts were equally viable (Table 1). Furthermore, AI21C, Ch. A/O, and Ch. A/C showed identical plaque morphologies in BHK cells (results not shown), and grew to similar titers in liquid culture (Table 1). Samples of each virus recovered from infected BHK cells were amplified using PCR and sequenced through the G–H loop, confirming the expected amino acid coding sequences (Fig. 2). Furthermore, the chimeric viruses maintained these sequences through 4 additional passages at low multiplicities of infection in these cells, demonstrating that these sequences were genetically stable.

Antigenic properties of the chimeric viruses

The antigenic properties of the chimeric and parental viruses were examined using a panel of serotype–specific MAbs (Table 2). Reaction with the A type–specific MAb 7SF3, mapped to an epitope in the G–H loop\textsuperscript{14}, was restricted to the A12 parent virus. Neutralization titers obtained with MAb 6EE2, which recognizes a sequential epitope near the C–terminus of VP1\textsuperscript{14}, indicated that this epitope was displayed equally well by the parent virus and both chimeras (Table 2). Reactions with the conformational epitope recognized by 2PD11, which includes residues near the C–terminus of VP3\textsuperscript{14}, revealed a similar reactivity profile (Table 2). These data indicate that
the substitution of foreign G–H loops did not greatly influence the antigenic structure of the virion. Reactions of type O–specific MAbs showed that the G–H loop–specific MAb 12FE915 reacted with both O1BFS and the A/O chimera, whereas 10GA4, which recognizes a conformational epitope located elsewhere in the virion, only reacted with O1BFS (Table 2). All of the type C–specific MAbs tested reacted with sequential epitopes transferred to the chimeric virus (Table 2), suggesting that several different epitopes were transferred with the type C loop sequences.

**Immunogenicity of the chimeric viruses in guinea pigs**

Guinea pigs were used to evaluate the ability of the chimeric viruses to induce a neutralizing immune response to both the A12 backbone and the donated G–H loop. Two micrograms of sucrose density gradient–purified, BE1 inactivated viruses were inoculated into guinea pigs. Sera collected 21 days post–immunization were tested for their ability to neutralize the virus in PRN assays. As expected, the highest PRN–70 titer obtained for each immunogen was with the homologous virus. These titers varied widely, from 2.2 logs for O1BFS to over 3 logs for A12 and the A12–based chimeras. Antibodies produced against type A12 also reacted with both chimeras, and antibodies elicited by C3RES recognized the A/C chimera as well (Table 3). In the case of O1BFS, the homologous reaction was the poorest detected, and PRN–70 reactivity could not be detected against the A/O chimera at a 1:10 serum dilution (Table 3). Chimeric viruses induced high levels of homologous antibodies and also elicited antibodies that cross–reacted with both of their parents. In the case of the A/O chimera, the homotypic reaction was over 3 logs, and the cross reactions with type O1, A12, and the A/C chimera were about 2 logs (Table 3). Interestingly, the A/O immunogen induced levels of neutralizing antibodies to O1BFS that were equal to those induced by immunization with O1BFS itself (Table 3). The A/C chimera elicited antibodies with homologous neutralization titers of 3 logs, and cross–reactive titers of over 2 logs with type C3, A12, and the A/O chimera (Table 3).

**DISCUSSION**

Intertypic chimeras of FMDV type A12 containing the sequences of the immunodominant epitope of types C3 or O1 have been created and characterized. These viruses grow well in cultured cells and display plaque phenotypes indistinguishable from the A12 parent (A12C). Chimeric viruses stably maintained the O1 or C3 sequences on passage, indicating that the loop sequences are readily interchangeable between viruses of these three serotypes. Reactions of a panel of MAbs with the chimeric viruses showed that the immunodominant antigenic sites of FMDV could be easily exchanged in an antigenically recognizable form. All tested MAbs known to react to sequential determinants in the G–H loop of VP1 efficiently neutralized chimeras expressing the substituted loop region. Furthermore, sequential or
conformational determinants outside of the loop of the A12 virus were maintained in the chimeric viruses, whereas sequential determinants mapped to the A12 G–H loop were lost upon substitution of this sequence.

To determine if the transferred antigenic sites remained immunogenic, we tested vaccines prepared from the chimeras in guinea pigs. These studies showed that the chimeric viruses were capable of producing cross–reactive immune responses. Specifically, chimeras induced neutralizing antibodies of over 2 logs to the A12 parent demonstrating the value of sites outside of the loop in eliciting a protective immune response.

Our data support the importance of the loop region in the antigenicity of FMDV and indicate that the immunodominant site is readily dissociable from the remainder of the virus particle. These data are particularly interesting since studies on serotype O virus have shown that sequences in the body of the virus can alter the conformation of epitopes found in the G–H loop\textsuperscript{20,21}. Taken together, our findings will serve as the basis for studies to try to enhance the immunogenicity of these sites to produce better FMD vaccines.

REFERENCES

ANTIGENIC CHIMERAS OF FMDV

RIEDER, BAXT, MASON

Table 1. Comparison of specific infectivity of full-length RNAs, and virus yields from BHK cells infected with viruses recovered from transfected cells.

<table>
<thead>
<tr>
<th>RNA Source (or virus)</th>
<th>pfu/µg&lt;sup&gt;a&lt;/sup&gt;</th>
<th>pfu/ml&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>pRM-C35</td>
<td>4.7 x 10&lt;sup&gt;3&lt;/sup&gt;</td>
<td>6.5 x 10&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>pRM-A/O</td>
<td>7.8 x 10&lt;sup&gt;3&lt;/sup&gt;</td>
<td>3.0 x 10&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>pRM-A/C</td>
<td>4.7 x 10&lt;sup&gt;3&lt;/sup&gt;</td>
<td>4.0 x 10&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>01BFS</td>
<td></td>
<td>3.3 x 10&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
<tr>
<td>C3RES</td>
<td></td>
<td>3.0 x 10&lt;sup&gt;7&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Specific infectivity on BHK cells using Lipofectin.

<sup>b</sup> Titers of virus obtained from overnight growth on BHK cells.

Table 2. Reactivity of the parent and chimeric viruses with MAbs raised against the parent viruses.

<table>
<thead>
<tr>
<th>MAbs&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Neutralization titer&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Virus</th>
<th>Virus</th>
<th>Virus</th>
<th>Virus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A12</td>
<td>A/O Ch.</td>
<td>A/C Ch.</td>
<td>O1BFS</td>
</tr>
<tr>
<td>Type A&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7SF3</td>
<td>2.0</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
</tr>
<tr>
<td></td>
<td>6EE2</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>&lt;0.7</td>
</tr>
<tr>
<td></td>
<td>2PD11</td>
<td>4.1</td>
<td>3.8</td>
<td>3.5</td>
<td>&lt;0.4</td>
</tr>
<tr>
<td>Type O&lt;sup&gt;c&lt;/sup&gt;</td>
<td>12FE9</td>
<td>&lt;0.7</td>
<td>3.8</td>
<td>&lt;0.7</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>10GA4</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Type C&lt;sup&gt;d&lt;/sup&gt;</td>
<td>7AB5</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>3.5</td>
<td>&lt;0.4</td>
</tr>
<tr>
<td></td>
<td>7EE6</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>2.9</td>
<td>&lt;0.4</td>
</tr>
<tr>
<td></td>
<td>7CF12</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>3.8</td>
<td>&lt;0.4</td>
</tr>
<tr>
<td></td>
<td>7CA8</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>4.4</td>
<td>&lt;0.4</td>
</tr>
<tr>
<td></td>
<td>7CA11</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>4.4</td>
<td>&lt;0.4</td>
</tr>
</tbody>
</table>

<sup>a</sup> Log PRN-70 values.

<sup>b</sup> Hybridoma designation.

<sup>c</sup> MAbs were produced at PIADC, USDA.

<sup>d</sup> MAbs provided by CPFA, Brazil.
Table 3. Neutralization of the parental and chimeric viruses with guinea pig antisera.

<table>
<thead>
<tr>
<th>Immunogen&lt;sup&gt;a&lt;/sup&gt;</th>
<th>A12</th>
<th>A/O Ch.</th>
<th>A/C Ch.</th>
<th>O1BFS</th>
<th>C3RES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A12</td>
<td>3.4</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
<td>2.2</td>
<td>2.2</td>
</tr>
<tr>
<td>O1BFS</td>
<td>&lt;1.0</td>
<td>2.2</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>C3RES</td>
<td>&lt;1.0</td>
<td>&lt;1.0</td>
<td>2.5</td>
<td>1.0</td>
<td>2.5</td>
</tr>
<tr>
<td>A/O chimera</td>
<td>2.2</td>
<td>2.2&lt;sup&gt;c&lt;/sup&gt;</td>
<td>&lt;1.0</td>
<td>3.4</td>
<td>1.9</td>
</tr>
<tr>
<td>A/C chimera</td>
<td>2.2</td>
<td>&lt;1.0</td>
<td>2.2&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2.2</td>
<td>3.1</td>
</tr>
</tbody>
</table>

<sup>a</sup> Identity of the BEI-inactivated virus.

<sup>b</sup> Log PRN-70 values from sera pooled from all four animals in each group, (PRN titers of <1.0 were detected in preimmune sera from all groups).

<sup>c</sup> Log PRN-70 titers of individual sera: 1.6, 1.6, 1.6, 2.2, 2.5.

<sup>d</sup> Log PRN-70 titers of individual sera: 2.5, 1.6, 1.6, 2.2, 2.2.
Fig. 1. Diagram of cDNAs used to produce antigen chimeras of FMDV. The top half of the figure shows the VP1 plasmid, p44, with the added MscI and NheI sites used to insert the G–H loop sequences from the type O1 BFS and C3RES viruses. Plasmid pRMC35 encoding the full-length cDNA of FMDV type A12\textsuperscript{10}, is shown in the bottom half of the figure.
**Amino acid # in VP1**

<table>
<thead>
<tr>
<th>Plasmid</th>
<th>130</th>
<th>140</th>
<th>150</th>
<th>160</th>
</tr>
</thead>
<tbody>
<tr>
<td>pRMC35</td>
<td>VLATVY</td>
<td>NGTNKYSASG</td>
<td>SGV-RGDFGSL</td>
<td>APRVAROLPA</td>
</tr>
<tr>
<td>pRM-A/O</td>
<td>VLATVY</td>
<td>NGecrYSma</td>
<td>vpnRGDIqvl</td>
<td>AqkVARtLPA</td>
</tr>
<tr>
<td>pRM-A/O</td>
<td>VLATVY</td>
<td>tGTtYttSa</td>
<td>___-tRGDialL</td>
<td>AtahARhLPA</td>
</tr>
</tbody>
</table>

Fig. 2. Alignment of amino acid sequences of the G–H loop of VP1 found in A12 virus and the antigenic chimeras. Lower case is used to highlight differences, "-" indicates a gap.
INTRODUCTION
The advent of Jet Aircraft has, in recent years, enabled horse persons to travel the world seeking new bloodlines and breeds of horses not commonly found in the U.S.A. Also, international competitive events for horses are becoming more numerous. Horses are now an international commodity. In concert with the forementioned international interfacing, our committee enjoyed the following guest doctors that participated in committee discussions: Bernard VanGoethen (E.C.); Robin Bell (UK); Norman Willis and Barry Stemshorn (Canada); and Hector Campos Lopez (Mexico).

EQUINE ENCEPHALITIS
Appended to this report is Dr. J. E. Pearson's USDA - Summary of Equine Encephalitis Surveillance, January 1, 1992 – October 15, 1993.

In early 1992, the Republic of Mexico animal health officials suspended vaccination of horses and other equids against Venezuelan Equine Encephalitis (V.E.E.) and declared epidemic V.E.E. as eradicated from Mexico in June, 1992. Dr. Hector Campos Lopez summarized the events of an epidemic of V.E.E. that occurred in the State of Chiapas along the Pacific coast of Mexico. During June and July, 1993, Dr. Campos' summary is highlighted as follows:

1. 61 horses were reported dead from V.E.E. (a certain few were not V.E.E.)
2. An official quarantine was placed on the affected and perifocal areas. Mosquito control was carried out.
3. Vaccination of equids, starting July 16 and ending in August, consisted of injecting 38,600 animals with TC83 including 15,763 in the perifocal area.
4. One hundred and fifty-eight disease investigations were carried out.
5. Movements of horses from Chiapas to slaughter in Mexico were reported to be: April-535, May-632, June-612, July-325, August-0, and September-395. 80% of the sick and dead horses were under two years old. Dr. J. E. Pearson (USDA) reported that scientists
REPORT OF THE COMMITTEE

familiar with V.E.E., believe that the V.E.E. viral strain is; formerly recognized as an endemic (sylvatic strain) has mutated to an epidemic (virulent) strain in Mexico.

6. The Mexican quarantine of the V.E.E. affected area in Chiapas was released on August 27, 1993.

Dr. Campos and his Mexican colleagues are to be highly commended for their strong actions against V.E.E.

Dr. J. E. Pearson reported briefly, in lieu of any person from Venezuela known to be at the 97th USAHA meeting, on an outbreak of V.E.E. in an area of Venezuela that borders the eastern shore of Lake Maracaibo (see Dr. Pearson's report entitled summary of Equine Encephalitis Surveillance, January 1, 1992 – October 15, 1993 appended to this report).

Under an Interim Rule, U.S.D.A. has been operating three quarantine stations for horses offered for importation from Mexico into the United States of America. These horse quarantine stations are reported to be screened facilities to keep out mosquitos. These quarantine stations are located at Tijuana, Jaurez, and Nuevo Laredo.

The Committee discussed this quarantining method on the Mexican side of the border. It was concluded that these three quarantine station situations did not provide adequate protection against V.E.E. relative to the horse populations in the U.S.A.

A resolution in concert with the posture of the American Horse Council was advanced – objecting to these land border port quarantine stations.

Dr. J. E. Pearson presented an overview on the epidemiology of V.E.E. as to aspects of: Reservoirs of the virus – rodents, vectors of this virus – mosquitos, disease spread by the movement of mosquitos and equids, the part that control measures, such as vaccination with TC83 and pesticide applications can play in stopping the perpetuation of disease.

EQUINE INFECTIOUS ANEMIA (EIA)

Dr. Joyce Bowling reviewed the Agar-Gel Immunodiffusion test results reported from October 1, 1992 – September 30, 1993.

IDEXX Laboratories' William J. Palen, PhD. reported on their 1993 findings. There was 99.8% correlation between their CELISA and AGID test results.

The U.S. map entitled Equine Infectious Anemia and a tabulation entitled, Progress Summary of Equine Infectious Anemia Program, are appended to this report. The map reflects the total animals tested as 1,035,073, among these 1,859 positive reactions were revealed.

EQUINE PIROPLASMOSIS (E.P.)

Detailed information was presented by Dr. David Stiller, USDA-ARS, Pullman, WA, concerning the currently recognized natural and/or experi-
mental New World tick vectors of equine piroplasms. The vector ticks include *Dermacentor nitens*, *D. albipictus*, and *D. variabilis*, for *Babesia caballi*, and *D. variabilis* and *Boophilus microplus*, for *Babesia equi*. *Babesia caballi* was in all cases transmitted transovarially, whereas *B. equi* was transmitted transstadially (nymph to adult) and intrastadially (by male ticks). In all transmission trials, the piroplasm strains used were of New World origin. Ticks acquired infection by feeding on spleen–intact equid hosts that, in turn, were infected either by infected ticks or inoculation of blood stablitate. Where known, estimates of tick infection rates (prevalences) were reported, as was information on vector tick host associations, geographic ranges, and, where applicable, temperature–associated northern limits in the range of *D. nitens* and the theoretical northern limits in the range of *B. microplus*.

Current efforts to use a DNA probe to assess the comparative prevalence and intensity of *B. equi* infections in different vector tick species and geographic strains, and thus to compare the ticks’ vector competence, were discussed in detail. In addition, ongoing attempts to use in–vitro feeding techniques and DNA hybridization to estimate tick–challenge parasite dose for ponies vaccinated with a recombinant product were described.

Finally, the seeming paradox of having in the United States native ticks that are efficient experimental vectors of equine piroplasms, yet having no evidence, either contemporary or historic, of disseminating EP in this country, was discussed, together with recommendations for further work aimed at resolving this matter. Two approaches that appear to be especially promising in this regard are: (1) selective surveys to determine the frequency of contact between horses and the ticks of interest, and (2) experiments to determine the vector competency of these native U.S. ticks for Old World strains of the piroplasms.

A letter from Dr. Hector J. Garcia, Director of Veterinary Services, Department of Agriculture, Commonwealth of Puerto Rico to USDA–APHIS–VS, c/o Dr. John B. Anderson was reflected to this committee. This letter requested that U.S.D.A. amend their regulations to allow the international shipment of horses affected with Equine Piroplasmosis to return to Puerto Rico. The committee elected to study this request in detail. A subcommittee on E.P. was appointed to review all scientific data relating to E.P., tick vectors of E.P. and Puerto Rico. This committee is to report back to USAHA in October, 1994. Dr. C. L. Campbell, Jr. (Chairman), J. B. Anderson, William Pace and Ralph Knowles were named to this E.P. subcommittee.

U.S.D.A. requested that the committee review the advisability of waivers for entry of E.P. affected horses to enter the U.S.A. for the 1996 Olympic Games. A discussion was held concerning the advisability of granting waivers for the entry of horses into the U.S.A. Georgia. Dr. James Quigley, State Veterinarian of Georgia, is definitely opposed to the entry of E.P. affected equids. The committee voted in favor of advising U.S.D.A. not to grant any waivers for the movement of equids to the 1996 Olympic Games.
REPORT OF THE COMMITTEE

It was further stated that Olympic equine potential participants have time to be treated and cleared of their blood parasites (B. caballi and B. equi) prior to entry into the U.S.A. in the summer of 1996.

Additionally, the committee was advised that U.S.D.A. had been requested to waive Equine Piroplasmosis test requirements on horses imported into the United States for the 1996 Olympic Games. In response to that request, a letter from the Deputy Administrator, Veterinary Services, U.S.D.A., was read to the committee in which the department had "notified the Atlanta Committee for the Olympic Games as well as the Federation Equestre Internationale, that there will not be a waiver of E.P. testing for horses imported for the 1996 Olympic Games".

A HORSE PASSPORT – FIELD TRIAL.

Drs. Ernest Zirkle and Linda Detwiler prepared a prototype draft entitled, "Equine Passport – for U.S. and International Travel". See draft appended to this report.

This prototype passport needs to be launched in a field trial in the mid-Atlantic states, with extensions to the states of, New York, Kentucky and Florida. The objective of adding Horse Passports to our present interstate and international health certification is to:

1. Better identify horses in commerce,
2. To provide more complete health data that can be kept with the horse during transit, and
3. To prepare the U.S. horse industry for the European Community mandate that as of January 1, 1998, it will be compulsory for member countries' horse stock that travel to be covered by a passport.

The committee requests the endorsement of the general body of the USAHA to launch a field trial involving the use of the prototype passports, after at least one major breed association in the U.S. has agreed to participate in this passport scheme.

EQUINE VIRAL ARTERITIS (E.V.A.)

An outbreak of E.V.A. at Arlington Park Horse Racetrack near Chicago with horse movements to Churchill Downs (KY), Ak-Sar-Ben (Nebraska) and Prairie Meadows (Iowa) has sensitized the thoroughbred racing "Community" as to the monetary losses that E.V.A. can exact from horseracing.

In an effort to provide guidance to the horse industry, a document entitled "Guidelines for the Control of Equine Viral Arteritis" was prepared. A second draft of these E.V.A. control guidelines was approved by the committee (as appended here); and it is requested that the general body of the USAHA endorse these guidelines.

At the 1992 committee meeting, an E.V.A. subcommittee was appointed. Their 1993 report is as follows:
To remind you how subcommittee came into being (Mrs. Amy Mann reported):

The American Horse Council (AHC) hosted a meeting on E.V.A. in conjunction with the 1992 USAHA meeting to begin a dialogue between regulatory and industry interests as well as laboratories. The major recommendation coming from that meeting was to begin an educational campaign directed at the horse industry with the future goal being self-regulation of the industry. To "spearhead" this effort, Dr. Knowles, in his capacity of Chairman of the IDOHC, assigned a subcommittee consisting of Dr. H. A. Virts, Dr. Don Lein, Dr. Charlie Vail and Mrs. Amy W. Mann.

Actions since taken include development of guidelines for dealing with E.V.A. on the breeding farms by the AAEP, submission of articles on E.V.A. with recommended actions for horse owners and breeders in dealing with E.V.A. and release of other articles to same effect. Finally, outbreaks of E.V.A. in midwestern states has pushed the industry into addressing these matters which will be discussed further by Ralph Knowles and Don Lein.

Summary of Equine Encephalitis Surveillance
January 1, 1992 – October 15, 1993

Since the 1971 epizootic of Venezuelan equine encephalitis (VEE), the National Veterinary Services Laboratories (NVSL) has been testing samples for the equine encephalitides as part of the VEE surveillance program. The majority of the samples are submitted by state veterinary diagnostic laboratories. Samples were also submitted by Veterinary Services, U.S. Department of Agriculture veterinarians and veterinarians in private practice.

Most of the positive cases are based on the results of tests on a single serum sample. A single sample was reported positive if it had a neutralizing antibody titer of ≥1:10 and hemagglutination inhibition antibody titer of ≥1:40 against only eastern equine encephalitis (EEE) or western equine encephalitis (WEE). Some of the EEE and WEE results have been confirmed by a diagnostic increase in antibody titer or virus isolation, and other positive EEE serology results have been confirmed by EEE IgM capture enzyme-linked immunosorbent assay (ELISA). The results shown in Tables 1 through 4 are composites of reports submitted to the Centers for Disease Control (CDC), Fort Collins, Colorado, from NVSL test results and from several state veterinary diagnostic laboratories.

January – December 31, 1992

For the period of January 1 through December 31, 1992, 355 equine diagnostic submissions were received at the NVSL, and 25 of these were positive for EEE and 9 for WEE. In addition to the equine submissions, there were 56 avian, 4 pig, 3 goat, 5 bovine, and 1 kangaroo submissions. At the
REPORT OF THE COMMITTEE

NVSL, there were two positive avian EEE cases and two WEE; this included one EEE and two WEE isolations from emus and an EEE isolation from pheasants. There were two EEE isolates from the Brownsville area of Texas which represented a unique situation as EEE had been recovered this far west in only one other instance which was reported to have been in the 1940s or 1950s. In 1992, there was one fatal human EEE case from Florida and one other EEE case in Massachusetts but no reported cases of WEE.

January – October 15, 1993

The first isolations of epizootic VEE since the VEE surveillance program initiation occurred in 1993. VEE was diagnosed in three countries: Guatemala, Mexico, and Venezuela. The NVSL participated in the identification of the isolates of VEE serotypes IC from Venezuela, serotype IE from Mexico, and implicated VEE by serology in two horses from Guatemala. The Venezuelan VEE outbreak occurred during December 1992 and January 1993 in the state of Trujillo and will be covered later in this report. The Mexican outbreak occurred in May through July 1993 with 75 cases, 66 deaths, and involved a number of municipalities in the state of Chiapas. The isolations made at the Commission for Exotic Disease Laboratory in Mexico City were submitted to the NVSL for typing. The NVSL identified the virus as serotype I, but the virus did not react with monoclonal antibodies to IAB and IC. Serotypes IAB and C are the only VEE strains that cause disease in horses. The isolate was sent to Dr. Rebeca Rico-Hesse, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Connecticut. She identified the isolate as VEE type IE. This strain is an enzootic strain that had not been reported previously as causing disease. She is continuing to characterize the strain. The Guatemalan incident occurred in August in the state of Tupiapa. Serum samples were submitted from two unvaccinated horses with nervous signs; the horses had seroconverted to VEE.

For this period, there were a total of 372 submissions received at the NVSL: 260 equine diagnostic submissions; 107 avian, the majority of which were ratites; 2 bovine; 1 cat; 1 pig; and 1 dog. There were 16 positive EEE equines and 4 avian (emus) and 8 WEE positive equines and 3 avian submissions (2 emus and 1 turkey). No human cases of WEE have been reported in 1993, but there have been 3 human EEE cases: one each in Florida, Mississippi, and Rhode Island. The latter case being fatal.

In 1993, seven horses in six states had antibody against VEE. Many of the horses had stable antibody titers; vaccination histories were vague or not available in most horses, and in most cases there was no apparent explanation for the VEE antibody titers.

In summary, the first VEE isolates from horses were recorded since 1973 in Venezuela and 1972 in Mexico, but there was limited EEE and WEE activity in 1993. There was continued and growing interest in equine encephalomyelitis in other species, particularly in ratites.
## Table 1. Eastern equine encephalitis positive cases
### January 1 – December 31, 1992

<table>
<thead>
<tr>
<th>State</th>
<th>NVSL Positive Cases</th>
<th>CDC and Other Sources</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Delaware</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Florida</td>
<td>0</td>
<td>51 (1 emu)</td>
<td>51</td>
</tr>
<tr>
<td>Georgia</td>
<td>1 (emu)</td>
<td>10 (1 dog)</td>
<td>11</td>
</tr>
<tr>
<td>Michigan</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mississippi</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>North Carolina</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>South Carolina</td>
<td>5 (1 pheasant)</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Texas</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Virginia</td>
<td>10</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>27</strong></td>
<td><strong>62</strong></td>
<td><strong>89</strong></td>
</tr>
</tbody>
</table>

Human cases – Florida 1, Massachusetts 1

## Table 2. Western equine encephalitis positive cases
### January 1 – December 31, 1992

<table>
<thead>
<tr>
<th>State</th>
<th>NVSL Positive Cases</th>
<th>CDC and Other Sources</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Idaho</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Missouri</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>3 (1 emu)</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>South Dakota</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Texas</td>
<td>2 (emu)</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Utah</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>11</strong></td>
<td><strong>1</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

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REPORT OF THE COMMITTEE

Table 3. Eastern equine encephalitis positive cases  
January 1 – October 15, 1993

<table>
<thead>
<tr>
<th>State</th>
<th>NVSL Positive Cases</th>
<th>CDC and Other Sources</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida</td>
<td>1</td>
<td>78</td>
<td>79</td>
</tr>
<tr>
<td>Indiana</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Lousiana</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Maryland</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Michigan</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Mississippi</td>
<td>3 (1 emu)</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>North Carolina</td>
<td>3 (2 emu)</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>South Carolina</td>
<td>5 (1 emu)</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Virginia</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>20</strong></td>
<td><strong>78</strong></td>
<td><strong>98</strong></td>
</tr>
</tbody>
</table>

Human cases – Florida, Rhode Island (1 death), Mississippi

Table 4. Western equine encephalitis positive cases  
January 1 – October 15, 1993

<table>
<thead>
<tr>
<th>State</th>
<th>NVSL Positive Cases</th>
<th>CDC and Other Sources</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arkansas</td>
<td>1 (emu)</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>California</td>
<td>3 (1 emu, 1 turkey)</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Idaho</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Missouri</td>
<td>0</td>
<td>2 (emu)</td>
<td>2</td>
</tr>
<tr>
<td>Nebraska</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Oregon</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Utah</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>11 (2 emus, 1 turkey)</strong></td>
<td><strong>2 (emu)</strong></td>
<td><strong>8 horses, 4 emus, 1 turkey</strong></td>
</tr>
</tbody>
</table>

Human cases – none reported
Venezuelan Equine Encephalitis (VEE) in Venezuela

Virus isolates from horses in the State of Trujillo, Venezuela, were forwarded to Dr. Rebeca Rico-Hesse, Department of Epidemiology and Public Health, Yale University School of Medicine, New Haven, Connecticut, for virus characterization by the Instituto de Investigaciones Veterinarias, Maracay, Venezuela. Dr. Rico-Hesse shared the isolates with the National Veterinary Services Laboratories (NVSL). Both laboratories identified the viruses as VEE subtype IC, an epizootic strain of VEE. The last isolation of an epizootic strain of VEE was in 1973 in Venezuela.

Dr. Rico-Hesse established a cooperative project to do molecular characterization of the isolates. The other scientists involved are from the Instituto de Investigaciones Veterinarias, Centro Nacional de Investigaciones Agropecuarias, Maracay, Venezuela, and Instituto Nacional de Higiene "Rafael Rangel," Ministerio de Salud, Caracas, Venezuela. The history that Dr. Rico-Hesse obtained from her Venezuelan colleagues was that between December 9, 1992, and January 28, 1993, the Ministry of Agriculture of Venezuela reported 26 cases of equine encephalitis with 10 deaths from the state of Trujillo in western Venezuela. Blood samples were taken from 66 unvaccinated horses in contact with these sick animals; 28 (42%) had antibody against VEE virus. Venezuelan equine encephalomyelitis virus was isolated from two of these horses. Clinical disease compatible with VEE infection was observed in humans; 5 of 33 persons surveyed had VEE antibody. A vaccination program for horses was initiated using the inactivated TC-83 vaccine. In June, clinical disease was observed in horses and humans in the state of Zuilia near Lake Maracaibo. Venezuelan equine encephalomyelitis virus subtype IC was isolated and identified by Dr. Rico-Hesse.
FURTHER STUDIES ON FOOT–AND–MOUTH DISEASE
VIRUS IN THE LLAMA
(Lama glama)

Michael David1, VMD, MPH; Alfonso Torres2, DVM, Ph.D; Charles Mebus2, DVM, Ph.D; Bernardo J. Carrillo3, DVM, Ph.D; and Alejandro Schude4, DVM, MS; Norberto Fondevilla3, DVM; Javier Blanco Viera3, DVM; and Folipe E. Marcovecchio3, DVM.

Two Animal and Plant Health Inspection Service (APHIS) funded studies were conducted at the Instituto Nacional de Tecnología Agropecuaria in Argentina to evaluate the susceptibility of South American llamas (Lama glama) to foot–and–mouth disease (FMD) virus and to determine the ability of llamas to carry and transmit the FMD virus.

Although the mortality rate caused by FMD is generally low, the disease is taken seriously because of its resulting high morbidity rate. Production losses, trade restrictions, and costly eradication and vaccination programs make it a disease that most countries would like to eradicate. The ability of domestic livestock such as cattle, sheep and goats to carry the FMD virus has been well documented.1-7 Livestock such as sheep and goats which frequently develop mild or inapparent clinical signs of FMD, may serve as reservoirs of the virus and infect susceptible species.6,8,9

While the epidemiology of FMD virus in camelids has not been extensively studied, circumstantial evidence and the few limited field surveys that have been reported suggest that camelids are very resistant to natural FMD virus infection.1,10,11 Susceptibility to FMD has been experimentally demonstrated,12,13 however, few studies have been conducted to assess the ability of camelids to carry and transmit FMD virus to susceptible domestic livestock. The possibility that camelids might carry FMD virus without developing clinical or serological evidence of disease was suggested in one report.12 Unlike cattle, which are known to carry FMD virus for extended periods of time,2 little is known about the carrier ability, if any, of camelids.

The studies summarized in this report are divided into a field survey

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1National Center for Import and Export, USDA, APHIS, Veterinary Services, 6505 Belcrest Rd. Hyattsville, MD 20782.

2Foreign Animal Disease Diagnostic Laboratory, USDA, APHIS, Veterinary Services, National Veterinary Services Laboratories, Greenport NY 11944.

3Instituto Nacional de Tecnología Agropecuaria, Centro de Investigaciones en Ciencias Veterinarias, Dirección Postal, CC77, 1708, Morón, Buenos aires, Argentina.
and an experimental study. All serum samples collected were analyzed for antibody to FMD virus using the virus neutralization test and the virus infection associated antigen test. Oesophageal-pharyngeal (OP) samples were collected and analyzed using established techniques.

Field Study

To assess the likelihood of llamas acquiring and maintaining FMD virus without showing clinical signs, farms with cattle and/or sheep, which also had llamas on the premises, were sampled. An attempt was made to identify farms that had reported a recent outbreak of FMD.

A total of nine farms were surveyed. Two farms were located in the province of Buenos Aires, one in La Pampa, two in Cordoba, and four in Jujuy. Seven of these farms had cattle and llamas, four also had sheep. One small farm had llamas only, and another had llamas and sheep, but no cattle. On all farms llamas could freely intermingle with the cattle and/or sheep. Three farms reported no occurrence of FMD, five reported having had an outbreak at least 12 to 24 months prior to sampling, and one farm (located in the province of La Pampa) reported having a recent outbreak. Healing buccal, lingual, and labial lesions were evident in many cattle on this farm. The number of animals on each farm and vaccination history (date when the animals were last vaccinated) are shown in Table I.

During the last four months of 1992, serum and OP fluid samples were collected from at least ten cattle and/or sheep and from 50–60 llamas at each farm. Tests for FMD antibody using the virus infection associated antigen (VIAA) test and the virus neutralization (VN) test (to FMD types A, C, and O), and for FMD virus in OP fluids were conducted at the laboratories of the Instituto Nacional de Tecnología Agropecuaria in Argentina. Aliquots of the serum and the OP fluids were forwarded to the United States for confirmatory testing.

All OP samples taken from llamas (0/460) and from the randomly selected cattle (0/60) and sheep (0/30) were negative for FMD virus. The serological results for each herd are presented in Table II by test and species. All llamas (0/460) and sheep (0/30) sampled were negative for both the VIAA and VN antibody tests. In cattle, however, positive VIAA (38/120) and VN (103/120) results were obtained. These results were confirmed at the USDA, APHIS, Veterinary Services', National Veterinary Services Laboratories (NVSL) Foreign Animal Disease Diagnostic Laboratory (FADDL) in Plum Island, New York, by a sampling of the positive and negative specimens collected.

Experimental study

An experimental trial was conducted to determine 1) the susceptibility of llamas to FMD infection when exposed to both actively shedding animals and other exposed animals, and 2) the likelihood of llamas becoming FMD...
virus carriers when exposed to livestock actively shedding FMD virus.

The entire trial was conducted in a high containment facility at the Instituto Nacional de Tecnología Agropecuaria in Argentina from October 1992 through January 1993. Six pigs were inoculated with FMD virus; two with type A, two with type C, and two with type O. Each pair of pigs inoculated with the same serotype was placed into separate isolation rooms and served as the source of FMD virus to which the initial group of 30 llamas was exposed. Three days after inoculation of the pigs, ten llamas and one susceptible 18 month old Holstein steer were placed in each room with the inoculated pigs. This became the first day (day 0) of the trial. The steer was added to each group of ten llamas and two pigs as a sentinel for FMD virus shedding by the pigs. On day 4 following exposure, the pigs and steers were removed from the isolation rooms and euthanized. The thirty llamas were then all placed into a single containment unit and thirty additional susceptible llamas were added to the group of exposed llamas. Both groups of llamas were observed for the development of lesions and sampled at regular intervals for 90 days.

On day 60 of the experiment, 40 susceptible domestic livestock (10 pigs, 10 goats, 10 steers and 10 sheep) were added to the expanded group of llamas. These sentinel animals were also observed for lesions and sampled.

A control group of 15 llamas and 20 domestic livestock were housed in a separate area to monitor for the possible escape or cross-contamination by FMD virus from the containment area.

All six pigs had developed vesicular lesions by the time the llamas were put into the isolation rooms. Two of these pigs, one inoculated with FMD virus type O and another inoculated with FMD virus type C, died within the four day period of exposure to the llamas. The three steers used for monitoring and verifying that FMD virus was being shed by the pigs became viremic and developed vesicular lesions. Foot-and-mouth disease virus of the corresponding type used to infect the pigs was isolated from blood and vesicular fluid samples collected from these steers.

The serological and virus isolation results of samples obtained from the experimentally exposed llamas are shown in Table III. None of the llamas that were experimentally exposed with FMD types A or C developed any clinical sign of FMD. None of these llamas developed VlAA or neutralizing antibody to any of the FMD types used, and none of them yielded any virus from either the OP fluids or blood collected.

Two llamas experimentally exposed with FMD virus type O developed lesions. The lesions, which were barely detectable, first appeared on day 7 post-exposure and could be discerned until about day 30 post-exposure. Neither of these two llamas ever stopped eating or demonstrated any discomfort as a result of these lesions. These two llamas, as well as a third one, developed both VlAA and neutralizing antibodies to FMD virus type...
FURTHER STUDIES ON FOOT-AND-MOUTH DISEASE

On day 14 post-exposure, VIAA antibody was detected in one of the animals with lesions while VN antibody was detected in both. However, by day 30, and for as long as the animals were sampled (until day 90), both animals with lesions, as well as a third llama not showing lesions, had VIAA and VN antibodies.

Foot-and-mouth disease virus type O was isolated from the blood and OP fluid of these same lesioned animals. Virus was isolated from the OP fluid of both lesioned animals on day 14 only, from the blood of one of the lesioned animals on days 7 and 14, and from the blood of the other lesioned animal on day 14 only. Subsequent sampling of the OP fluid after day 14 post-exposure did not yield any virus.

All 30 llamas added on day 4, all sentinel livestock introduced on day 60 of the trial, and all control animals remained healthy, developed no lesions, were negative to the VIAA and VN antibody tests, and did not yield FMD virus from either the OP fluid or blood that was collected.

All positive results and those from a sampling of the negative animals were corroborated by USDA's FADDL diagnosticians.

Conclusions

From the results of the study we concluded that 1) the serological tests (VIAA and VN) are adequately sensitive to detect FMD infected llamas; 2) llamas are resistant to FMD virus infection; and 3) in contrast to cattle, infected llamas only carry FMD virus in their esophageal–pharyngeal region for a short time.

<table>
<thead>
<tr>
<th>FARM</th>
<th>No. LLAMAS</th>
<th>No. BOVINES</th>
<th>No. BOVINES</th>
<th>Vx HISTORY</th>
<th>FMD OUTBREAK</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>60</td>
<td>800</td>
<td>0</td>
<td>06/1992</td>
<td>Not recent*</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
<td>0</td>
<td>0</td>
<td>08/1990*</td>
<td>Not recent</td>
</tr>
<tr>
<td>C</td>
<td>43</td>
<td>50</td>
<td>400</td>
<td>10/1991</td>
<td>Not reported</td>
</tr>
<tr>
<td>D</td>
<td>22</td>
<td>28</td>
<td>350</td>
<td>1990</td>
<td>Not reported</td>
</tr>
<tr>
<td>E</td>
<td>300</td>
<td>30</td>
<td>300</td>
<td>1990</td>
<td>Not recent</td>
</tr>
<tr>
<td>F</td>
<td>190</td>
<td>0</td>
<td>1500</td>
<td>None</td>
<td>Not reported</td>
</tr>
<tr>
<td>G</td>
<td>100</td>
<td>3000</td>
<td>0</td>
<td>10/1992</td>
<td>Not recent*</td>
</tr>
<tr>
<td>H</td>
<td>200</td>
<td>2200</td>
<td>1300</td>
<td>11/1992</td>
<td>Recent*</td>
</tr>
<tr>
<td>I</td>
<td>85</td>
<td>500</td>
<td>0</td>
<td>08/1992</td>
<td>Not recent</td>
</tr>
</tbody>
</table>

*Month and/or year when bovines were last vaccinated
*Not recent = FMD outbreak occurred on the premises 12 to 24 months prior to sampling.
*Recent = FMD outbreak occurred on the premises within 30 to 60 days of sampling.
*Last vaccination occurred when owner had cattle on the premises.
Table II. Virus-infection associated antigen (VIAA) and virus neutralization (VN) results by farm and species.

<table>
<thead>
<tr>
<th>FARM</th>
<th>LLAMAS</th>
<th>BOVINES</th>
<th>BOVINES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>VIAA</td>
<td>VN</td>
<td>VIAA</td>
</tr>
<tr>
<td>A</td>
<td>0/50¹</td>
<td>0/50</td>
<td>4/10</td>
</tr>
<tr>
<td>B</td>
<td>0/50</td>
<td>0/50</td>
<td>—⁴</td>
</tr>
<tr>
<td>C</td>
<td>0/43</td>
<td>0/43</td>
<td>3/10</td>
</tr>
<tr>
<td>D</td>
<td>0/16</td>
<td>0/16</td>
<td>4/20</td>
</tr>
<tr>
<td>E</td>
<td>0/81</td>
<td>0/81</td>
<td>ND²</td>
</tr>
<tr>
<td>F</td>
<td>0/60</td>
<td>0/60</td>
<td>—⁴</td>
</tr>
<tr>
<td>G</td>
<td>0/50</td>
<td>0/50</td>
<td>10/10</td>
</tr>
<tr>
<td>H</td>
<td>0/50</td>
<td>0/50</td>
<td>9/10</td>
</tr>
<tr>
<td>I</td>
<td>0/60</td>
<td>0/60</td>
<td>8/60</td>
</tr>
<tr>
<td>TOTAL</td>
<td>0/460</td>
<td>0/460</td>
<td>38/120</td>
</tr>
</tbody>
</table>

¹Number positive/number tested  
²Dash indicates there were no animals of this species on the premises.  
³ND=Not done  
⁴VIAA=Virus isolation

Table III. Summary of clinical observations, serological results and virus isolation results among the experimentally exposed (EE) llamas.

<table>
<thead>
<tr>
<th></th>
<th>DAY 0</th>
<th>DAY 7</th>
<th>DAY 14</th>
<th>DAY 30</th>
<th>DAY 60</th>
<th>DAY 90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lesions</td>
<td>0/30¹</td>
<td>2/30</td>
<td>2/29²</td>
<td>2/29</td>
<td>0/29</td>
<td>0/29</td>
</tr>
<tr>
<td>VIAA</td>
<td>0/30</td>
<td>0/30</td>
<td>1/29</td>
<td>3/29</td>
<td>3/29</td>
<td>3/29</td>
</tr>
<tr>
<td>VN - 0</td>
<td>0/30</td>
<td>0/30</td>
<td>2/29</td>
<td>3/29</td>
<td>3/29</td>
<td>3/29</td>
</tr>
<tr>
<td>VN - A</td>
<td>0/30</td>
<td>0/30</td>
<td>0/29</td>
<td>0/29</td>
<td>0/29</td>
<td>0/29</td>
</tr>
<tr>
<td>VN - C</td>
<td>0/30</td>
<td>0/30</td>
<td>0/29</td>
<td>0/29</td>
<td>0/29</td>
<td>0/29</td>
</tr>
<tr>
<td>VI² - OP</td>
<td>0/30</td>
<td>0/30</td>
<td>2/29</td>
<td>0/29</td>
<td>0/29</td>
<td>0/29</td>
</tr>
<tr>
<td>VI-Blood</td>
<td>ND⁴</td>
<td>2/30</td>
<td>1/29</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

¹Number of animals positive/number tested.  
²One of the EE llamas died as a result of a uterine infection following parturition.  
³VI=Virus isolation  
⁴ND=Not done
FURTHER STUDIES ON FOOT-AND-MOUTH DISEASE

REFERENCES


Chairman: Mr. Dan B. Childs, Lake Placid, FL
Vice Chairman: Mr. J. C. Lemmermen, Longmont, CO

J.A.Acree, MD; W.L.Adams, GA; J.N.Armstrong, NV; L.T.Benson, NY; B.H.Bokma, PR; R.B.Caffey, MD; R.A.Carmichael, IA; J.L.Cooper, VT; L.A.Detwiler, NJ; A.D.Dunn, IL; P.M.Eppele, SD; W.H.Fales, MO; R.Fetzner, VA; W.C.Foote, UT; R.Frost, CA; H.J.Hansen, MA; F.H.Harding, IL; R.Harrington, TX; F.E.Hasenauer, CA; R.D.Heilman, VA; W.P.Heuschele, CA; E.Hoffman, CA; G.R.Holyoak, UT; J.L.Hourrigan, VA; T.H.Howard, WI; T.Hunt, MI; D.D.Hupe, KS; R.F.Kahrs, MD; R.C.Knowles, DE; N.Konerup, WA; H.A.Kryder, MD; D.W.Luchsinger, VA; A.Mann, DC; C.A.Mebus, NY; A.Morgan, MD; C.J.Nelson, TX; P.Phillips, WI; W.D.Prichard, OR; G.Quaassdorff, VT; G.B.Rea, OR; T.C.Schooler, TX; T.J.Seubert, WI; D.A.Stringfellow, AL; P.Sutmoller, VA; P.J.Taylor, MT; S.Tellez, TX; S.V.Timberlake, NY; M.C.Turner, TX; W.Utterback, CA; C.D.Vail, CO; W.H.Waldo, NE; J.S.Walker, MD; R.D.Whiting, MD; G.W.Wilson, DC; G.O.Winegar, MD

The Import Export Committee of USAHA met October 27, 1993, at 1:30 P.M. in room 4 of the Sahara Hotel, Las Vegas, Nevada.
Mr. J. C. Lemmermen presided over the meeting, attended by 17 members, and 25 guests.
Mr. Shelby V. Timberlake, chairman of the Embryo Transfer Subcommittee, reported on their meeting held Monday, October 25, 1993.

Some of the highlights were:

U.K. BSE new cases are on the decline, as expected. The study of the possible transmission of BSE through embryo transfer, has been negative thus far. The study won't be finished until the year 2000. They have transferred embryos from affected cows to 345 recipients, and have had 259 calves born with no apparent transmission of the disease.
IETS manual has been translated into four languages, and is soon to be translated into two more.

The entire report of the subcommittee accompanies this report.

The NCA report was delivered by Dr. Wes Bonner, and Ms. Connie Greig. Wes emphasized that NCA supported BSE research, and they expect APHIS to protect the U. S. livestock industry. He also revisited the resolution we passed last year concerning the eradication of the Bont Tick from the Caribbean, and the dangers to the cattle industry if the Bont Tick, and Heartwater disease ever gets to the mainland, and infects the susceptible cattle population there.

NCA is also requesting notification of destination states before im-
Ms. Greig reported on U.S., Canada mutual concerns about trade. A joint meeting of the health committees of both NCA, and CCA was held October 20th with APHIS personnel, and representatives of Ag Canada. The joint NCA/CCA Animal Health Working Group adopted the following mission statement:

"To review existing Canadian, and U.S. regulations for Bluetongue, Anaplasmosis, Brucellosis, and Bovine Tuberculosis, to ensure that, while protecting the health status of our respective national herds, we do not impose barriers to bilateral trade that can not be justified by current science."

The joint committee made several recommendations regarding these diseases, in particular, anaplasmosis. They recommended a scientific review of technology and the literature, a risk assessment by U.S. and canadian scientists, a study of current treatment, and an assessment of the practicality of clearing an animal. Dr. King has asked Gary Golgrove, APHIS, to act as liaison with Ag Canada on the project. Their other recommendations will probably be reported in the other USAHA committee meetings.

Dr. Bonner then gave some final comments about the progress of the Mexican TB problem, and recommended we all try to be present for the debate in the Tuberculosis committee meeting on Thursday.

Dr. Kryder came forward to introduce his staff from APHIS and they gave the APHIS Import/Export statistics for the previous year. A copy of the full report accompanies this report. Some of the highlights were:

Export animals: Dr David informed us of the U.S./Mexican Import/Export working group, and the U.S./Canadian Import/Export working group that meet two times a year to discuss trade concerns between our countries. There are also working groups made up of the U.S./Mexican, and U.S./ Canadian border states, to discuss concerns the individual states may have.

Import Animals and Avian I/E: Dr. Richeson highlighted the report. Harry S. Truman Import Animal Center cannot support itself on two lots per year. The selection lottery has been modified, and there is now a 32,000 dollar fee to sign up for the lottery to keep slots open for those who really have a use for the facility. An incident involving 23 camels imported from Norway and Sweden, which were discovered to be positive to TB, and had to be destroyed when the importer could find no other home for them and couldn't pay the quarantine fees, prompted a policy change. In the future all quarantine fees will be paid "up front" and only U.S. residents will be allowed use of the facilities.

Animal Products: Dr. Garcia reported an increase of almost 500 permits issued in Fy 1993. He also reported on the change in disease status requested by several countries in the last year. Dr. Garcia stated that many countries are increasing their requirements to get animal products from the U.S. into their markets.
Plant Protection and Quarantine: Dr. Kahrs explained that although PPQ has to do primarily with plants, they are many times the first line in animal disease protection at the ports.

Dr. Tom Galvin reported for Dr. E. F. Gersabeck, on the Bont Tick eradication in the Caribbean. He stressed that although it will take at least 20 years for the effects of the Bont Tick borne diseases to reach our borders, the results would be devastating. The contention that it may take 20 years to reach us is supported by observation that the infections seem to be heading for the southern parts of the island chain and will most likely jump to the South American mainland, infect native ticks and then begin the trek through Central America, and Mexico to get to the U.S.. However, he stressed that if we don’t stop this situation while it is still in the islands, it will be next to impossible to stop once it reaches the mainland. Dr. Bonner in his earlier comments stated that he thought the cattle in Florida were in the greatest danger. According to this report ranches in Texas will suffer before the cattle in Florida are affected. The report also brought up another disturbing fact from the economic analysis done to determine the effect on animal agriculture from this situation, of the expected 761.9 million dollar annual loss to meat and milk production in the U.S., 85% of that loss will be from loss of milk production in the nation’s dairy farms. The good news is, the United Nations eradication program, which the U.S. will participate in, is due to begin in 1994.

Dr. Roger Perkins next spoke about the review of part 98 of the CFR. The reasoning behind the review was that since it was written many species not covered have requested consideration for importation, and it only covered bovine embryos. Many other species are now under consideration for importation of germplasm. His department is also busy developing protocols for the importation from many nations. Sixteen new or revised protocols have been offered to nine countries, including protocols for the importation of embryos of Zoological species, endangered species and other animals that would be almost impossible to import as live animals.

Dr. Sheesley gave an interesting report on the concerns and progress on the NAFTA talks. He stressed that unlike trade agreements in the past, NAFTA has built in to it, dispute settlement procedures, that will allow for the timely and fair settlement of disagreements without negating the whole document. This paper was given before this committee and the Epizootic Attack Committee. The paper is printed behind the Epizootic Attack Committee Report.

Dr. Hugh Metcalf discussed "Regionalization and Risk Assessment" with the committee. There is a statute dating from the 1930’s prohibiting recognizing "regions or areas" as free of disease for importation purposes. However the U.S. is always trying to get our trading partners to "regionalize" the U.S. when it comes to a particular pocket of infection in this country that may affect trade from another part of the country. Both NAFTA and GATT
will exempt the signatories from this statute, therefore it will be necessary to use Risk Assessment to evaluate the relative danger of importing from one of these "regions".

APHIS has developed a risk rating system that no longer relies on "disease free, or infected" status to classify a country or region. The regions are rated on a scale from R-1, to R-U. R-1 meaning negligible risk, roughly equivalent to disease free, and isolated from any chance for infection. R-2 would be like Chile and FMD, currently "free" but surrounded by infected countries, with no isolation to prevent spread across it's borders, a certain amount of risk management would be required to import safely from there. R-3 could mean infection present but the country has an eradication program in place, and is making progress in the elimination of the disease. R-4 could mean the country at this time is trying to control the disease and live with it, very risky to try to import from here. R-U would simply mean a country or region with an unknown disease status.

The Committee had asked USDA/APHIS to comment on the recent outbreak of VEE in Mexico. Dr. Kryder got Dr. Mateus, from Mexico to come and speak to our group after his talk in the Foreign Animal Disease Committee. Dr. Mateus assured us that the outbreak in Mexico was confined to the State of Chiapas, and all the affected and exposed animals had been found, and accounted for. He stated that although the outbreak was indeed VEE, they were still studying, and conducting research on the virus to try to determine how the outbreak got started, or where the infection came from, as Chiapas is a poor region and importation of horses into that area is rare.

Dr. Michael David reported on the Argentine study on the transmission of FMD in Llamas, which seems to support the proposal to rescind the special rule regarding the importation of Llamas from Chile through HSTIAC. His paper was delivered in the Committee on Infectious Diseases of Cattle, Bison and Llamas Tuesday so I won't take the time to fully describe the data here. His conclusions were:

1. The tests being used to diagnose FMD in Llamas are effective.
2. Llamas are refractory to FMD.
3. When infected llamas don't stay sick for long, and don't harbor the infection to spread it to other species.

Mr. Donald Christ, President of International Llama Assn., talked to the committee addressing the concerns of the members of his organization. They represent a total herd of 70,000 head, and a membership of 7,000. Although this is a ten–fold increase in recent years, it is a relatively small industry compared to the cattle, dairy, or sheep industries of this country. They are concerned that their industry may be blamed for the introduction of a devastating disease to one of the other species populations, because of the premature relaxing of the import requirements on Llamas from Chile. He asked APHIS to reconsider their proposal, and continue research into FMD, and TB in Llamas.
IMPORT-EXPORT

Dr. Ralph Knowles, of our committee apprised the committee of the recent outbreak of Equine Viral Arteritis at racetracks in New England this last year, and said he just wanted to sensitize the committee to possible need to set some standards or regulations concerning the EVA status of horses in this country in the near future.

There being no further business, the committee adjourned at 5:30 pm.

EMBRYO MOVEMENT SUBCOMMITTEE

Chairman: Mr. Shelby V. Timberlake, Pelham Manor, NY
Vice Chairman: Mr. Howard J. Hansen, Greenfield, MA

R.A. Carmichael, IA; D.B. Childs, FL; R.D. Heilman, VA; W.P. Heuschele, CA; N. Konnerup, WA; D.W. Luchsinger, VA; C.A. Mebus, NY; A. Morgan, MD; P. Phillips, WI; P.J. Taylor, MT; J.S. Walker, MD; G.O. Winegar, MD

The meeting was called to order by Shelby V. Timberlake, Chairman, at 1:40 p.m. on October 25, 1993. There were twenty-four (24) in attendance including committee members Hansen, Konnerup, Mebus, Taylor and Timberlake. Absent were Carmichael, Childs, Heuschele, Luchsinger, Morgan, Phillips, Walker and Winegar.

Dr. Michel Thibier Director of the Laboratory for Control of Reproduction, Maison Alfort, France reported on the EEC movement of genetics.

About 100,000 embryos were transferred – 50% fresh – 50% frozen. Some countries were near 100% fresh and frozen. In 1992 there were 22,699 flushes producing 109,559 embryos transferable with 96,300 transferred.

Breakdown of Embryo Transfer

27,000 – France from 6,679 flushes
13,500 – Germany from 3,506 flushes
15,549 – Netherlands from 2,560 flushes

Dr. Thibier reported on current OIE activities regarding embryo transfer under consideration with special emphasis on bovine embryos FMD issues and IETS categorization of diseases; also:

IVF produced embryos
Ovim pickup
Fresh embryos
Review of 10 washing procedures

Comments were made regarding the study of ovine/caprine brucellosis (brucella melitensis) for embryos and ova.

Using the overhead projector, Dr. Thibier discussed the EEC
REPORT OF THE COMMITTEE

directive 89/556 modified by 93/52 dated 7/19/93 with respect to micromanipulated and IVF produced embryos, official approval of IVF units and FMD.

Other annexes under consideration
- Conditions for micromanipulated embryos
- Conditions for IVF units approval and health surveillance
- Protocols for testing, flushing and washing fluids

Dr. Thibier also discussed the directive for bovine semen EEC 88/407 which was modified by 93/60 on 7/28/93 with respect to
- Frozen semen
- IBR-IPV
- FMD
- Lepto
- Bovine Leukosis

Dr. Tony Wrathall, Head, Central Veterinary Laboratory, Ministry of Agriculture, Fisheries, and Food, Weybridge, England, gave his UK update. Dr. Wrathall reported on BSE (Bovine Spongiform Encephalopathy). Latest statistics reveal:
- Total number confirmed cases - 105,340
- Total number infected herds - 27,170
  of which 46% dairy - 10% beef

Current animal incidence 10 cases per 10,000 adults. First outbreak in 1985 – Ban of foodstuffs in 1988. The number of cases increased since 5-year incubation but we are just now seeing some effects as a result of the foodstuff ban. Drop in younger animals incidence more noticeable. May be some carryover, however, from foodstuffs existing on farms after ban. Dr. Wrathall believes, however, that the BSE epidemics are now showing signs of being under control.

With respect to the BSE embryo transfer project, embryos properly handled, carry no risk of BSE. In this project, all embryos were from BSE positive donor females; one-half were from BSE positive bulls, and one-half were from BSE negative bulls. Recipients were from New Zealand and BSE negative:
- 345 recipients to date show no sign of BSE
- 259 progeny to date show no signs of BSE

The project completion date is year 2000. Dr. Wrathall also gave an update on the differing results in the BSE embryo projects of Foster (Scotland) group and those of Dr. Warren Foote's team.

Dr. Brian Evans, Chief, Artificial Insemination and Embryo Transfer, Agriculture, Canada, reported on embryo imports for the past 12 months.
- 1992 – Canada imported embryos of 3 species from 7 countries
- 1993 – Canada imported embryos of 5 species from 12 countries
- 1992 – A total of 900 imported
- 1993 – A 30% increase over 1992

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In 1992 - Canada exported 7000 embryos to countries to 18 countries, a 17% increase over the previous year. 1993 is 30% over that figure. To date 50 embryo collection teams have been approved in Canada.

Howard Hansen, Chairman of the Import-Export Committee of the International Embryo Transfer Society, reported on this year's session held on October 23 and 24 at the Sahara Hotel. Tony Wrathall, Research Chairman, discussed work that has been published. He reported no changes in 1993 Categorization of Diseases. Positive work is continuing on wildlife embryo movement; also with lab animals and the examination of biological products for evidence of contamination.

Dr. Brian Evans reported on regulatory matters which included discussion by Drs. Evans; Faizi of the U.S.; Wrathall (UK) and Thibier (FR). Paul Sutmoller discussed Risk Assessment and Wrathall, Animal Welfare concerns in Embryo Transfer.

Dr. David Stringfellow reported on the IETS Manual which is now translated into Spanish, Portuguese, Italian and French with a Russian edition being discussed.

Dick Nelson reported on the new embryo forms and the various changes that have been made.

Jack Haslam, Veterinary Counsellor, Embassy of Australia, gave an update on Australia's import policy and shipments involved with Canada, U.S., selected European countries, New Zealand, and current talks with Japan; also shipments from FMD countries and the off-island incubation program.

Australia is following IETS Standards with respect to embryos and accreditation of collection teams.

Dr. Paul Sutmoller, together with Nelle Ahl of USDA/APHIS discussed in depth their work on Risk Assessment using several models, particularly FMD, to illustrate their work. Their study is expanding on this project and will be reported at our next meeting.

Dr. Paul Taylor of Taylor Llamas gave an update on his work with embryo transfer in llamas and artificial insemination. Dr. Taylor is engaged in a project to import embryos and semen from Chile.

There is a 20% survival rate when freezing and thawing semen. Dr. Taylor hopes to report on the first successful embryo transfer by next year's meeting.

Dr. Roger Perkins, Staff Veterinarian, National Center for Import/Export, Veterinary Services, USDA/APHIS, discussed the current review of Part 98, after the comment period ended in September 1993. Dr. Perkins believes the timing appropriate and said the IETS Categorization of Disease Pathogens is important to this decision. Dr. Perkins confirmed the various completed protocols with France and other countries and those proposed for embryos and semen from other countries.

Chairman Timberlake presented The American Embryo Transfer
REPORT OF THE COMMITTEE

Society covering memo which accompanied the AETA revision of the Part 98 regulation. It reads:

To all AETA members, associate members, and interested parties and organization.

As you may or may not know, USDA/APHIS has published their intent in the Federal Register to solicit opinion from the general public in reference to making changes in Part 98, The Importation of Certain Animal Embryos. It has been the position of AETA and the Government Liaison, Health and Regulation Committee, for many years that we cannot obtain sensible export regulation and preach the safety of washing embryos as opposed to antibody testing methods when our own government does not accept this ad evidence by its import regulations. Current leukosis, FMD, Buetongue, brucella abortus and IBR are listed by OIE as Category I or disease or disease agents for which sufficient evidence has accrued to show that the risk of transmission is negligible provided that the embryos are properly handled between collection and transfer; this means 10 times washing and the use of Trypsin in the case of IBR.

The AETA Committee has revised the regulations and has set out a position statement that basically says that import requirements should be drawn on a country-to-country basis and on individual species. This does give APHIS/VS much leeway in determining what the regulations should be for each country and species. We are also asking for direct input as APHIS draws up new requirements.

There being no additional new or old business to discuss, the meeting was adjourned at 4:45 p.m.

ANIMAL AND PLANT HEALTH INSPECTION SERVICE (APHIS)
REPORT TO THE IMPORT-EXPORT COMMITTEE OF THE U.S.
ANIMAL HEALTH ASSOCIATION FISCAL YEAR (FY) 1993

IMPORT ANIMALS

Two importations went through the Harry S Truman Animal Import Center (HSTAIC) in FY 1993. The first, in October of 1992, consisted of 102 breeding swine from Germany. The swine were negative to all tests for foot-and-mouth disease (FMD), hog cholera, and other swine diseases, and were released January 1993.

The other importation of 425 alpacas and llamas from Peru was released September 7, 1993. USDA veterinary personnel involved with this importation received hazardous duty pay because of the personal risk involved due to the rebellious "Shining Path" political organization in Peru.

Several thousand straws of bovine semen were imported from Brazil, a country where FMD exists. An APHIS veterinarian supervised the testing of the 26 bulls and several teasers, as well as the collection and processing of the semen.
Veterinary Services (VS) is considering more restrictive regulations and guidelines for the importation of cattle from Mexico in response to resolutions promulgated at the 1992 USAHA meeting in Louisville, Kentucky. These actions were taken as a result of the increased numbers of tuberculosis (TB)-lesioned carcasses found by USDA meat inspectors on slaughter of Mexican cattle in the United States. In addition to the USDA action, the Mexican Department of Animal Health has instituted more effective testing measures, and has voluntarily banned the export of Holstein cattle for at least 6 months because of the high incidence of TB in these animals.

Due to the outbreak of Venezuelan equine encephalitis (VEE) in the Chiapas province of Mexico, a regulation was published in July which requires a seven day vector-free quarantine period for imported equidae from Mexico. Horses affected with the disease will develop clinical signs, including death within 7 days. Screening the facility prevents infected mosquitos or other insects from coming in contact with the animals and transmitting the disease.

An estimated 50,000 heifers have been spayed by U.S. and Mexican accredited veterinarians under APHIS direct veterinary supervision, as required in the conditions developed by VS. All USDA travel and salary costs for this verifcation of surgery is reimbursed through a cooperative agreement between USDA and those requesting this service.

APHIS Import–Export staff veterinarians met with Mexican counterparts several times during the year to address issues of animal health affecting the import and export of cattle, other ruminants, poultry, and equine and their products. These meetings provide a forum for information dissemination and discussion. In this way, each country understands both sides of the issues.

After written and oral consultations with the United States Animal Health Association (USAHA) Sheep and Goat Committee, State veterinarians and industry representatives, APHIS has initiated regulation changes and developed protocols for the importation of sheep and goats and their embryos and semen. The Scrapie Certification Program, requiring a 5 year post–entry quarantine, is necessary for these importations.

APHIS has drafted protocols and regulations for the importation of bovine, sheep, and goat embryos from Africa, and wild ruminant semen from Thailand, Kenya, and Nepal. Protocols were written for importation of swine from Australia and Ireland, and bovine semen from Ireland.

APHIS is meeting with officials of the 1996 Olympic Games to develop quarantine and test requirements for the importation of horses into Atlanta, Georgia.

APHIS has published several proposed and final regulations this year as follows:

Final–to add Baudette, Minnesota as a limited port of entry.
REPORT OF THE COMMITTEE

**Final**–to establish user fees for services provided by APHIS for the import and export of animals.

**Proposal**–Part 98, Importation of semen and embryos. This version removes certain restrictions, and adds others, concerning the testing of donor animals and the washing of embryos.

**Proposal**–Part 92, Importation of ruminants and swine from countries where FMD and rinderpest exists through the Harry S Truman Animal Import Center (HSTAIC.) This revises the lottery process to fairly select importers and to efficiently utilize the facility. Currently, 2 importers per year are not adequate for USDA to maintain the facility.

**Proposal**–to remove the quarantine requirement in HSTAIC for the importation of camelids from Chile. Research has shown that the animals may be safely quarantined in the New York Animal Import Center. Boer goat embryos and 10 live goats were imported from Australia for research purposes during the past year. The animals resulting from the embryos are quarantined for scrapie until 1995.

Five head of Wagyu cattle were imported from Japan during the past year.

Twenty–three head of Bactrain camels were refused entry due to caudal–fold responses to the tuberculin test. Mycobacteriosis was diagnosed by NVSL. The animals were subsequently euthanized, as the importer could not find another country that would accept the animals.

**AVIAN IMPORT ACTIVITIES**

**A. Poultry and Hatching Eggs**

There were 6,282,363 poultry, including day old chicks, and 17,593,184 poultry hatching eggs imported into the United States during fiscal year (FY) 1993.

**B. Commercial Birds**

The importation of commercial birds continues to decline. The decline seen in recent years has been due to less availability of species, combined with a number of countries restricting international trade of birds. This decline was compounded during FY 1992 when a large number of international airlines refused to ship "wild–caught" birds, as well as the placement of an importation quota for most species of birds by the Department of Interior. There were 133,435 commercial birds imported during FY 1993. There were 14,528 commercial birds in 3 quarantined lots that were infected with VVND and were refused entry into the United States.

**C. Pet Bird Program**

Pet birds are currently being imported and quarantined at New York, New York; Miami, Florida; Los Angeles, California; Honolulu, Hawaii; and Mission, Texas. There were 1,386 birds imported and quarantined during FY 1993. All pet birds were tested for VVND, and no virus was isolated.
D. Smuggled Birds

Birds that were illegally entered into the United States and seized were quarantined at USDA facilities. There were 665 birds quarantined. Following the successful completion of the quarantine and test procedures, these birds were sold at public auction as permitted by a Memorandum of Understanding between the Departments of Agriculture, Interior, Justice, and Treasury.

An additional 182 confiscated parrots quarantined in the Mission, Texas smuggled bird station were also infected with VVND and had to be euthanized.

E. Ostrich Importation

USDA officials have approved a total of 57 farms in 8 countries as a result of site inspections, and these farms have been qualified to ship ratites or ratite hatching eggs to the United States.

During FY 1993, 1322 ostrich chicks were imported through New York Animal Import Center and 452 through the Miami Animal Import Center. A total of 1025 chicks were released at the end of a 30–day quarantine from New York and 311 from Miami, Florida (77.5%). In addition, 1246 emu were imported and 1238 released from quarantine (99.4%).

A total of 70,414 ostrich eggs were imported during FY 93. Of these eggs imported 15,556 chicks were released at the end of quarantine (22.1%). Currently, there are approximately 41 privately owned bird quarantine stations equipped to incubate ratite eggs and quarantine ratite chicks.

ANIMALS/AVIAN IMPORTS, FY 1992 AND 1993
(TABLE NAMED -ANIMALS/AVIAN IMPORTS, FY 1992 AND 1993–)

EXPORT ANIMALS

During FY 1993, Animal and Plant Health Inspection Service (APHIS) personnel participated in continued negotiations with various countries to either update current animal health protocols or establish new ones. Specifically, new protocols were established or were updated for the following:

1. bovine semen to Argentina, Chile, Israel, Senegal, New Zealand, Sweden, the Russian Federation, and Zimbabwe;
2. bovine embryos to Chile, Japan, Taiwan, New Zealand, Senegal, the Russian Federation and Israel;
3. cattle to Algeria, Chile, Poland, Senegal, South Africa, the Russian Federation and Egypt;
4. horses to Argentina, Chile, Israel, Jamaica, Korea, South Africa, and the European Community (EC);
5. goats to Bahrain, Taiwan, Chile, Thailand, the Russian Federation, and Egypt;
6. sheep to Egypt, Thailand, and Taiwan;
7. swine to Chile, Ukraine, the Russian Federation, and Brazil;
8. porcine semen to Canada, South Africa, and Chile;
9. equine semen to Mexico;
10. poultry to Israel, Ukraine, and Chile;
11. caprine embryos and semen to Israel.
REPORT OF THE COMMITTEE

The requirements for exporting bovine embryos and semen to the EC have now been in effect for over a year.

The U.S./Mexico Animal Health Working Group, which was established in early 1992, meets about every 6 to 8 months to discuss changes in import health requirements for each country. APHIS also continues to participate in the Canada–U.S. Trade Agreement (CUSTA) Technical Working Group meetings with Agriculture Canada at least twice a year. In addition, a U.S.–Mexico border port meeting was held during May 1993 to establish uniform import and export procedures for the U.S.–Mexico border. A similar meeting with Canada is tentatively planned for November 1993. Staff representatives met with EC Member State representatives in August 1993 to discuss horse movements between the United States and the EC. This meeting was the first in a series of U.S./EC meetings on horse issues.

Additional ports of embarkation with export inspection facilities that satisfied the necessary requirements were added to Part 91, Title 9 of the Code of Federal Regulations.

Several diseases affected U.S. export markets this year. The occurrence of porcine respiratory and reproductive syndrome (PRRS) in the United States has been used by several countries to restrict the importation of live swine, porcine semen, and pork. Venezuela is the country which most recently imposed a total ban on the importation of swine and pork from countries which have reported PRRS.

USDA's routine surveillance for avian influenza (AI) and the reported finding of non–pathogenic strains of the virus in a few backyard flocks and several live poultry markets in the Northeast caused several countries in Latin America to restrict the importation of day-old-chicks, hatching eggs, and poultry meat. Veterinary officials from Colombia and Venezuela were invited by the poultry industry to observe the distinction between commercial poultry and backyard flocks. To date, only Venezuela continues to maintain a total ban on U.S.–origin poultry because of AI.

ANIMALS/AVIAN EXPORTS, FY 1992 AND 1993
(TABLE NAMED "ANIMALS/AVIAN EXPORTS, FY 1992 AND 1993")

ACTION TAKEN ON REQUESTS BY FOREIGN GOVERNMENTS TO BE RECOGNIZED FREE OF SPECIFIED DISEASES

During FY 1993, the U.S. Department of Agriculture officially recognized The Netherlands, Spain, France and New Caledonia as being free of foot–and–mouth disease (FMD) and Spain free of hog cholera (HC).

In September 1993, a proposed regulation was published in the Federal Register to recognize Belgium as being free of FMD.

In September 1993, a team of veterinarians from the Animal and Plant Health Inspection Service (APHIS) conducted an onsite evaluation of
the FMD situation in Germany. A final decision to recognize Germany as being free of FMD will be made after the report on Germany has been finalized.

Onsite evaluations of the FMD, swine vesicular disease (SVD), and velogenic viscerotropic Newcastle disease programs in Austria and the FMD program in Hungary took place in October 1993. A final decision on the requests by Austria and Hungary to be recognized free of these diseases will be made after the reports of the evaluation have been reviewed.

On September 22, 1992, an interim rule published in the Federal Register added Denmark to the list of countries where bovine spongiform encephalopathy (BSE) has been reported. Denmark reported that a cow imported from the United Kingdom (U.K.) in 1988 was diagnosed as having BSE. This was the only case reported in Denmark and Danish authorities have slaughtered all of the cattle on the affected farm and all cattle in a neighboring herd.

Following the review of the comments submitted by the public and the European Community and based on epidemiological information provided by Denmark, it was decided to remove Denmark from the list of countries where BSE exists. The only infected animal was a cow which had been exported to Denmark in 1989 from the U.K. Evidence was provided to substantiate that the animal originated from a herd that had been fed meat and bone meal of U.K. origin prior to its export to Denmark. Because only one animal had been infected and because of the superior regulatory and surveillance program in Denmark for BSE, USDA determined that this was an isolated incident and that there was no justification to keep Denmark on the list of BSE-affected countries.

An outbreak of SVD in 1993 in Spain in March 1993 resulted in USDA's withdrawal of that country's recognition as being free of SVD. The presence of SVD in Spain will delay approval by APHIS to allow the importation of certain cured and dried hams from Spain into the United States.

Portugal will be added to the list of countries where BSE exists. The Government of Portugal has confirmed that outbreaks of BSE have occurred in that country.

ANIMAL PRODUCTS AND BY-PRODUCTS

A total of 6,370 permits were issued in FY 1993 by the Import-Export Products Staff authorizing the importation of organisms, vectors, biological materials, and animal products and byproducts. This was an increase of 489 permits over the number issued in FY 1992.

The user's fee docket for permits for animal products, organisms and vector, and approved establishments has been published and comments are now under consideration. It is anticipated that the final rule will be published in the near future.
REPORT OF THE COMMITTEE

In anticipation of the move towards regionalization, APHIS is developing strategies for evaluating and recognizing disease free areas. These include standards for assessing and analyzing risk factors that are critical to verifying and maintaining disease free areas.

APHIS has published a proposed regulation that will allow importation of cooked ground beef patties from FMD-affected countries.

The United Kingdom is now requiring that export certificates for dairy and pet food products be issued by VS personnel on the basis of an inspection of the manufacturing facilities in which the products were produced. Other countries, such as the Republic of South Africa, Israel, and France, have regulations that do not require VS inspection of manufacturing plants, but the exact procedure for certification is vague.

PLANT PROTECTION AND QUARANTINE -- PORT OPERATIONS

X-RAY BAGGAGE INSPECTION

Plant Protection and Quarantine (PPQ) continues to expand the use of "x ray" as a screening tool in passenger baggage clearance at major international airports. There are x-ray scanning machines located at all foreign-arrival and predeparture sites. Such machines for predeparture clearance are at Ponce, Roosevelt Roads, Aguadilla, and San Juan, Puerto Rico, and four islands of Hawaii, where passengers bound for the U.S. mainland are inspected because of plant pest concerns, such as the Mediterranean fruit fly. The international airports are San Juan, Miami, Honolulu, Chicago, Kennedy (New York), Houston, Dallas, Boston, Atlanta, Dulles (Washington, DC), Los Angeles, San Francisco, Seattle–Tacoma, Philadelphia, Orlando, and Newark. San Ysidro, on the Mexican border, is a land border port with such a device. It is used to screen the items carried by the average one million pedestrians that cross at that port each month. X-ray Machines are used in two postal facilities.

DETECTOR DOG PROGRAM

Thirty three trained dog teams at major airports are used in clearing passenger baggage. The airports are: Atlanta, Orlando, Miami, Houston, Dulles, Dallas, Charlotte, Philadelphia, San Juan, Newark, Kennedy, Boston, Chicago, Los Angeles, San Francisco, and Seattle–Tacoma. Los Angeles, Honolulu, and San Francisco (Oakland mail facility) have dog teams in their post offices.

The program will expand in the next 2 years to sixty teams.

AUTOMATED COMMERCIAL SYSTEMS (ACS)

There are now 57 air carriers participating in ACS at 18 airports. There are 300 sea carriers participating at 32 seaports. Although the U.S.
IMPORT–EXPORT

Customs Service (Customs) has not become fully automated as yet, a paperless system is a reality. This permits our officers to place holds and releases after they query the manifests. Participation by airlines and shipping lines is still on an elective basis and has been progressing slowly.

REGULATED GARBAGE, MARPOL ANNEX V

The U.S. Coast Guard is the enforcement Agency for Annex V of the International Convention to Prevent Pollution of the Seas (MARPOL 73/78). This Annex prohibits discharge into the sea of "all plastics including, but not limited to, synthetic ropes, fishing nets, and plastic garbage bags." It also prohibits discharge of food wastes and other floating materials within specified distances of land. These regulations became effective December 31, 1988. USDA regulated garbage handling requirements have not changed. All food or food-contaminated materials, such as plastics contaminated by galley waste, must be retained aboard the vessel in covered, leakproof containers. If offloaded, such garbage must be incinerated or heated to an internal temperature of 212 °F for 30 minutes. There is an increasing interest in the strict enforcement of MARPOL Annex V requirements. APHIS PPQ continues to play a major role because of their vessel inspection and garbage control requirements.

During the period of March 1992 through February 1993, APHIS generated 38 percent (58 reports) of the MARPOL V violations. This was more than Coast Guards 32 percent (49 reports).

AIRPORT 1990's

Processing the increasing number of international travelers continues to present many challenges to all Federal clearance agencies. As reported last year Customs has adopted a new plan, "Airport 1990's," which calls for Customs to be more selective and examine reduced numbers of passengers and bags. In response, APHIS is using "rovers" and "choke points" to control passenger movement.

IBIS, Interagency Border Inspection System, is used by approximately 20 agencies to focus on the individual person and any past violation history. Thus, past violators of APHIS programs can be "electronically" listed. Because of the numbers, PPQ has limited this to $100 violators, persons who flagrantly did not declare prohibited items and attempted to conceal those items. IBIS is being expanded to more effectively identify passengers requiring personal inspection by the FIS agencies including APHIS. This system designated Advance Passenger Inspection System (APIS) is being implemented to expedite passenger clearance but more effectively protect American Agriculture.
REPORT OF THE COMMITTEE

REPORT OF ANIMAL PRODUCTS IMPORTED/EXPORTED
(September 1992—September 1993)

Vessels and Aircraft Arrivals

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessels arrived</td>
<td>80,912</td>
<td>40,203</td>
</tr>
<tr>
<td>Vessels boarded</td>
<td>11,863</td>
<td>6,185</td>
</tr>
<tr>
<td>Vessels monitored for garbage violations</td>
<td>427,275</td>
<td>11,863</td>
</tr>
<tr>
<td>Lots consisting of garbage removed from these vessels</td>
<td>6,185</td>
<td>4,213,312 kg</td>
</tr>
<tr>
<td>Aircraft arrived from foreign locations</td>
<td>17,580,423</td>
<td>14,816 kg</td>
</tr>
</tbody>
</table>

Meat and Other Animal Products Confiscated/Refused Entry

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ship passenger baggage</td>
<td>473</td>
<td>2,543</td>
</tr>
<tr>
<td>Aircraft passenger baggage</td>
<td>210,094</td>
<td>403,922</td>
</tr>
<tr>
<td>Border crossing</td>
<td>23,282</td>
<td>32,168</td>
</tr>
<tr>
<td>Post office</td>
<td>10,928</td>
<td>14,816</td>
</tr>
</tbody>
</table>

Footwear Cleaned and Disinfected

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,427 Pair</td>
<td>325</td>
<td>$53,525</td>
</tr>
</tbody>
</table>

Maritime Garbage Civil Penalties

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>25,517</td>
<td>$1,320,890</td>
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Baggage Civil Penalties

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>169</td>
<td>$45,950</td>
<td></td>
</tr>
</tbody>
</table>

Notification Violations

<table>
<thead>
<tr>
<th>Description</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>174</td>
<td>$7,810</td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Animals</th>
<th>FY 1991</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>2,018,326</td>
<td>1,962,375</td>
<td>2,528,537</td>
</tr>
<tr>
<td>Swine</td>
<td>1,061,971</td>
<td>705,414</td>
<td>801,162</td>
</tr>
<tr>
<td>Horses</td>
<td>31,407</td>
<td>24,867</td>
<td>32,489</td>
</tr>
<tr>
<td>Sheep</td>
<td>22,223</td>
<td>20,651</td>
<td>24,306</td>
</tr>
<tr>
<td>Goat</td>
<td>190</td>
<td>125</td>
<td>961</td>
</tr>
<tr>
<td>*Other</td>
<td>15,500</td>
<td>6,316</td>
<td>13,256</td>
</tr>
<tr>
<td>**Total</td>
<td>3,149,617</td>
<td>2,719,748</td>
<td>4,400,711</td>
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</table>

Semen (doses)

<table>
<thead>
<tr>
<th>Animals</th>
<th>FY 1991</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bovine</td>
<td>730,293</td>
<td>338,302</td>
<td>323,490</td>
</tr>
<tr>
<td>Goat</td>
<td>0</td>
<td>56</td>
<td>500</td>
</tr>
<tr>
<td>Sheep</td>
<td>1,449</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Equine</td>
<td>336</td>
<td>570</td>
<td>2,009</td>
</tr>
<tr>
<td>**Total</td>
<td>732,078</td>
<td>338,928</td>
<td>323,490</td>
</tr>
</tbody>
</table>

Embryos

<table>
<thead>
<tr>
<th>Animals</th>
<th>FY 1991</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bovine</td>
<td>176</td>
<td>347</td>
<td>820</td>
</tr>
<tr>
<td>Goat</td>
<td>0</td>
<td>0</td>
<td>1,100</td>
</tr>
<tr>
<td>Sheep</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>**Total</td>
<td>176</td>
<td>347</td>
<td>1,920</td>
</tr>
</tbody>
</table>

301
## IMPORT-EXPORT

<table>
<thead>
<tr>
<th>CATTLE</th>
<th>FY 1991</th>
<th>FY 1992</th>
<th>FY 1993</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Ports</td>
<td>820,997</td>
<td>1,104,555</td>
<td>1,190,675</td>
</tr>
<tr>
<td>Air/Ocean Ports</td>
<td>6</td>
<td>2</td>
<td>406</td>
</tr>
<tr>
<td>Mexican Ports</td>
<td>1,197,323</td>
<td>857,818</td>
<td>1,337,456</td>
</tr>
<tr>
<td>TOTAL</td>
<td>2,018,326</td>
<td>1,962,375</td>
<td>2,528,537</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SWINE</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Ports</td>
<td>1,059,489</td>
<td>700,768</td>
<td>796,787</td>
</tr>
<tr>
<td>Air/Ocean Ports</td>
<td>2,482</td>
<td>4,648</td>
<td>4,375</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,061,971</td>
<td>705,414</td>
<td>801,162</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>EQUINE</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Ports</td>
<td></td>
<td>20,585</td>
<td></td>
</tr>
<tr>
<td>Air/Ocean Ports</td>
<td></td>
<td>2,228</td>
<td></td>
</tr>
<tr>
<td>Mexican Ports</td>
<td></td>
<td>9,676</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>32,489</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AVIAN</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Poultry</strong></td>
<td></td>
<td></td>
<td>6,282,363</td>
</tr>
<tr>
<td><strong>Eggs</strong></td>
<td></td>
<td></td>
<td>17,593,184</td>
</tr>
<tr>
<td><strong>Commercial Birds</strong></td>
<td></td>
<td></td>
<td>133,435</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td>24,008,982</td>
</tr>
</tbody>
</table>

*Other Animals contains numbers of animals imported that are not cattle, goats, sheep, or swine: such as wild ruminants, llamas, alpacas, water buffalo, deer, elephants, hippopotami, rhinoceroses, tapirs, wild-birds, or pet birds.

**A break down of types is described in section "AVIAN IMPORT ACTIVITIES"
<table>
<thead>
<tr>
<th>LIVESTOCK EXPORT: (including slaughter animals)</th>
<th>FY 1992</th>
<th>FY 1993*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>335,461</td>
<td>31,088</td>
</tr>
<tr>
<td>Horses</td>
<td>66,141</td>
<td>18,839</td>
</tr>
<tr>
<td>Swine</td>
<td>239,259</td>
<td>34,778</td>
</tr>
<tr>
<td>Sheep</td>
<td>978,019</td>
<td>623,911</td>
</tr>
<tr>
<td>Goats</td>
<td>44,157</td>
<td>34,769</td>
</tr>
<tr>
<td><strong>TOTAL LIVESTOCK</strong></td>
<td>1,663,037</td>
<td>743,385</td>
</tr>
<tr>
<td>Bovine Embryos</td>
<td>2,817</td>
<td>1,725</td>
</tr>
<tr>
<td>Bovine Semen</td>
<td>3,392,480</td>
<td>1,382,562</td>
</tr>
<tr>
<td>Caprine Semen</td>
<td>1,125</td>
<td></td>
</tr>
<tr>
<td>Equine Semen</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Porcine Semen</td>
<td>417</td>
<td>156</td>
</tr>
<tr>
<td><strong>TOTAL SEMEN</strong></td>
<td>3,394,044</td>
<td>1,382,718</td>
</tr>
<tr>
<td>Avian Eggs (Dozens)</td>
<td>28,310,159</td>
<td>10,507,602</td>
</tr>
<tr>
<td>Avian Poultry</td>
<td>35,383,345</td>
<td>9,395,100</td>
</tr>
<tr>
<td>Avian Other</td>
<td>28,788</td>
<td>829</td>
</tr>
<tr>
<td>Canine/Feline</td>
<td>21,161</td>
<td></td>
</tr>
<tr>
<td>Other Species</td>
<td>73,367</td>
<td></td>
</tr>
</tbody>
</table>

* Partial year data totals
IMPORT-EXPORT

STATUS OF TROPICAL BONT TICK
Edward F. Gersabeck, Ph.D.
U.S. Department of Agriculture
Animal and Plant Health Inspection Services
International Services

BACKGROUND

The tropical bont tick, *Amblyomma variegatum*, was introduced into the Caribbean in 1828 on cattle imported to the island of Guadeloupe from Senegal, West Africa. Since being introduced into the eastern Caribbean, this tick has become established on 14 islands is reported from 19 (fig. 1). The spread of *A. variegatum* is attributed to the inter–island movement of livestock, uninspected commodities movement, and the cattle egret which can transfer immature ticks between the islands.

The tick is a vector of the rickettsia *Cowdria ruminantium*, the causative agent of heartwater in ruminants. Previously unexposed ruminant populations are highly susceptible to infection with heartwater. Death losses reach over 50 percent in cattle and 80 to 90 percent in sheep and goats. To date, heartwater has been confirmed on three islands and serological evidence of heartwater has been located on nine additional islands (fig. 2).

*A. variegatum* is also associated with increased incidence of the skin infection, dermatophilosis, which is caused by the bacteria *Dermatophilus congo/ensis*. *D. congo/ensis* occurs throughout the world but rarely appears as clinical dermatophilosis without the presence of *A. variegatum*. Immunologically naive ruminants are more susceptible to dermatophilosis than animals that have developed tick resistance. Morbidity and mortality rates associated with bovine dermatophilosis reach 33 and 15 percent, respectively, in unexposed herds. Additionally, livestock populations on some infested islands are decreasing due to decreased reproductive capacity attributable to dermatophilosis. Where the tropical bont tick and livestock are present, producers must treat their animals with an acaricide and antibiotics to reduce morbidity and mortality from associated diseases.

The range of *A. variegatum* has not yet extended to mainland North, Central, or South America. However, the tick has been spreading despite control programs. It is estimated that at least one island per year will become infested. Reintroductions of tropical bont tick into St. Croix and Puerto Rico, which occurred in 1993, emphasize the need for a regional eradication effort. Infestation of mainland wildlife could result in the endemic presence of *A. variegatum*. If this occurs, eradication would be unlikely. As a result, domestic livestock will be at risk from heartwater and dermatophilosis.

Dispersal of the tick occur through legal and illegal movement of livestock, transport of uninspected commodities, and birds. Mark–release–recovery studies show that cattle egrets can carry immature ticks between
REPORT OF THE COMMITTEE

islands.

For instance, egrets marked in Guadeloupe were found in the Florida Keys, the mainland United States, and Newfoundland, Canada. At the same time, the biology of the tick and tick control programs in the U.S. Territories in the Caribbean make the likelihood of introduction into the United States low during the next 20 years (0.02 to 0.001). The more likely scenario will be the tick exiting from the southern end of the Caribbean and infesting South America. From South America, the tick would likely slowly move North and probably enter the U.S. through the U.S.–Mexico border area.

Spread to mainland areas would have further and much more serious consequences. Heartwater can be transmitted experimentally by the Gulf Coast Ear tick (Amblyomma maculatum), and the cayenne tick (Amblyomma cajennense). The Gulf Coast Ear tick occurs in the United States, Mexico, and Central America. The cayenne tick occurs in Mexico, Central America, South America, Jamaica, Cuba, Trinidad, and 4 counties in south Texas. In addition, white-tailed deer and other wild ruminants are susceptible to heartwater. Therefore, even if A. variegatum does not become widely distributed, a biological transmission cycle for heartwater could become established in the native tick and wildlife populations of the Western Hemisphere. This would result in an unresolvable and constant disease threat to livestock. Heartwater would be then become persistent and endemic in the Americas.

ECONOMIC IMPACT TO THE AMERICAS

An analysis of reduced beef, mutton, goat meat, cow milk, and goat milk production attributable to the presence of A. variegatum estimates that the spread of A. variegatum in the Western Hemisphere would cost producers about $760.9 million annually. The value of annual meat and milk production would be reduced by about $722 million, and producers would incur increased costs for tick control totaling about $39.9 million. Dairy farms would be the most severely affected by the spread of A. variegatum. Reductions in the production of milk account for about 85 percent of the loss. Lower beef output would account for 14 percent of the reduced value, followed by goat's milk, mutton, and goat meat, which would each account for less than 1 percent of the reduced value. The value of domestic livestock inventories in the affected areas exceed $37 billion in 1991. Therefore, estimated losses represent about 2 percent of the total value of livestock inventory.

The economic impact of A. variegatum expansion in the Western Hemisphere would not be uniform. Livestock production does not comprise a significant component of the national economy in many of the countries at risk for A. variegatum. For instance, imports account for over 50 percent of the meat and dairy products consumed in many Caribbean island nations. The impact would be more severe on the mainland, where livestock pro-
duction of greater importance.

Brazil would be the most severely affected by the spread of *A. variegatum*. Revenue for Brazilian livestock producers would be lowered by about $224.2 million annually. This figure represents about 29 percent of total estimated losses. Producer revenue in Mexico and Venezuela would be reduced by about $144.4 and $67.7 million, respectively. U.S. producer revenue would be reduced by $50.6 million. This figure represents about 7 percent of estimated *A. variegatum* losses.

Estimated losses were only generated for commercial livestock operations. *A. variegatum* expansion in the Western Hemisphere would also affect the living standards of subsistence farm families. The productive capabilities of their livestock would decrease due to the tick's presence. In turn, the amount of meat and milk consumed in many rural households would go down as well.

The impact to the United States would be about 7 percent of this total, or $51 million annually, in reduced livestock value. Although the likelihood of *Amblyomma variegatum* becoming established in the United States within the next 20 years is small, once it or heartwater was to become established in any mainland areas, eradication would be extremely difficult and infestation of susceptible areas of the United States inevitable.

**SUMMARY**

Eradication of the tropical bont tick while it is restricted to the Caribbean area would provide the greatest level of security to the rest of the Americas. An eradication program is being proposed by the Food and Agriculture Organization of the United Nations in conjunction with the Caribbean Countries. The commitment of the United States will be in proportion to the estimated impact, which is about 7 percent of the total impact to the western hemisphere. The initial phase of the eradication program is scheduled to begin in 1994.

If the tropical bont tick is eradicated from the Caribbean, it has a low probability of reintroduction. There are two reasons for this low probability. First, sanitary regulations will prohibit the importation of the infested animals. Second, the distance between Africa and the Caribbean exceeds the flight distance of the only known vector, the cattle egret.
RESULTS OF THE ELISA SEROPREVALENCE SURVEY FOR ANTIBODIES TO PARATUBERCULOSIS IN TEXAS DAIRY AND BEEF CATTLE

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Pan American Veterinary Laboratories
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Due to an increased awareness of paratuberculosis in Texas a cooperative project* was initiated to assess the seroprevalence of antibodies to this disease in the state's market cattle. ELISA testing was performed by Pan American Veterinary Laboratories (PAVL). Brucellosis market cattle identification (MCI) program samples collected at 20 randomly selected livestock markets were used for the beef portion of the survey. Dairy MCI cattle samples were collected at the four Texas markets that have exclusive dairy cattle sales. A standard ELISA protocol was employed using antigen from Allied Monitor, Fayette, Missouri and the Mycobacterium phlei absorption step as described by Yokomizo, et al.¹, to reduce non-specific reactions.

The prevalence of antibodies to paratuberculosis in all samples (2,491) was 19.1%. The prevalence rate in the 1,209 beef cattle (25.2%) was significantly higher than that in the 1,282 dairy cattle (13.3%) (P < 0.0001). Beef cattle consigned from Texas premises had a significantly higher positive rate (25.4%) than did the dairy cattle originating in Texas (14.8%) (P < 0.0001). The prevalence of antibodies did not differ between Texas beef cattle and those from out of state but Texas dairy cattle had a higher prevalence of positive results (14.8%) than did dairy cattle originating from out of state (10.1%). Regional differences in paratuberculosis antibody prevalence rates were identified between Texas Animal Health Commission Areas in both beef and dairy breeds.

Based on these results, paratuberculosis appears to exist in Texas market cattle at a significant level, and although some bias may be present in the beef results due to possible spring culling, these results should reflect the prevalence in Texas beef and dairy herds. Efforts should be undertaken to assess the herd prevalence rate of this disease in Texas so accurate economic loss estimates can be developed.

* Participants: Dr. Frank Mann, Chief Investigator; Texas Veterinary Medical Foundation; Dr. Allen Roussel and Dr. Noah Cohen, Texas A&M University; Texas Veterinary Medical Diagnostic Laboratory; Texas Animal Health Commission; and Pan American Veterinary Laboratories.

Paratuberculosis in Multiple Species in a Wildlife Park.

Dr. Collins reported that his laboratory had processed over 2600 samples from a major wildlife park. A minimum of 50 animals were culture positive for *M. paratuberculosis* including a water sample from a common drinking area. The magnitude of the problem with multiple species involvement has lead to a greater awareness of paratuberculosis among both public and private zoological gardens.

Comparison of Elisa and Fecal Culture in Dairy Herds.

Dr. Rossiter reviewed the New York Paratuberculosis program indicated the state had moved to a combination serological and culture approach for both certification and control/eradication programs. She believes education is the key element for producers to eradicate the disease. Occasionally herds are encountered with a high serological response then later become fecal culture positive. Herds with a low serological response are usually culture negative.

Results of the Elisa Seroprevalence Survey for Antibodies to Paratuberculosis in Texas Dairy and Beef Cattle were reported by Dr. Alexander. Of 2000 sera from market cattle tested with the Elisa procedure developed by Allied Laboratories, 25% of the sera from beef cattle and 13% from dairy cattle were seropositive. The study implies paratuberculosis to be a significant problem in Texas cattle the magnitude of which had not been
appreciated previously. A manuscript for this paper is included in the proceedings.

A Comparison of IDEXX Paratuberculosis Test to an Elisa using the protoplasmic Antigen.

Dr. Jacobson's report showed that multiple cutpoints may be more useful than a single cutpoint in elisa serology for Johne's disease. Multiple cutpoints allows the grouping of cattle into categories of varying risk for the disease. Once the cattle in each risk group are identified those animals with the higher risk for disease should be cultered while those in the lowest risk group would likely be culture negative. A manuscript for this paper is included in the proceedings.

An Assessment of the IDEXX Paratuberculosis Serological Test.

Dr. Whitlock provided information about the effect of time mixing both substrate and conjugate with it's diluent before adding to the Elisa plate. Over a ten minute time period the absorbance gradually increased in a panel of sera. The effect of conjugate post mixing time also varied but in a triphasic manner. The optimal time post mixing of the conjugate seemed to be 10 to 12 minutes post mixing. The recommendation for both conjugate and substrate was to choose one time and adhere to that same time for each test run. An assessment of sensitivity and specificity with 1100 well characterized sera found the sensitivity to be about 45% and the specificity to be 99%, both comparable to earlier studies. This study also reported the sensitivity of detection for low or early shedding animals to be about 12% while animals with clinical signs were more easily detected with nearly 90% sensitivity.

Paratuberculosis: Different Diagnostic Approaches for Management Vs Eradication of the Disease.

Dr. Jacobson emphasized the importance of identification of all infected animals in those herds desiring eradication. This approach may require culture. Herds with a goal to manage the disease could do so with a serological test with one cut point. Different management goals may require different diagnostic approaches to the disease.

Diagnosis of Johne's Disease: Possible Role of Dot Immunoassay

Dr. Zarkower reviewed the component parts of the Dot Immunoassay with pertinent sensitivity and specificity data. The dotblot as modified is able to be used in the field by the practitioner and therefore presents a rapid reliable test for paratuberculosis.

Michigan's Johne's Program: An Update.

Dr. Donch reported that Michigan had completed phase two of a four-phase study of Johne's disease. In phase one, 9.1% of Michigan cattle were found culture positive at slaughter. Critical evaluation of the Idexx Elisa test in two herds reported a specificity of 95.4% with an overall sensitivity of 47%. Cattle in the early stages of infection were the least likely to be detected by the Elisa test.
Horizontal Transmission of Johne's Disease among Bulls.

Dr. Rossiter's paper will be published in the proceedings.

Is Paratuberculosis a Food Safety Issue?

Dr. Collins presented a brief review of the literature reporting an increasing level of association between Crohn's disease and paratuberculosis. Investigators are isolating *M. paratuberculosis* from Crohn's patients' tissues with increasing frequency. Is this association causal? The exact significance of the findings are unknown. How might the disease be transmitted. Milk from paratuberculosis cattle has been shown to contain *M. paratuberculosis* and if it survives pasteurization could be consumed by the public. However, the epidemiological surveys for Crohn's indicate urban populations are at greater risk than rural people.

The report of the task force is attached as appendix 1.

Two resolutions were presented to the committee which were passed and are attached.

The meeting was concluded at 5:15 pm.
PREFACE

Paratuberculosis (Johnne's disease) is a growing concern to the U.S. cattle industry. Years of research effort has produced several new diagnostic tests to detect *Mycobacterium paratuberculosis* infected cattle. These tests have been evaluated independently by several research groups and been found to be sufficiently accurate to be used in a program to certify cattle herds as being low risk or free of infection.

Several states have had paratuberculosis control and herd certification programs for a number of years. Industry leaders, particularly the pure-bred cattle organizations, asked veterinarians in state and federal regulatory agencies and paratuberculosis researchers to develop a recommended method for certifying herds as being low risk or free of paratuberculosis in order that a uniform system of testing and interpreting tests be established on a national basis (See resolutions from the April, 1991 meeting of the Livestock Conservation Institute). Toward this end a task force was formed, chaired by Ms. Diana Whipple. The Task Force was composed of representatives from all sectors of the cattle industry, state and federal regulatory veterinarians, the AVMA, AABP, and several universities active in paratuberculosis research. The attached program description is the product of several years of work by the task force.

We hope that a National Program to certify herds free of paratuberculosis will some day be operated either by a federal agency like USDA or a private concern in order to insure uniform methods and rules are applied nationally. At the present time it is not likely that the USDA will initiate such a program and no private agency has been identified to run the program. Therefore, at this time the National Program outlined in the following document is meant to be a blue print that individual states can follow in creating their own paratuberculosis certification program.

Task Force for Development of a National Paratuberculosis Certification Program:

Ms. Diana Whipple, USDA/ARS/NADC, Task Force Chairperson
Dr. Michael T. Collins, University of Wisconsin–Madison
Dr. Debbi Donch, Michigan Dept. Agriculture
Dr. Jacob Hines, American Association of Bovine Practitioners
Dr. Richard Jacobson, New York State Diagnostic Laboratory
Mr. John Lang, Livestock Conservation Institute
Dr. Donald Lein, New York State Diagnostic Laboratory
Dr. Marcus L. Mueller, Livestock Conservation Institute
Mr. Richard E. Nelson, Purebred Dairy Cattle Association, Inc.
Dr. Ken Olson, American Farm Bureau
Dr. Ron Rhode, National Association of Animal Breeders
Mr. Alden Servais, National Milk Producers Federation
Dr. Donald C. Sackett, American Veterinary Medical Association
Dr. Max Van Buskirk, Pennsylvania Department of Agriculture
Dr. Robert Whitlock, University of Pennsylvania
Mr. Gary Wilson, National Cattlemen's Association
National Paratuberculosis Certification Program

1. Herd definition:
   A. All cattle under common ownership or supervision that are grouped on one or more parts of any single premises (lot, farm, ranch).
   B. All cattle on two or more premises geographically separated but on which cattle have been interchanged or where there has been contact between the premises. Contact of animals between separated premises under common management shall be assumed to have occurred unless otherwise established by the herd owner or manager.

2. Certification levels:
   Level 1: Herd test negative after one sampling.
   Level 2: Herd test negative after two samplings.
   Level 3: Herd test negative after three samplings.
   Level 4: Herd test negative after four samplings.
   Level 5: Herd test negative after five samplings.
   Level 5 Monitored: Herd test negative after six or more samplings.

3. Criteria for herds qualified to enter certification program:
   A. The herd has been in existence for at least one year. OR
      The herd was assembled with cattle originating directly from paratuberculosis certified herds only.
   B. A herd assembled with cattle originating directly from certified herds only shall start at the lowest certification level of the herds from which the assembled cattle were acquired. A negative first herd test will qualify the newly assembled herd for the next certification level.

4. Animal identification:
   A. All animals must have permanent identification other than a plastic ear tag or neck chain.
   B. Acceptable means of permanent identification are: registration or association numbers accompanied by identification document, ear tatoos, USDA uniform series ear tag (metal tags), and electronic ID.

5. Animals to be tested:
   A. For annual certification – All cattle 24 months old and older are required to be tested.
   B. For cattle being removed from the herd – All cattle being removed from the herd that are exhibiting clinical signs of Johne's disease.
C. For cattle being added to the herd – A negative serum antibody test is required before arrival on the premises and a fecal sample for *M. paratuberculosis* detection must be submitted to a laboratory no later than 15 days after arrival.

6. **Testing interval:**
   A. Certified herds are to be tested every 14 months (+/- 2 months).
   B. Herds not tested within 16 months of the last sampling will lose their certification status. The next negative herd test will qualify the herd for level 1 certification.

7. **Testing laboratories:**
   A. All tests for the National Paratuberculosis Certification Program must be performed at an accredited laboratory. Laboratory accreditation will be on the basis of satisfactory performance on an annual check test for serum antibody, *M. paratuberculosis*-detection based tests, or both. Precise mechanisms for conduct of annual check tests remain to be determined.

8. **Test samples to be collected:**
   A. For annual certification.
   1. Level 1, 3, and 5: Blood for the detection of serum antibodies against *Mycobacterium paratuberculosis* (ie, ELISA test).
   2. Level 2 and 4: Feces for the detection of *M. paratuberculosis* (ie, fecal culture).
   3. Level 5 monitor either type of test at the option of the owner.
   B. For cattle being removed that are showing clinical signs of Johne's disease: Both blood for serum antibody testing and feces for organism detection.

9. **Tests:**
   A. Serum antibody test.
      Any test sufficiently sensitive and specific for detection of antibodies to *M. paratuberculosis* in bovine serum. Definition of "sufficiently sensitive and specific" will be on the basis of results of performance of a check test and proficiency standards set by the Program.
      Note: Early in the program it is recommended that the USDA-licensed ELISA for *M. paratuberculosis* be the test of choice.
   B. *M. paratuberculosis*-detection test.
      Any test sufficiently sensitive and specific for detection of *M. paratuberculosis* in bovine fecal samples. Definition of "sufficiently sensitive and specific" will be on the basis of results of performance of a check test and proficiency standards set by the Program.
NATIONAL PARATUBERCULOSIS CERTIFICATION PROGRAM

Note: Early in the program it is recommended that fecal culture be the test of choice. Furthermore, fecal culturing should be done at laboratories that have demonstrated proficiency at performing this test.

10. **Collection of samples:**
   All blood and fecal samples are to be collected by, or under the supervision of, a licensed accredited veterinarian.

11. **Veterinary certification:**
   The veterinarian performing or supervising the collection of test samples is to certify that the samples collected were from the animals identified on the test documents.

12. **Owner/manager certification:**
   The herd owner/manager is to certify:
   
   A. At the initial test date; that the herd has been in existence for at least one year or was assembled only from certified herds.
   
   B. At each test date; that all animals 24 months or older were sampled and included in the herd test.
   
   C. At each test date; a list identifying all animals previously tested but no longer in the herd.
   
   D. At each test date; that all animals added to the herd since the last herd test were raised in the herd or tested at the time of arrival on the premises (see 5.C.).
   
   E. At each test date; a written statement certifying that to the best of his/her knowledge no animals that left the herd tested positive for paratuberculosis or were exhibiting clinical signs of Johne's disease.

13. **Definition of a positive animal:**
   An animal is defined to be positive, ie, infected with *Mycobacterium paratuberculosis*, only if *M. paratuberculosis* is demonstrated by an organism detection test on tissues or feces of the animal.

14. **Consequences of identification of a positive animal during a herd test:**
   Identification of a positive animal during the certification herd test will result in the loss of certification status. The next negative herd test will qualify the herd for Level 1 certification.

15. **Protocol to be followed if an animal is positive by a serum antibody test:**
   A. An animal positive on a serum antibody test must be retested by a *M. paratuberculosis* detection test as soon as possible, but no more than 120 days after the date the blood was drawn for the serum antibody test.
B. The certified herd will maintain its present certification status pending the results of the *M. paratuberculosis* detection test.

C. A negative result on the *M. paratuberculosis* detection test will allow the herd to move to the next certification level.

D. If an animal is removed from the herd while waiting for serum antibody test results, a fecal sample shall be collected and submitted to a laboratory. The sample will be tested for *M. paratuberculosis* if the antibody test is positive.

E. Failure to retest the animal within 120 days will result in loss of certification status. The next negative herd test will qualify the herd for Level 1 certification.

16. **Protocol if an animal sold from a certified herd is identified as positive:**

   A. If an animal sold from a certified negative herd is identified as positive by an organism detection test within 16 months of the date of sale, selling certified herd shall, within 120 days of being notified, conduct a herd retest of all eligible animals by both the serum antibody and organism detection tests.

   B. The selling certified herd will maintain its present certification status pending the results of the herd test.

   C. If the herd retest is negative, the herd will maintain its "present" certification status. The herd owner/manager shall then have the option of maintaining his/her present test schedule or retesting his/her herd test date so that his next herd test is not due until 14 months after the retest.

   D. If a positive animal is identified on this retest, the selling herd will lose its certification status. The next negative herd test will qualify the herd for Level 1 certification.

17. **For special circumstances or appeals an advisory board of will convene to consider the facts and render a final decision.**

**RECOMMENDED HERD MANAGEMENT PRACTICES**

**INTRODUCTION**

*Mycobacterium paratuberculosis* can infect and cause disease in a variety of domesticated, wild, and exotic species of ruminants. In order to allow for the introduction of outside genetics to a herd, but minimize the risk of introducing paratuberculosis into a certified herd from outside sources, the following management practices are recommended.

**HERD ADDITIONS**

There is a high risk of introducing paratuberculosis into a herd from
herds of unknown status. Consequently, totally closed herds are recommended. If cattle are to be introduced into a certified herd, they should be obtained from a herd of equal or higher paratuberculosis certification level. If cattle from other than a certified herd of equal or higher status are bought, leased or returned to the farm, it is recommended that they be tested negative by a paratuberculosis serum antibody test prior to being brought onto the premises. Upon arrival at the certified herd, it is recommended that the animal be kept in isolation from animals less than 1 year of age until retested by both a serum antibody test and a \( M. \text{paratuberculosis} \) detection test within 120 days of arrival.

**SEmen**

The risk of transmission of paratuberculosis through semen is low. However, \( M. \text{paratuberculosis} \) can be shed in the semen of infected bulls that are showing clinical signs of Johne's disease. Therefore, it is recommended that semen from bulls with clinical signs of Johne's disease not be used.

**Embryos**

The greatest potential for transmission of paratuberculosis through embryo transfer is by the use of recipients of unknown paratuberculosis status. An infected recipient can contaminate pastures and calving pens with \( M. \text{paratuberculosis} \) and transmit the infection to the calf which it carries. Only cattle within the certified herd or from a herd of equal or higher paratuberculosis certification level should be used as embryo recipients. The risk of transmission of paratuberculosis by the embryo itself is theoretically possible, but not probable. The transfer of embryos from cows with clinical signs of paratuberculosis represents a low risk of transmission, however, it is not recommended.

**Wild Ruminants**

Exposure to wild ruminants on public and private land should be avoided to the extent possible.

**Commingling**

A certified herd should not be commingled with or grazed behind sheep, goats, or commercially raised deer, elk or bison.

**Fence Line Contact**

Fence line contact with animals of unknown paratuberculosis status presents a low risk of exposure to \( M. \text{paratuberculosis} \). However, it should be avoided when possible.
A PREVALENCE SURVEY OF LIVER FLUKES (DISTOMA) IN BEEF COWS AT SLAUGHTER IN THE WESTERN UNITED STATES

Briskey, D. W., Scroggs, M. G., Hurtig, F. S. 
Merck & Co., Inc., AgVet Division, Rahway, NJ

INTRODUCTION

The common liver fluke, Fasciola hepatica, has been considered a problem parasite of cattle in the Southeastern and Northwestern United States. Five % liver condemnations have been documented in fed cattle at slaughter in the United States (1,2). Condemnation rates have been reported to be higher in some areas. Liver condemnations are a direct loss in cattle production. However, indirect losses are greater and include: reduction in average daily gain and lower feed conversion ratios in feeder cattle, reduced milk production in both beef and dairy cows, and reduced weaning weights in cow/calf operations(3,4). Higher fluke burdens may lead to clinical disease and death losses, particularly in young, poorly managed stock.

The distribution of lymnaeid snail intermediate hosts limits F. hepatica enzootic areas. The Gulf Coast region and northwestern states have long been recognized as fluke endemic areas. In neutral soils (pH 6 to 8), such as alluvial river basins, coastal prairies and marshes, or mountain meadows, the snail intermediate host can flourish. Irrigation in the western states has enlarged snail habitats and resulted in broader liver fluke distribution (4). Expansion of fluke infection occurs in areas considered to be fluke-free when the snail intermediate hosts are present and infected cattle are introduced.

Surveys of liver fluke infection have been conducted in fed cattle but few, if any, have been conducted in beef cows. This survey was conducted in cow slaughter plants west of the Mississippi River to determine the prevalence of liver fluke infection in beef cows.

METHODOLOGY

The method for determining 95% confidence limits as described by Snedecor and Cochran was utilized to set a targeted minimum number of 200 beef cow livers to be examined at each of 7 slaughter facilities (5). Data gathered at each facility included number of beef cow livers determined to either show evidence of previous infection or actual presence of flukes, and the total number of beef cow livers examined. One of the authors examined each liver along with a USDA FSIS inspector at each slaughter facility. This examination included both lengthwise and crosswise incisions of major bile ducts in each liver. Livers were noted as positive for liver fluke (distoma) according to definitions set forth by USDA FSIS inspection guidelines. In addition, livers condemned for any reason other than distoma were also
A PREVALENCE SURVEY OF LIVER FLUKES (DISTOMA)

examined for evidence of liver flukes and counted as positive if evidence of fluke was present.

RESULTS

Beef cow livers were observed in 7 slaughter facilities for evidence of liver fluke infection. The location (by state), number of livers examined, number of positive livers, % prevalence and date of liver observations are noted in Table 1.

Table 1. Liver observation data

<table>
<thead>
<tr>
<th>Location</th>
<th>Total Number</th>
<th>Examined</th>
<th>Positive</th>
<th>Prevalence*</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idaho</td>
<td>207</td>
<td>76</td>
<td>36.7%</td>
<td>4/01/92</td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>205</td>
<td>108</td>
<td>52.7%</td>
<td>7/13-15/92</td>
<td></td>
</tr>
<tr>
<td>Texas(east)</td>
<td>199</td>
<td>32</td>
<td>16.1%</td>
<td>7/20/92</td>
<td></td>
</tr>
<tr>
<td>Texas(north)</td>
<td>301</td>
<td>52</td>
<td>17.3%</td>
<td>7/22/92</td>
<td></td>
</tr>
<tr>
<td>Texas(south)</td>
<td>327</td>
<td>51</td>
<td>15.6%</td>
<td>7/29/92</td>
<td></td>
</tr>
<tr>
<td>Colorado</td>
<td>511</td>
<td>30</td>
<td>5.9%</td>
<td>8/04/92</td>
<td></td>
</tr>
<tr>
<td>Nebraska</td>
<td>163</td>
<td>19</td>
<td>11.7%</td>
<td>8/27/92</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1,913</td>
<td>368</td>
<td>19.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Prevalence expressed with 95% confidence interval

Regionally, Idaho and California were designated Northwest with 44.7% prevalence of liver flukes in beef cow livers examined. The 3 Texas plants were termed South Central with 16.3% prevalence and Colorado plus Nebraska formed the High Plains region with 7.3% prevalence.

An attempt to identify state of origin of all cows was made. Since some of the animals originated from sale barns, exact origin was undetermined. Fourteen states were recorded for traceable animals.

DISCUSSION

Expectations for liver fluke prevalence in beef cows were based on fed cattle surveys that recorded fluke prevalence of 4.92 to 6% (1,2). The number of livers condemned due to distoma, liver fluke infection, far exceeded expectations, a prevalence of 19.2%

While exact area of origin for each cow was impossible to identify, cows from the following states were identified: Arkansas, California, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, Nevada, New Mexico, Oklahoma, Oregon, Texas, Washington and Wyoming.

The prevalence observed by region follows recognized fluke endemic areas. The western region had the highest prevalence, 44.7% and included
cows from northern California, Oregon, Washington, Nevada and Idaho. The next highest prevalence percentage was 16.3%. These cows originated in the south central region. Animals were shipped from Arkansas, Louisiana, New Mexico, Oklahoma and Texas. Some areas in this region are not considered to be endemic for liver fluke. The lowest prevalence, 5.9%, was found in the High Plains region with beef cows from Colorado, Idaho, Kansas, Montana, Nebraska and Wyoming.

Since the prevalence percentage was almost 4 times that of fed cattle, several factors must be considered for this finding. Seasonal variances occur affecting the transmission period for liver fluke infection in each of the regions examined. Additionally, transportation tends to influence the prevalence of liver fluke infection in cattle. If the snail intermediate host is present, cattle from liver fluke endemic brought in to pasture for any length of time can get the infection started. As weather conditions in much of the United States seasonally destroy the infective stage of the liver fluke on the pasture, the cow serves as the reservoir to carry the fluke infection over into the next season. Thus with a 19.2% prevalence found in cows in this survey, treatment with a flukicide should be considered.

SUMMARY

A survey of beef cow livers for liver fluke prevalence was conducted in 7 western slaughter facilities from April to August, 1992. A total of 1,913 livers were examined with 368 livers condemned for distoma, liver fluke infection. This was a prevalence of 19.2%, almost 4 times higher than has been reported in fed cattle. These data support the need for disseminating information regarding current knowledge of cattle liver fluke prevalence to producers, veterinarians and other industry specialists associated with cow/calf operations in the western United States, and highlight potential losses incurred by the industry from liver flukes. Since cows serve as the reservoir for infection for their calves, consideration for timely treatment should be given.

REFERENCES

REPORT OF THE COMMITTEE ON PARASITIC DISEASES
AND PARASITICIDES

Chairman: Dr. M. G. Scroggs, Amarillo, Texas
Vice Chairman: Dr. L. F. Moore, Shawnee, Kansas

L.B. Biehl, IL; R.E. Bohlender, NE; B.H. Bokma, PR; R.O. Drummond, TX; R.D. Gadd, SD; S.C. Gartman, TX; D.C. Gigstad, KS; F. Gvillo, CA; G.W. Hausman, FL; T.J. Holt, NY; J.A. Jarvinen, IA; R.D. Jones, SD; S.E. Kunz, TX; J.E. Novy, APO; R.E. Omonhundro, TX; W.E. Pace, FL; P.A. Pickerill, TX; R.L. Pyles, NM; J.L. Schlater, IA; J.E. Strickland, GA.

This committee met at 1:30 P.M. on Monday, October 25, 1993, in the Cleopatra Room, Sahara Hotel, Las Vegas, Nevada.

The meeting was called to order by Dr. Scroggs, Chairman. Twenty-one were in attendance, 10 of which were committee members.

Dr. Tom Galvin, USDA, APHIS, IS, gave a very informative update on the screw worm program in Mexico and Central America. Dr. Galvin reported that agreements for cooperation have been signed with Belize, Guatemala, El Salvador and Honduras. Agreements with the countries of Nicaragua and Panama should be signed soon. The last outbreak of screw worms in Belize was October, 1991. Three to 26 million sterile flies were released per month in 1992 in Belize. None have been released in 1993. As in Belize, other countries mentioned above have seen a reduction in the reported cases of screw worms as the program of releasing sterile flies progresses.

Funding in this program is paid 85% by the United States and 15% by the cooperating country. Annual estimated benefit, in 1992 dollars, to livestock production in the United States, Mexico and Central American countries was $715 million, $217 million and $65.7 million, respectively. More importantly, the benefit to human health was dramatic. In El Salvador, there were 350 cases (estimated) of human infestations compared to 0 in 1993. Nicaragua has reported 104 human infestations thus far in 1993, 4 of which were fatal. Of course, wildlife populations are benefiting from the program plus reduction in the use of pesticides is achieved.

Future goals for the program were presented by Dr. Galvin. These are to establish a control zone at the Panama-Colombia border and secondly, build a new sterile fly plant in this area to reduce risk of accidental release of flies and reduce transportation costs from the older plant in Mexico.

Dr. Galvin also reported on the screw worm outbreak that occurred in Mexico in 1992 and 1993. The first outbreak was found on January 22, 1992 only 122 miles from the Mexican–Texas border. The last reported case was found on June 17, 1993 south of the outbreak found the previous year. It has cost more than $9.2 million dollars to attempt to eradicate these outbreaks. This has set the program back for 12 to 24 months.
Dr. Bob Bokma, USDA, APHIS, VS gave an update on the tick eradication program in Puerto Rico. Several *Amblyoma varigatum*, the tropical bont tick, infestations have been found on Puerto Rico. Spraying with amitraz is still the method of control for the *Boophilus* tick. An amitraz collar was tried for control but was abandoned after lack of efficacy 28 days later. A study group met recently with recommendations that should improve the efficiency of the program.

Dr. P. Pickerill, USDA, APHIS, VS gave a report on the fever tick program in Texas. Illegal movement across the border continues to be a problem but tick patrols persist in tracking infested cattle. One owner of a small herd has refused to allow inspection of his herd which borders 17 other ranches. Wildlife continue to serve as reservoirs for the tick. Ivermectin baited corn fed daily to deer has shown promise in eliminating the tick but is expensive.

Dr. J. Schlater, USDA, NVSL, Ames, Iowa gave a report on the number of specimens submitted to the laboratory for identification. Some 9–13,000 are submitted annually. Most of the tick specimens are sent from Puerto Rico and Texas. Cryptosporidia and giardia are being seen in cattle samples submitted.

Dr. M. G. Scroggs, Merck & Co., Inc., AgVet Division, presented information on Ivomec Premix for Swine. This formulation was recently approved by F & DA. This product will be fed for 7 days at the rate of 100 mcg/kg or 2 ppm in complete feeds. Claims are for both, internal and external parasites in swine less than 220 pounds. Withdrawal prior to slaughter will be 5 days.

No resolutions were submitted but it is recommended that APHIS, EPA and industry work closer to find chemicals that will assist the efforts in Puerto Rico to eradicate ticks. There are chemicals available, but not approved in the United States, that could greatly enhance the tick eradication program. Possibly, emergency clearances could be issued for emergency use. Lack of profitability in industry tends to slow down the discovery of newer, more effective chemicals for external parasite control.

It is also suggested that state veterinarians encourage veterinary practitioners, in their respective states, to report case of scabies observed. Scabies has been seen but failure to properly report the outbreaks has tended to mask this disease.

This committee adjourned at 4:30 P.M. after a very informative and thought provoking meeting.
The Federal Food, Drug, and Cosmetic Act, Section 501(a)(5) and Section 512(a)(1)(A), requires that animal drugs be used only according to approved label directions. This applies to species, dosage, route of administration, indications for use, and users (veterinarians and non-veterinarians alike).

In 1984, FDA published the first edition of the Extra-Label Use of new Animal Drugs in Food-Producing Animals (ELDU) (CPG 7125.06).

The policy of enforcement discretion applies to veterinarians only. It says that FDA will not ordinarily take enforcement action when veterinarians illegally use drugs under certain circumstances. These are:

1. A careful medical diagnosis is made by an attending veterinarian within the context of a valid veterinarian-client-patient relationship;
2. A determination is made that (a) there is no marketed drug specifically labeled to treat the condition diagnosed, or (b) drug therapy at the dosage recommended by the labeling has been found clinically ineffective by the veterinarian in the animals to be treated;
3. Procedures are instituted to assure that identity of the treated animals is carefully maintained;
4. Significantly extended time period is assigned for drug withdrawal prior to marketing meat, milk, or eggs; steps are taken to assure that the assigned timeframes are met, and no illegal residues occur; and
5. The prescribed or dispensed extra-label drug (prescription legend or over the counter) bears labeling information which is adequate to assure the safe and proper use of the product. At a minimum, the following label information is recommended:

- The name and address of the veterinary practitioner.
- The established name of the drug (active ingredient), or if formulated from more than one ingredient, the established name of each ingredient.
- Any directions for use specified by the practitioner (including the class/species or identification of the animals; and the dosage, frequency, route of administration, and duration of therapy).
- Any cautionary statements specified by the veterinarian.
- The veterinarian's specified withdrawal/discard time(s) for meat, milk, eggs, or any food which might be derived from the treated animal(s).

ELDU policy has been revised 4 times – last one July 1992.
PROPER DRUG USE AND RESIDUE AVOIDANCE

ELDU policy is controversial and misunderstood especially with regard to its applicability to lay persons.

This background led to the preparation and publication in July 1993 of the CPG titled Proper Drug Use and Residue Avoidance By Non-Veterinarians. It is the main subject of this presentation.

Compliance Policy Guides have 2 purposes:
1. Guidance for FDA and State enforcement personnel on evidence and charges to be considered regarding extra-label use.
2. Education of the regulated industries about the enforcement standards and for guidance on how to be in compliance and avoid charges

Policy

FDA allows veterinarians acting in accordance with CPG 7125.06 "Extra Label Use of New Animal Drugs in Food-Producing Animals" to consider use of a new animal drug, i.e., an approved new animal drug not a bulk drug, contrary to label directions when the health of the animal is immediately threatened and suffering or death would result from failure to treat the affected animal(s). If a veterinarian dispenses a drug for extra-label use the drug must conform with special labeling requirements as noted above and no drug residues above permitted levels may be present in the final food product.

The presence in food of violative drug residue causes the food to be adulterated under Section 402(a)(2)(D). The failure of producers to establish systems to monitor and control drug use can result in adulteration of live food-producing animals.

Food-producing animals, even though not in their final, edible form, have been held to be food under the statute (United States v. Tomahara Enterprises, Ltd – live calves intended as veal are food). More generally, courts have long held that unprocessed or unfinished articles are or can be food under the Act. Thus, FDA regards live animals raised for food as "food" under the Act.

Further, in the context of holding food-producing animals, FDA believes that "insanitary conditions" includes a lack of adequate controls concerning treatment of food-producing animals with drugs. A failure to maintain adequate controls with respect to use of animal drugs could result in a reasonable possibility of injury to human health because illegal residues often result from the lack of such controls.

For these reasons, FDA may regard live animals raised for food as adulterated under 402(a)(4). FDA encourages persons involved in raising, handling, transporting, holding, and marketing food-producing animals to establish control systems with the following elements:
MITCHELL

a) Identifying and tracking animals to which drugs were administered, in order to preclude the sale of edible animal tissue, milk, or eggs containing illegal residues (identification may be by specific animal identification, pen or lot, quarantine/segregation, or other means);

b) Maintaining a system of medication/treatment records that, at a minimum, identifies the animal(s) treated (individual animals, pens, lots, etc.), the date(s) of treatment, the drug(s) administered, who administered the drug(s), the amount administered, and the withdrawal time prior to slaughter (and when milk, eggs, etc. can be used, if appropriate);

c) Properly storing, labeling, and accounting of all drug products and medicated feeds;

d) Obtaining and using veterinary prescription drugs only through a licensed veterinarians based on a valid veterinarians/client/patient relationship (VCPR); and

e) Educating all employees and family members involved in treating, hauling, and selling the animals on proper administration techniques, observance of withdrawal times, and methods to avoid marketing adulterated products for human food.

Individuals who handle food-producing animals and do not administer drugs, e.g., livestock dealers are encouraged to have records on the source of the animal and whether the animal has been medicated (when, name of drug, and withdrawal period) to preclude sale of meat, milk, or eggs that contains illegal residue.

The occurrence of an illegal residue will be regarded as prima facie evidence of improper drug use, and may be appropriate for enforcement. Before recommending enforcement, FDA will consider whether evidence of proper drug use as described above, exists to demonstrate that every reasonable effort has been taken to prevent illegal residues.

FDA is prepared to recommend regulatory action if the misuse is contrary to label directions, i.e., extra-label drug use. If an illegal residue is involved the food is adulterated under 402(a)(2)(D). When inadequate controls are documented the food is also adulterated under 402(a)(4).

The use of the quality assurance programs of producer organizations appear to provide the guidance needed to avoid violation of the principles in this CPG.
This issue is complex, difficult to explain and cannot be covered adequately in fifteen minutes, but I will try to hit the high points.

One of the major issues facing the poultry industry and animal industry is the great deceleration of new drug and combination clearances by the Food and Drug Administration – Center of Veterinary Medicine (FDA/CVM). As background information, these facts need discussing before getting too far.

From the time a new compound is discovered, until it is marketed, is approximately 10 years. The amount of money spent for research and development of a significant compound is $20 – 50 million. The typical time period for the review of an animal drug that is submitted to FDA/CVM is three years.

The following table shows the number of applications approved by the FDA/CVM for all species of animals and poultry and the dollars spent on research and development:

<table>
<thead>
<tr>
<th>YEAR</th>
<th>71-79</th>
<th>80-89</th>
<th>90-91</th>
</tr>
</thead>
<tbody>
<tr>
<td># apps yearly</td>
<td>44</td>
<td>32</td>
<td>14</td>
</tr>
<tr>
<td>$ mil. spent yearly</td>
<td>$83</td>
<td>$278</td>
<td>$402</td>
</tr>
</tbody>
</table>

The number of applications approved per million dollars of research money spent is out of proportion and getting worse – one clearance per $1.8 million in 71-79, one per $8.7 million in 80-89 and one per $28.7 million in 90-91. Sixteen times as much in the 90's as in the 70's for a clearance. Is it any wonder that the drug companies are upset and concerned?

CCM–approved compounds for food producing animals 1986–1992

<table>
<thead>
<tr>
<th>YEAR</th>
<th>'86</th>
<th>'87</th>
<th>'88</th>
<th>'89</th>
<th>'90</th>
<th>'91</th>
<th>'92</th>
</tr>
</thead>
<tbody>
<tr>
<td># NEW DRUGS</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Only one of these compounds was for poultry.

Why have we seen such a drop in new drug clearances? FDA/CVM cites poor experimental data as the reason for very few new drug approvals.
DRUG USE ISSUES FACING THE INDUSTRY

We are concerned that the drug approval process is being delayed for reasons other than isolated incidence's of poor quality data.

Here are some of the reasons that I think we have seen very few drugs cleared in the past several years.

A - ATTITUDE - FDA/CVM has a pristine attitude. Everything in a submission must be perfect. They are not allowing for any margin of error. There are no gray areas. They must prevent their fellow man from being "poisoned" by harmful drugs. The world is not perfect, neither is a drug clearance. This change in attitude was sudden and occurred about the time drug clearances ceased. If someone in CVM has or is helpful to an industry person, they may be transferred.

B - EXPERIENCE - As of September 1991, 40% of CVM data reviewers had less than 2 years of regulatory experience, and were not receiving formal training. Since that time, training programs have been initiated. This information is part of a GAO report. These reviewers have had 3 additional years of experience, but drug clearances are not happening.

C - CHANGE OF REVIEWERS - A CVM reviewer and company researcher agree in writing on a protocol for a field or efficacy trial. The reviewer gets transferred and the new reviewer will not honor the previous commitment. Can we get someone in authority to make sure there is continuity in the drug approval process?

D - REQUIREMENTS - FDA/CVM wants field and efficacy trials run at GLP standards. These trials are not, but are being treated as such. Safety trials must follow the guidelines of farm crop chemicals. Is this reasonable? Is grandfathering of those compounds in the pipeline allowed? We, in no way, want to harm the target animal, the consuming public or the environment. Good science rather than public opinion of consumer advocate groups must be used when clearing drugs. The requirements could be so stringent that most existing drugs would fail.

E - EFFICACY - Why should drug companies go to extremes in proving efficacy? Can this be proven in test pens and very limited field trials? Would a drug company spend $20–50 million and 10 years developing a drug that won't work? We, as an industry, will make that determination shortly after being marketed. Relax the efficacy requirements.

F - BIG BROTHER - The General Accounting Office, at the request of congressional members, has conducted five reviews of FDA/CVM's regulation of animal drugs. They have not addressed the amount of time CVM takes to review and approve new animal drugs. If drugs aren't cleared, justification is not necessary for decisions not made. The GAO delays drug clearances. Maybe this is their intent.

Let's move on to some other areas that concern the poultry industry.

1 - EXTRA LABEL USE - Where does the FDA/CVM stand on this issue? Can we legally use cleared drugs at less than approved levels?
Can we use drugs cleared for other food producing animals in poultry? We need answers.

2 - CLIENT VETERINARIAN-PATIENT RELATIONSHIP - When a feed mill enters the picture, FDA/CVM says that a third party enters the above relationship. If the veterinarian is employed by a poultry company, he is treating his own birds and assuming responsibility for residues. Why can't he use approved drugs at different levels provided no residues are produced? For example, a coccidiostat is cleared with a certain broad spectrum antibiotic at 500 gms per ton. A 350 gm level works but is not cleared. Can this be used? Can a prescription be written for this combination? Can new regulations be written to permit this?

3 - SHUTTLE PROGRAMS - FDA/CVM has told the drug companies that they cannot promote the use of shuttle coccidiostat programs. For example, a shuttle program is the use of one drug from 0–21 days of age, and another from 22–49 days of age during the life of a broiler chicken. The poultry industry has found, over time, that this program is more efficacious than one drug fed throughout the life of a broiler and prolongs the life of both drugs. The majority of broilers grown today are on a shuttle program. It would be helpful if the drug companies could assist the poultry companies in developing research data to get the best combinations to use in a shuttle.

4 - LOSS OF CLEARED DRUGS - During the past few years, the poultry industry has lost an anticoccidial, two antiblackhead drugs, triple sulfa, furizalidone, and piperazine. It is difficult to estimate what the loss of these drugs cost the poultry industry.

The poultry and animal industry operate in a world market. To compete, we must have the most effective drugs and combinations. Several drug companies have indicated that they will not seek new drug clearances because of FDA/CVM. Where does this leave the poultry industry? Competing at a disadvantage to the European and South American markets.

We cannot expect an increase in drug and combination clearances until there is an attitude change beginning at the top of the FDA. Thus far, political pressure has not been helpful. To survive as an industry in the world market, we must have a pipeline of new drugs and combinations.
The committee met on October 26 and 27, 1993 with a total of 75 members and guests attending.

Dr. Ben Pomeroy and Dr. Harold Chute presented a eulogy for our dear friend and colleague, Dr. Glenn Snoeyenbos of Massachusetts, who passed away this year.

I. DISEASES OF IMPORTANCE AND RELATED ISSUES

A. POULTRY INDUSTRY–SUPPORTED DISEASE RESEARCH PRIORITIES

Dr. C. Beard, Chairman of the SEPEA Research Committee, presented the following summary of industry supported research.

The Southeastern Poultry and Egg Association made the decision in the early 1980s to use a portion of their revenues for the funding of problem-solving research. They established a diverse panel of individuals representing the university research community and different aspects of the poultry industry to evaluate research proposals which were submitted for funding consideration. This 15–person panel is now termed the Research Advisory Council (RAC). It meets twice yearly in Atlanta and evaluates between 40 and 60 proposals at each session. In 1993, over $1 million in research proposals were approved and funded.
REPORT OF THE COMMITTEE

The proposals cover all aspects of the industry from nutrition to poultry waste. Poultry health proposals have historically received a large share of the funds. The amount requested and granted has ranged from less than $10,000 to $90,000. The subject matter has also ranged from the very basic research to the applied. The trend is moving toward funding research that will generate information that will be of use to the industry in the near term. Funding has gone to 32 universities, to USDA-ARS and to private research groups.

There are also special funds which are generated by the producers of by-products. These research funds are used to support research on the utilization of poultry by-products such as feather meal in ruminant feed.

One important "spin-off" to the SOUTHEASTERN research program is the support it provides for graduate students. SOUTHEASTERN is committed to their research funding activity as evidenced by their recent decision to employ a full-time scientist to manage the program. Research results are communicated to the industry by summaries especially written for industry use. If more information is desired, industry members may then request a copy of the final report or contact the researcher directly.

VALUE OF RESEARCH BY YEAR
(not including By-Products)

<table>
<thead>
<tr>
<th>Year</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>$6,545</td>
</tr>
<tr>
<td>1976</td>
<td>3,500</td>
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<td>1979</td>
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<tr>
<td>1992</td>
<td>817,632</td>
</tr>
<tr>
<td>1993</td>
<td>1,000,716</td>
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</tbody>
</table>

B. CURRENT POULTRY INDUSTRY HEALTH ISSUES

1. Broiler Industry Subcommittee – Dr. Tom Holder, Allen's Hatchery, presented the following summary of current broiler industry health issues.

   a. Mycoplasma Testing – We do not have a good confirmation test for mycoplasma. There is a continuing need for reference antisera
TRANSMISSIBLE DISEASES OF POULTRY

from NVSL. The reference antisera required are strong positive, weak positive, and negative sera. Once these are available, work needs to move forward in getting testing labs certified.
b. Mareks Disease – Condemnations are increasing due to this disease. There have been several novel pathotypes isolated from different geographic areas. Research monies for Marek's disease need to continue. We must stay ahead of increased condemnations.
c. Infectious Bronchitis – What is the status of the national typing laboratory? We must identify new strains of this virus so that new vaccines can be produced if needed. When will the lab be operational?
d. Squamous Cell Carcinoma – What is the true nature of this disease? Is it neoplastic? Can affected birds be trimmed? Scientific evidence gathered thus far needs to be presented to FSIS for a ruling.
e. Ascites – This condition is not truly understood as to the true cause in growing birds under normal conditions. More research needs to be funded in this area.
f. Vaccine Clearances – USDA biologic's division seems to have gone beyond their mandate of safety and efficacy. Is this really necessary? When one looks at safety and efficacy, they don't always agree. The least reactive vaccines, as a rule give the poorest protection. Vaccine clearances are by committee and this is slowing the process. Minor submissions are being treated as major submissions.
g. Research Funds – Why does poultry get such a small amount of USDA research funds compared to swine and cattle? What must we as an industry do to get our fair share?

2. Table Egg Industry Subcommittee – Dr. Gary Waters, DeKalb Research, presented the following summary of current table egg industry health issues.

The egg production industry is currently experiencing higher than expected prices for its products. The disease and health related issues that are of concern include our old nemesis Salmonella enteritidis which appears to not be increasing in flock incidence, possibly due to the extreme efforts applied to mouse control. The concern that S.e. has reached a threshold below which our current programs will not effectively go appears real. The regulatory proposals that allow for a previously positive flock to be certified as clean when specific testing is accomplished has given the industry new hope.

Avian influenza (H5N2) is again causing concern. Ratites have been diagnosed positive in several states and caused some states to enact emergency import health certificate regulations. The A.I. found in the live
markets of the East coast and reported by our poultry media resulted in four South American countries placing an embargo on all U.S. origin poultry; this has hurt the primary breeder companies.

The approval of new Mycoplasma gallisepticum vaccines which are not pathogenic for turkeys may present a tool for eliminating the pathogenic field organism.

New variant strains of Fowl Pox and Infectious Bronchitis are being diagnosed as well as a hepatitis syndrome of unknown etiology.

The concentration of greater and greater numbers of birds in multiple age complexes will ultimately intensify our health problems.

3. Turkey Industry Subcommittee - Dr. G. Yan Ghazikhanian, Nicholas Turkey Breeding Farms presented the following summary of current turkey industry health issues.

Members of the United States Turkey Industry from 14 turkey growing states were contacted to investigate the status of 1992/93 turkey health in their regions.

We are very pleased to report that for the most part turkey health has been very good. There has not been industry disruptive diseases in any region. Diseases and health disorders reported by the industry members were isolated cases and of local importance, even though some of them were common among turkeys raised in many states.

In this presentation, diseases and health disorders in affected turkeys are reported under three regions; East, Midwest and West/Southwest.

Eastern Region (NC, VA, PA, MI & IN):
* Spiking mortality in 2.5 week old poults with the duration of 3–4 days with no definitive etiology has been reported. Common enteric viruses isolated from some cases. No EEE virus was recovered from the reported cases.
* Breast blisters and breast buttons (Focal Ulcerative Dermatitis) were at 20–40% incidence level.
* Summer heat affected the performance of turkeys in this region by exacerbating the respiratory infections due to mixed infection of colibacillosis, mild Newcastle, bordetellosis and aspergillosis causing high condemnations.
* A few cases of spontaneous tibial bone breakage with unknown etiology were reported. It is suspected that, perhaps, some level of mineral imbalancement affected the turkeys with rapid skeletal growth rate.
* Poult enteritis in one to three week old poults.
* Minor incidences of leg disorders.
* Blackhead (histomoniasis).
* Fowl cholera infection, either induced by live vaccine strains or
field strains of *P. multocida.*
* Unidentified management related reduced production performance.

**Midwest Region (MN, IA, WI, MO & AR):**
* Poult enteritis.
* Colisepticemia in young turkeys.
* Breast blisters and breast buttons (FUD) from 6–30% incidence level.
* Spontaneous tibial and femur bone breakage.
* Minor incidences of leg disorders.
* Blackhead (histomoniasis).
* Liver granuloma with undefined etiology has been noticed. Roundworm larvae migration in some cases was suspected to cause such lesions.
* Dust pneumonia in breeder hen turkeys raised under dark house conditions to delay sexual maturity to obtain synchronized egg production has caused breeder hen mortality.
* Cellulitis and severe skin inflammation at the tail head of male turkeys. Rodent bites were suspected.
* Sulfa medicine toxicity.
* Incidental *M. synoviae* infection.

**West/Southwest Region (CA, CO, & TX):**
* Poult enteritis with common enteric viral and bacterial etiology.
* Minor leg problems (varus, valgus).
* Clinical osteomyelitis (staph, actimo, etc.).
* Occasional aspergillosis outbreaks in commercial flocks.
* Breast blisters and breast buttons (FUD) at 20–40% incidence level.
* Pox infection in breeder hens.
* Colibacillosis after increased ambient temperature. Strain 078 was recovered.
* Incidental *M. gallisepticum* infection.

4. Ratite Industry – Dr. Karen Hicks, Mesquite Veterinary Clinic, presented the following summary of the ratite industry and related health issues.

Little is known about diseases of ratites. No valid research has been completed on etiological agents, epidemiology, or pathogenesis of diseases of ratites. There are however, published reports of isolation of infectious disease agents including viral, bacterial, fungal, and parasitic agents as well as reports of nutritional diseases.
Private veterinary practitioners consider improper management the primary "disease" of the ratite industry. The majority of ratite owners have little or no animal husbandry experience. This lack of experience coupled with unpoliced lay journal articles which primarily contain testimonials from other producers concerning questionable management techniques has resulted in high chick mortality for many producers. In addition to improper housing, poor ventilation, excessive heat, and overmedication, little is known about the nutritional requirements of ratites.

The continued isolation of potentially significant disease causing agents is cause for concern to the industry. The fact that lay journals continue to publish information concerning infectious agents as causes of disease "syndromes" without fulfilling Koch's postulates is also a concern. Potentially significant disease agents which have been isolated will be discussed, although nothing has been published on them yet. Included in this list is *Mycoplasma spp.*, IBDV, AI, EIA, Adenovirus, Corona virus, Paramyxo II virus, Leucosis, and Reo virus. It can be expected that most families of pathogens that cause disease in other avian species may also cause disease in ratites and that many of these pathogens will be species specific.

*Mycoplasma spp.* have been isolated from tracheal and cloacal cultures of ostrich at several labs. The *Mycoplasma* isolated has not been speciated, but is not M.S., MG, or MH (Shivaprasaud, 1993). *Mycoplasma synovia* was diagnosed by florescent antibody testing in a lame emu, however, the organism was not isolated from the emu. *Mycoplasma spp.* have been isolated from asymptomatic birds as well as from birds with varying clinical signs. The significance of the isolation is unknown.

IBDV like particles have been demonstrated in ostrich chicks associated with bursal necrosis. The ostrich chicks had been housed with a domestic chicken (Phalen, 1993).

Equine Encephalomyelitis virus has been isolated from emu & ostrich. Both eastern and western strains have been isolated. Antibodies for WEE & EEE have been demonstrated in many normal birds. EEE in emus was associated with hemorrhagic diarrhea and high mortality (Tully, 1992). TVMDL, Amarillo, Texas has isolated WEE from ostrich chicks with a variety of symptoms. They are currently investigating the role of the virus in disease production (Richard Mock).

Avian Influenza virus has been isolated from emus and rheas in two states. $H_5N_2$ and $H_5N_1$ have been isolated, both strains were found to be nonpathogenic to poultry. Several states enacted emergency interstate health requirements of a negative AI test 10 days prior to entry for any ratites. This requirement is questionable as a protective measure since birds shedding the virus would probably be sero negative on AGID testing and those that are positive simply immune to the disease.
Adenovirus, Corona virus and Reo viruses have all been isolated from ratites with various clinical signs. Adenovirus has also been isolated from clinically normal animals. The roll any of these viruses may play in disease production is unknown, as clinical signs vary widely and isolation from any particular disease outbreak have been sporadic. Consistent clinical symptoms, histopathological changes, and virus isolation in a flock have not been reported.

Avian Leucosis has been diagnosed in emu and ostrich, producing clinical syndromes similar to those found in poultry.

The relationship between stress factors and disease production by potential infectious agents is unknown.

5. Avian Import/Export Activities – Dr. Keith Hand, USDA APHIS VS, submitted the following report.

Poultry and Hatching Eggs
There were 6,282,363 poultry, including day old chicks, and 17,593,184 poultry hatching eggs imported into the United States during fiscal year (FY) 1993.

Commercial Birds
The importation of commercial birds continues to decline. The decline seen in recent years has been due to less availability of species, combined with a number of countries restricting international trade of birds. This decline was compounded during FY 1992 when a large number of international airlines refused to ship "wild-caught" birds, as well as the placement of an importation quota for most species of birds by the Department of Interior. There were 133,435 commercial birds imported during FY 1993. There were 14,528 commercial birds in 3 quarantined lots that were infected with VVND and were refused entry into the United States.

Pet Bird Program
Pet birds are currently being imported and quarantined at New York, New York; Miami, Florida; Los Angeles, California; Honolulu, Hawaii; and Mission, Texas. There were 1,386 birds imported and quarantined during FY 1993. All pet birds were tested for VVND, and no virus was isolated.

Smuggled Birds
Birds that were illegally entered into the United States and seized were quarantined at USDA facilities. There were 665 birds quarantined. Following the successful completion of the quarantine and test procedures, these birds were sold at public auction as permitted by a Memorandum of Understanding between the Departments of Agriculture, Interior, Justice, and Treasury. An additional 182 confiscated parrots quarantined in the Mission,
Texas smuggled bird station were also infected with VWND and had to be euthanized.

**Ostrich Importation**

USDA officials have approved a total of 57 farms in 8 countries as a result of site inspections, and these farms have been qualified to ship ratities or ratite hatching eggs to the United States.

During FY 1993, 1,322 ostrich chicks were imported through New York Animal Import Center and 452 through the Miami Animal import Center. A total of 1,025 chicks were released at the end of a 30-day quarantine from New York and 311 from Miami, Florida (77.5%). In addition, 1,246 emu were imported and 1,238 released from quarantine (99.4%).

**C. DISEASE STATUS REPORTS**

1. **NVSL Diagnostic Bacteriology Laboratory Activities** – Dr. Lee Ann Thomas, USDA APHIS NVSL, presented the following report on activities of the NVSL Diagnostic Bacteriology Laboratory.

   The isolation and identification of *Salmonella enteritidis* serotype enteritidis (SE) continue to be primary activities of the Bacterial Identification Section of the Diagnostic Bacteriology Laboratory. Support was provided for the SE Phage Type 4 (SE PT4) Commercial Bird Survey and the SE Pilot Project. In addition, the testing of flocks implicated in human SE outbreaks continues at the NVSL.

   There were no isolations of SE PT4 from commercial birds this fiscal year. A total of 915 swabs representing 296 importations of commercial birds were tested. Twenty-four percent of swabs were positive for salmonellae. The most common serotype isolated and identified was *S. typhimurium* from 139 swabs. One swab was positive for *S. enteritidis* PT8. It was identified from a group of emus imported from the Netherlands. A total of 33 serotypes were identified.

   Activities of the SE Control Program and the SE Pilot Project resulting in a total of 7359 samples for the isolation and identification of SE. From these samples more than 10,000 suspect salmonella colonies were isolated and characterized as either SE or as other salmonellae. A summary of results is given on the next page:
TRANSMISSIBLE DISEASES OF POULTRY

<table>
<thead>
<tr>
<th>Type of Sample</th>
<th>No. of Samples</th>
<th>No. Positive for SE (%)</th>
<th>No. Positive for Other Salmonellae(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue</td>
<td>2465</td>
<td>113 (5%)</td>
<td>14 (&lt; 1%)</td>
</tr>
<tr>
<td>Environmental</td>
<td>4075</td>
<td>769 (19%)</td>
<td>1295 (32%)</td>
</tr>
<tr>
<td>Eggs/Insects</td>
<td>173</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mice</td>
<td>646</td>
<td>322 (50%)</td>
<td>91 (14%)</td>
</tr>
</tbody>
</table>

High mortality of ostrich chicks in quarantine stations resulted in a large number of submissions (25) for bacteriologic analysis. The most commonly identified organism was *Escherichia coli* (14 submissions). It was frequently identified from yolk sac swabs or aspirates. A wide variety of other bacteria were identified, among these potential pathogens such as *Bordetella bronchiseptica* (lung), *Clostridium difficile* (gut), and *Clostridium spp.* (gut and yolk sac) were found.

Finally, there has been a good deal of discussion and activity this year in the area of avian mycoplasma serology. The NVSL in response to these discussions has proposed the following:

* Provide for a fee positive and negative plate control antisera for *Mycoplasma gallisepticum* (chicken and turkey), *M. synoviae* (chicken and turkey, and *M. Meleagridis* (turkey).

* Provide for a fee positive and negative hemagglutination inhibition (H1) antisera for *M. gallisepticum* (chicken and turkey), *M. synoviae* (chicken and turkey, and *M. meleagridis* (turkey).

* Determine interest in NVSL providing training in avian mycoplasma serology.

* Increase emphasis on developmental projects that address current testing difficulties.

* Initiate dialogue with the poultry industry on support of graduate training in avian mycoplasma diagnostics.

2. Newcastle Disease

a. Investigations and outbreaks – Dr. C. Groocock, APHIS VS, and Dr. J. Pearson, APHIS NVSL, presented the following report.

There has been no velogenic Newcastle disease (VND) virus isolated from domestic birds for over 1 year. All samples submitted from suspected VND cases were negative. Also, VND has not been isolated from domestic pet birds for over 2 years. This is the longest time period without a VND case since record keeping was initiated in 1972.

b. Criteria for characterization of NDV isolates – Dr. G. C.R. Dulac, Agriculture Canada, presented the following report prepared by R. Heckert,
INTRODUCTION - Historically, Newcastle disease virus (NDV) isolates have been classified into one of three pathotypes based upon an assessment of virulence by the following in vivo tests: 1) intracerebral pathogenicity index in day-old chicks (ICPI), 2) intravenous pathogenicity index in six-week-old chickens (IVPI), and 3) the mean death time for nine-day-old embryonated chicken eggs (MDT) (1). This classification system has been useful in an academic sense, but is less meaningful when attempting to control international poultry movement.

The criteria for classifying countries with regard to Newcastle disease have been published recently under the auspices of the Commission of the European Communities (EEC) (2). According to the decision of the commission, Newcastle disease is defined as "an infection of poultry caused by any avian strain of paramyxovirus 1 with an intracerebral pathogenicity index in one-day-old chicks greater than 0.7". Traditionally, Canada has utilized the historical classification system to define the pathogenicities of Newcastle disease viruses isolated in its territory. The intracloacal inoculation route has not been used in Canada to define the pathogenicity of Newcastle disease viruses. For eventual trading purposes, between Canada and the EEC, it was important to determine if Canada could be classified as free of Newcastle disease, based upon the EEC definition. In this paper, we present the results of a retrospective study of all Newcastle disease viruses isolated from commercial poultry flocks and feral birds during the previous two and a half years. Specifically we wished to determine if any Newcastle disease isolates had an ICPI greater than 0.7, which could potentially have a negative impact upon trade.

RESULTS - A total of thirty eight Newcastle disease viruses isolated from commercial poultry flocks and feral birds during the previous two and a half years were examined in this study. Twenty-three of these isolates were from chickens, three from turkeys, four from pigeons, six from cormorants, one from a pelican, and one from a duck (Tables 1 and 2). As shown in Table 1, all the viruses isolated from the commercial chicken and turkey flocks would qualify as non pathogenic viruses by the EEC criteria. Except for three specimens, all the strains of NDV isolated had ICPI values near those expected for the vaccinal strains of NDV, i.e., 0 to 0.4.

Of the four Newcastle disease viruses isolated from pigeons, two had an ICPI above 0.7. These had been classified as mesogenic strains according to the current pathotyping methods.

The six specimens from cormorants and the related sample isolated from a pelican in 1992 would be considered pathogenic by the EEC standard.
and were classified as velogenic with the current system.

One Newcastle disease virus isolated from a duck had an ICPI of 0.87 and was classified as a mesogenic virus in the current system (Table 2).

With the current system of pathotyping the Newcastle disease viruses, all the isolates from commercial chicken and turkey flocks were within the lentogenic range and would have also been considered non-pathogenic by the EEC guidelines. Assuming that Canada can satisfy the other EEC zoosanitary criteria of Newcastle disease freedom, the application of the EEC pathotyping standards for Newcastle disease would not be expected to constitute an obstacle to trade for the Canadian poultry industry.

The prevalence of pathogenic strains of Newcastle disease viruses in feral birds is of concern to the poultry industry. The presence of such strains of viruses in feral birds justifies maintaining the Newcastle disease monitoring carried out by the federal authorities. Agriculture Canada recommends the practice of good husbandry and biosecurity measures which will prevent introduction of pathogenic Newcastle disease viruses from feral birds into commercial poultry flocks.

The methods of pathotyping Newcastle disease viruses currently in use in Canada appear to be adequate for the present needs. In addition the information now being gathered is also sufficient for eventual commercial trade negotiations.

REFERENCES


**REPORT OF THE COMMITTEE**

Table 1. Intracerebral Pathogenicity Indices And Pathotypes Of Newcastle Disease Viruses Isolated From Chickens And Turkeys Between 1991–1993.

<table>
<thead>
<tr>
<th>Submission No.</th>
<th>ICPI(1)</th>
<th>Pathotype</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CHICKEN</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>92DC2332</td>
<td>0.70</td>
<td>L(2)</td>
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<tr>
<td>92DC2640</td>
<td>0.26</td>
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<td>92DC3114</td>
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<td>92DC3155B</td>
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<td>91–1714</td>
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<td>91–1935</td>
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<td>91–1995</td>
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<td>93DC2211</td>
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<tr>
<td><strong>TURKEY</strong></td>
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<td>92DC2623</td>
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<td>L</td>
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<td>91–532</td>
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<tr>
<td>91–533</td>
<td>0.14</td>
<td>L</td>
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</tbody>
</table>

(1) ICPI = INTRACEREBRAL PATHOGENICITY INDEX
(2) L = LENTOGENIC

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Table 2. Intracerebral Pathogenicity Indices and Pathotypes of Newcastle Disease Viruses Isolated From Feral Birds.

<table>
<thead>
<tr>
<th>Accession No.</th>
<th>ICPI (1)</th>
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<tr>
<td>PIGEON</td>
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<td>92DC2138</td>
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<td>93DC1349</td>
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<td>M</td>
</tr>
<tr>
<td>CORMORAN</td>
<td></td>
<td></td>
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<tr>
<td>92DC2330</td>
<td>1.26</td>
<td>V(4)</td>
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<td>92DC2583</td>
<td>1.50</td>
<td>V</td>
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<td>92DC2585</td>
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<tr>
<td>PELICAN</td>
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<td>V</td>
</tr>
<tr>
<td>DUCK</td>
<td></td>
<td></td>
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<tr>
<td>93DC1348</td>
<td>.87</td>
<td>M</td>
</tr>
</tbody>
</table>

(1) ICPI = INTRACEREBRAL PATHOGENICITY INDEX  
(2) L = LENTOGENIC  
(3) M = MESOGENIC  
(4) V = VELOGENIC

c. Dr. J. Pearson, APHIS NVSL, presented the following comments regarding U.S. and European procedures for characterization of Newcastle Disease viruses.

In May 1993, the European Community (EC) published a commission decision outlining requirements for importing poultry and poultry meat from third countries. The United States will meet most of the requirements, particularly in the area of disease reporting and regulatory action. The following are some areas of virus characterization where the United States and the EC differ.

1. The EC requires regulatory action to be taken if a Newcastle disease virus (NDV) is isolated that has an intracerebral pathogenicity index (ICPI) of more than 0.7. This would include all mesogenic and velogenic isolates. At the National Veterinary Services Laboratories (NVSL), the NDV characterization technique has been to inoculate four 4- to 6-week-old
chickens by swabbing the cloacal with a 1:10 dilution of amnionic-allantoic fluid from the first passage of NDV in embryonating chicken eggs. The chickens are observed for 8 days. In addition, a mean death time (MDT) of the isolate is determined in embryonating chicken eggs, and the virus is characterized using a battery of monoclonal antibodies. Regulatory action is taken if the inoculated chickens die, which would be the definition for velogenic NDV. Regulatory action can be taken even if the dead birds do not have visceral lesions. If the MDT and monoclonal antibody binding pattern do not concur with the chicken pathogenicity results, all tests are repeated. A mesogenic strain (ICPI of about 0.7–1.3) does not require regulatory action as it will not kill chickens. The mesogenic strains should be detected using the current criteria because they usually produce mild clinical disease in chickens, and their MDT and monoclonal antibody binding pattern are different than velogenic or lentogenic NDV isolates. This year, for the first time in over 10 years, a mesogenic strain of NDV was isolated. The isolate was from an anhinga (order: Pelecaniformes) submitted from Sea World in Florida. No regulatory action was taken. The NVSL has the capability to conduct the ICPI but has no plans to perform the procedure as it does not serve as a basis for regulatory action. The biggest differences between the U.S. and EC procedures are the virus characterization procedures and the requirement to take regulatory action if a mesogenic NDV is isolated.

2. The pigeon paramyxoviruses have an ICPI of greater than 0.7, but they do not affect chickens if inoculated by the cloacal route. The United States takes no regulatory action to control or eradicate this disease. The virus is widespread in Europe, but there is no evidence that they are taking regulatory action.

3. The EC requires that ND vaccine viruses have an ICPI no greater than 0.4 if 10 to the 7 embryo infective doses\(_{50}\) (EID\(_{50}\)) are administered to each bird in the ICPI test; if 10 to the 8 EID\(_{50}\) are used, the ICPI can be 0.5. The viruses used to produce inactivated vaccines must have an ICPI of no greater than 0.7. The U.S. vaccine and regulatory personnel do not usually do the ICPI test, but the LaSota and B1 strains used in the United States should have an ICPI of 0.4 or less.

4. The EC and U.S. avian influenza (AI) characterization procedures are very similar. The only difference is that in the EC regulatory action will be taken if an AI isolate has an IVPI greater than 1.2, and the United States will take regulatory action if an isolate kills within 10 days six or more of eight 4- to 8-week-old chickens inoculated by the intravenous route. The results of these two procedures will be almost identical.

The EC officials have visited the United States and reviewed our procedures but have not ruled on their acceptability.

3. Turkey Rhinotracheitis and Swollen Head Syndrome (TRT) – Dr.
James Pearson, USDA APHIS NVSL, gave the following status report. In fiscal year 1993, 1,291 serum samples were tested. All samples were negative for antibody. A half-day session on turkey rhinotracheitis and swollen head syndrome was held during the American Association of Avian Pathologists annual meeting in July 1993. The presentations should increase awareness of the potential for introduction of these diseases. Apparently the diseases are now established in Mexico.

D. USDA SECRETARY'S ADVISORY COMMITTEE ON FOREIGN ANIMAL AND POULTRY DISEASES

1. Dr. B. Easterday, University of Wisconsin, gave the following report on the recommendations of this committee.

The Secretary's Advisory Committee on Foreign Animal and Poultry Diseases (FAPD) met in Laurel, Maryland, June 29–July 1, 1993, for the purpose of advising and offering recommendations to the Secretary of Agriculture on issues concerning exotic diseases of livestock and poultry.

The Advisory Committee made specific recommendations relating to poultry and other avian species as follows:

a. The Committee recommended that the USDA–APHIS request that the USAHA Committee on Transmissible Diseases of Poultry and other Avian Species revisit the subject of avian influenza infection terminology with respect to characterization of the agent AND (emphasis added) clinical signs of the disease. [There was concern that there is a need for more descriptive terminology related to avian influenza infection to accurately assess the significance of avian influenza outbreaks in relation to interstate and international trade.]
b. The Committee recommended that APHIS re-evaluate the definition of exotic Newcastle disease virus and consider ALL (emphasis added) velogenic strains as exotic. (Current policy designates velogenic viscerotropic Newcastle disease virus as the only exotic Newcastle Disease virus.)

Other recommendations relating to poultry and other avian species were:

a. Recommended that the USDA establish a permanent USDA-operated multi-species animal import quarantine facility on the west coast of the US and eliminate the use of privately operated quarantine facilities for other than avian species.
b. Recommended that the fee schedule for NVSL not be allowed to interfere with foreign animal and poultry disease diagnosis and surveillance.
c. Recommended continued support to Plum Island for continued research capabilities, facilities improvement and maintenance of qualified staff.
REPORT OF THE COMMITTEE

E. EMERGING DISEASES – Dr. Fred Hoerr, University of Alabama, gave the following report.

Infectious coryza occurred in a flock of 80,000 broiler chickens in Alabama in 1993. The flock experienced high morbidity, 20% mortality and 67% condemnations at slaughter. An increased incidence of infectious coryza in broiler breeders preceded the epizootic in broilers.

II. DRUG USE ISSUES


b. Drug Use Issues Facing Industry – Dr. T. Holder, Allen's Hatchery, discussed drug use issues facing animal industry today. The complete text of his comments is located in another location in this proceedings.

III. MICROBIOLOGIC CONTAMINATION OF RAW POULTRY MEAT AND EGGS

A. Salmonella Negative Contamination Goal For Animal Feed

1. Dr. Morris Cover, Chair of the USAHA Feed Safety Committee, gave the following information on committee activities.

For several years FDA-CVM has considered possible regulations requiring a zero tolerance of Salmonella in feeds for animals and poultry. After discussion by a steering committee, it was decided to find an appropriate science based organization to serve as a forum for debate on this issue. The U.S. Animal health Association was selected. Following this, an Ad Hoc Committee was formed at the 1991 annual meeting to organize the procedure for discussion and debate on this issue. At this meeting, four subcommittees were formed to study the issue and to recommend procedures toward reducing the presence of Salmonella in feed, working toward elimination of this microbiological contaminant. These committees are:

- Microbiology
- Feed and feed ingredients
- Live production
- Transportation

Preliminary reporting of progress was presented at the 1992 USAHA Meeting. The U. S. Animal Health Association has accepted the Feed Safety Committee as an official standing committee of the organization. This year (1993) these committees will report on procedures and practices for all
phases of feed production which will reduce the presence of Salmonella in feeds for food animals. Such recommendations will be in a H.A.C.C.P. type format. Hopefully these recommendations will be accepted by both industry and Federal/State Regulatory agencies as good manufacturing/good laboratory practices. Our goal is to greatly reduce the presence of Salmonella in feed, working toward elimination. Recommendations from each subcommittee will be discussed and reviewed by the full feed Safety Committee and possibly passed along through the regular channels of the USAHA.

There is one very important characteristic of this activity. We have brought together industry, regulatory and the scientific community in a spirit of cooperation and coordination to solve a very difficult issue. It seems to me that more progress can be made on this and on any similar issue by discussions in a forum such as USAHA. Such problems are best solved in a spirit of cooperation, rather than in an atmosphere of adversity. I am excited about this move toward such a philosophy and believe we can arrive at a solution acceptable to all those involved in this issue.

2. Dr. George Mitchell, Center for Veterinary Medicine – FDA, made the following remarks pertaining to FDA's program for salmonella negative feeds.

Salmonella and other food pathogens continue to present a human and animal health hazard. CVM continues to seek improvements in the margin of safety of products consumed by animals and for animal products used by the consumer. Toward this goal, the Center continued to emphasize a zero salmonella goal for animal feed and feed ingredients. To improve our ability to detect salmonella in animal feed and feed ingredients, CVM is funding an extramural research project at the University of Arkansas directed at optimizing the media and detection method for salmonella in animal feeds. During the past year, under a contract with the State of Iowa, samples of soybean meal from all soybean meal processors in Iowa were collected and analyzed for salmonella. Ten of the eleven plants were negative for salmonella. The one plant from which positive samples were detected, reviewed its process, made changes, and re-sampled. The most recent samples from the plant were negative for salmonella. Getting industry to take this approach to the salmonella problem in animal feed is one of the goals of CVM's program. Also, during FY-93 and continuing into FY-94, we surveyed products from approximately 100 animal protein renderers and 75 vegetable protein processors for salmonella. Preliminary results from the survey will be presented by Dr. McChesney at the Feed Safety Committee meeting on Tuesday, October 26. We anticipate that the complete results will be available in January 1994.

CVM continues to work with the United States Animal Health Association (USAHA) toward a zero salmonella goal. At the feed Safety Committee meeting Dr. McChesney will be presenting an overview of the
REPORT OF THE COMMITTEE

minimum elements that FDA would require a HACCP based quality assurance program to address. We anticipate that the feed ingredients and live production subcommittees of the Feed Safety Committee will also be emphasizing HACCP plans and may present generic HACCP programs that could be adapted to different segments of the feed industry. The microbiology subcommittee has been active during this past year and is expected to recommend statistical valid, risk based sampling plans for assessing the zero salmonella goal.

FDA is preparing a food safety initiative that will be heavily based on HACCP and is directed at applying HACCP principles to all aspect of food and feed production from farm to table. The first part of this initiative, the seafood HACCP program, should publish in the Federal Register before the end of the year, and an advance Notice of Proposed Rulemaking relating to HACCP should also publish during the same time-frame.

Since the Feed Safety Committee is meeting at the same time we are, I would like to update you on Dr. McChesney's HACCP presentation.

Before beginning our discussion of HACCP, I would like to address quality assurance programs that are already in place and that may not meet the definition of HACCP program. If a processor has a quality assurance program in place that enables the production of a quality product meeting the zero salmonella definition, we are not requesting that it scrap its current program. We are suggesting that the processor re-evaluate its program and consider expanding it to other contaminants and that the HACCP approach offers a method to do this.

Sanitation is an ongoing problem and should be addressed for both personnel and facilities. However, from a sanitation point of view, every part of the plant has the potential to be a critical control point. Identifying sanitation critical control points and including them in the HACCP plan can result in the HACCP plan becoming so unfocused as to be meaningless. Because of this, we suggest that sanitary guidelines be developed, but not incorporated into the HACCP plan.

For a HACCP program to increase the margin of safety in our food supply will require that each manufacture tailor a HACCP plan to the particular plant. We anticipate that FDA or a State or other inspector would review an individual plant's HACCP plan during an inspection and judge the plans against core requirements. We do not anticipate a pre-approval process for HACCP plans.

Those of you familiar with HACCP programs will note that the minimum elements discussed at the Feed Safety Committee are not new and that they encompass the basic HACCP principles.

1. Every processor should have a written HACCP plan that is specific for each location where products are processed. Furthermore, the HACCP plan should be specific for each product processed at the location.

2. The HACCP plan should identify the safety hazard or hazards
that must be controlled for each product at the plan. In today's discussion we are focusing on salmonella; however, since a HACCP plan is directed at controlling the process, it has the potential to control multiple hazards. However, the other hazards need to be identified.

3. Identify the critical control points for each of the identified hazards and include these in the written HACCP plan. When considering whether a control point is critical or not it is important to consider that a critical control point is a point in the process where there is a high probability that improper control may cause, allow, or contribute to a hazard or to filth in the final product or lead to decomposition of the final product. In general there will only be a few control points that are truly critical and many points where the process is controlled. Identifying and focusing on the critical control points is absolutely essential to the success of a HACCP program, or any quality assurance base program.

4. Identify the critical limits that must be met at each of the critical control points and include these in the written HACCP plan.

5. Identify procedures that will be used to control and monitor each of the critical control points to ensure compliance with the critical limits and the person(s) responsible for monitoring the critical control point.

6. Establish a record keeping system that will document the monitoring of critical control points and contains the actual values obtained during monitoring. The part of the HACCP plan dealing with records should also provide for internal record review and record retention.

7. An essential part of any quality assurance program is training. The HACCP plan should identify a person who is responsible for developing and modifying the plan, evaluating critical limit deviations and corrective actions, and performing the record reviews. In addition, a document outlining the training provided to enable employees and management to implement the quality assurance program should be available.

The minimum elements for a quality assurance program that I have outlined are by no means a complete HACCP or quality assurance program. Rather they are guidance for the core requirements on which we envision all segments of the industry developing programs and plans that are specific for a segment and particular plant. I believe that it is safe to conclude that the application of HACCP to the food and feed industries is the wave of the future within FDA.

B. Committee Resolution – The Committee submitted a resolution concerning the USAHA Salmonella Enteritidis Task Force to the Resolutions committee.

IV. AVIAN INFLUENZA

1. Avian Influenza Subcommittee – Dr. Ben Pomeroy, University of Minnesota and Dr. Robert Eckroade, University of Pennsylvania, submitted
REPORT OF THE COMMITTEE

the following report.
This report includes data from questionnaires sent to State Veterinarians and laboratory results reported by NVSL-USDA-APHIS-VS.

INDIVIDUAL STATES
A questionnaire was sent to 48 State Veterinarians and members of the Committee. Replies were received from 30 states. No corrections were suggested in the table listing the influenza types isolated from turkeys, chickens, and other domestic fowl in the U.S. or based on serology (1964–1992) that was published in the 1992 USAHA Proceedings. The column, Year First Identified, indicates the first year AI was identified in the state and has no relationship with the next column, Hemagglutin Antigens Identified. The H antigens are listed in numerical order and the isolates are specifically listed for 1993 from each state.

TURKEYS
According to the FY1993 reports and the NVSL laboratory report, the incidents of AI in turkeys were based primarily on serology and a few isolations of the virus.

Indiana
H1N1 was identified in one flock serologically by NVSL.

Iowa
One flock was identified serologically with H1N1 by NVSL.

Maryland
Turkeys in two poultry dealer flocks were found serologically positive for H5N2 and H1N1.

Michigan
H1N1 was identified serologically on three occasions by NVSL.

Minnesota
Minnesota has continued its extensive monitoring program of broiler and turkey flocks in 1993 – positive AGPT samples were submitted to NVSL. Only one virus isolation was made from a field case. In the 1992–93 influenza season, the first positive flock was identified in July 1992 and the last flock in January, 1993. The first three flocks had been raised on range. The outbreaks involved 15 flocks on 11 farms and there were 7 different introductions. One breeder flock was infected with H1N1 and the 14 market flocks were involved with 3 serotypes, H4N2, H5N8, and H7N3. The first flock in the 1993 season was identified in August and was infected with H5N9. No other flocks have been identified to October 1, 1993. No chicken broiler flocks were found infected.

North Carolina
H1N1 was identified serologically in eight laboratory submissions to
TRANSMISSIBLE DISEASES OF POULTRY

NVSL. 

North Dakota 
One flock was identified serologically with H6N8 by NVSL. 

Pennsylvania 
A turkey flock of 32,000 was found serologically positive for H5N2 in December, 1992. No virus isolations were made. Surveillance of premises within a 3 mile radius of the turkey flock resulted in no virus isolations. However, in January, 1993 three chickens at a poultry show tested positive on AGP test and were serologically positive for H5N2.

Epidemiologic information indicated a positive connection between the turkey flock and a live poultry market in Philadelphia and H5N2 was isolated from chickens in the market. The Philadelphia market was linked to other live poultry markets in the Northeast. Surveillance of these markets was initiated and the results are reported under Live Poultry Markets. In March, 1993, H5N2 virus was isolated from a small poultry hauling operation in Pennsylvania.

USE OF AVIAN INFLUENZA VACCINE

Minnesota reported the use of AI vaccine (H1 and H6) in breeder and market flocks. North Carolina used H1 vaccine in 93 breeder flocks. Ohio used H1 vaccine in 31 breeder flocks. No state responded to the use of AI vaccine in chickens.

CHICKENS

Michigan 
Serological evidence of AI was identified in samples submitted to NVSL (H6, N2, N6; H1).

Ohio 
Virus isolate from a chicken revealed H2N2 and serological identification of H2, N5, N2 at NVSL.

LIVE POULTRY MARKETS (NVSL)

Following the incident in Pennsylvania, surveillance of live poultry and auction markets in the Northeastern states was initiated in January, 1993. An H5N2 virus was isolated from fowl in 11 markets in New York, 5 markets in New Jersey. Trace backs identified one backyard flock in New Jersey infected with H5N2. This flock of 800 birds was depopulated. Antibody titers (H5N2) were also detected in backyard and dealer flocks in Pennsylvania, Delaware, Virginia, New Jersey and Maryland.
REPORT OF THE COMMITTEE

Florida
In Florida sentinel birds are used in live-poultry markets and botanicals. This surveillance program resulted in one viral isolation (H5N2) and nine other premises having serological positive birds. These premises were depopulated and subsequent repopulation has remained negative.

All AI isolates (H5N2) from live poultry markets tested in chickens at NVSL were classified as non-pathogenic.

OTHER FOWL (NVSL)
In the live poultry markets and backyard flocks, other fowl such as ducks, geese, turkeys, guinea fowl, pheasants, etc. may exist. Isolates from some of these birds have been made and H5N2 virus has been identified in guinea fowl, pheasant, duck; other serotypes have been isolated such as H3N8, and H6N2. Serological evidence of AI indicated a variety of serotypes; H1N1, H2N7, H3N8, H5N2, H10N7, H11N8, and H12N5.

Wisconsin
Duck showed serological evidence of H10N7 and swan had a variety of H and N antibodies.

Michigan
Duck, geese, swan serums showed a variety of H and N antibodies including H5N9, and H11N9.

Ohio
H1N1 was isolated from Muscovy duck.

Arkansas
H9N2 was isolated from quail.

California
H1N1 was isolated from quail.

IMPORTED BIRD ISOLATION (NVSL)
NVSL made AI virus isolations from tissues of wild and exotic birds imported from 6 countries and birds from 3 states.

Table 2. Isolation of Avian influenza viruses from wild and exotic (Import) birds. October 1, 1992 – September 30, 1993

<table>
<thead>
<tr>
<th>Species of Birds</th>
<th>Country of Origin</th>
<th>Subtype</th>
<th>Month/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parrot</td>
<td>Singapore</td>
<td>H4N6</td>
<td>February 1994</td>
</tr>
<tr>
<td>Longtail broadbill</td>
<td>China</td>
<td>H3N6</td>
<td>April 1993</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Species</th>
<th>Country</th>
<th>Virus Code</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuthatch</td>
<td>Tanzania, Belgium, China</td>
<td>H4N6</td>
<td>May 1993</td>
</tr>
<tr>
<td>Magpie robin</td>
<td>Tanzania, Belgium, China</td>
<td>H7N6</td>
<td>May 1993</td>
</tr>
<tr>
<td>Magpie robin and finch</td>
<td>Tanzania, Belgium, China</td>
<td>H4N2, H7N6</td>
<td>May 1993</td>
</tr>
<tr>
<td>Unknown Species</td>
<td>Belgium, Guinea</td>
<td>H4N6</td>
<td>May 1993</td>
</tr>
<tr>
<td>Loon</td>
<td>Maryland</td>
<td>H10N7</td>
<td>June 1993</td>
</tr>
<tr>
<td>Softbill</td>
<td>North Carolina</td>
<td>H7N1</td>
<td>June 1993</td>
</tr>
<tr>
<td>Spec. thrush</td>
<td>China, Australia</td>
<td>H4N6</td>
<td>June 1993</td>
</tr>
<tr>
<td>Parakeet</td>
<td>California</td>
<td>H4N6</td>
<td>July 1993</td>
</tr>
<tr>
<td>Brownbill</td>
<td>California</td>
<td>H4N6</td>
<td>July 1993</td>
</tr>
<tr>
<td>Thrush</td>
<td>Unknown Country</td>
<td>H4N6</td>
<td>August 1993</td>
</tr>
<tr>
<td>Nun</td>
<td>Unknown Country</td>
<td>H4N6</td>
<td>August 1993</td>
</tr>
<tr>
<td>Finch</td>
<td>Belgium</td>
<td>H4N6</td>
<td>September 1993</td>
</tr>
</tbody>
</table>

### RATITES (NVSL)

H5N2 and H7N1 AI viruses were isolated from emus and rheas in Texas and H7N1 in rheas in North Carolina. None of these isolates were pathogenic to chickens and turkeys at NVSL. Ratites had been distributed from Texas into 11 states and Canada. Serological studies indicate several H and N antibodies were present in serum samples submitted to NVSL from nine additional states. This is the first report of AI in rheas and emus in published literature.

### STUDIES AT SAINT JUDE RESEARCH LABORATORY

H5N2 isolates were submitted to Saint Jude from the live poultry markets in the Northeast and Florida and from ratites. The studies indicated the viruses were similar but were different from the isolates associated with the 1983–84 AI outbreak in Pennsylvania.

Studies on pathogenicity in chickens and turkey at NVSL indicated the isolates were non-pathogenic.

### SUMMARY

Avian influenza was identified in the following species and states.
REPORT OF THE COMMITTEE

FY1993.

Turkeys

- Indiana: H1N1
- Iowa: H1N1
- Maryland: H5N2
- Michigan: H1N1
- Minnesota: H1N1, H4N2, H5N9, H6N8, H7N3
- North Carolina: H1N1
- North Dakota: H6N8
- Pennsylvania: H5N2

Chickens

- Michigan: H6, H8, H1
- Ohio: H2N2, H2, H5, N2

Live Poultry Markets

- New Jersey: H5N2
- New York: H5N2
- Pennsylvania: H5N2
- Florida: H5N2

Back Yard Flocks/Dealers

- Delaware: H5
- Maryland: H5N2
- New Jersey: H5N2
- Pennsylvania: H5N2
- Virginia: H2N3, H4

Other Fowl

Live poultry markets/dealers and back yard flocks harbor not only chickens, but turkeys, guinea fowl, pheasants, ducks, geese, swans, etc. Isolations of H5N2 were made from guinea fowl and ducks in New Jersey and New York; pheasants in New York and Pennsylvania. Positive serology were identified in ducks in Maryland, New Jersey, Pennsylvania, and Virginia. Other serotypes were also identified, H1N1 in Muscovy duck in Ohio, duck in Pennsylvania, quail in California; H2N7, Virginia; H3N8, duck, New Jersey; H6N8, goose, Pennsylvania; H10N7, duck, Pennsylvania and Wisconsin; H11N8 and H12N5, geese, Pennsylvania; and H9N2, quail, Arkansas.

Ratites

H5N2 and H7N1 AI viruses were isolated from emus and rheas in Texas and H7N1 in rheas in North Carolina. Serological positive samples were detected in nine additional states that indicated a broad exposure to AI viruses.
Import Bird Isolation

NVSL made Al virus isolations from tissues of wild and exotic birds originating from six countries and three states. The serotypes identified were H3N6, H4N2, H4N6, H7N1, H7N8, and H10N7.

Pathogenicity Tests

All H5N2 isolates were tested in chickens/turkey at NVSL and all were considered non-pathogenic. Studies at Saint Jude Research Laboratories for gene molecular characterization indicated that all the H5N2 isolates were the same and were not related to the H5N2 isolates associated with the outbreak in 1983-84.

No commercial flocks of chickens were involved with Al in FY1993.

Use of Avian Influenza Vaccine – Turkeys

Minnesota reported the use of H1 and H6 vaccines in market and breeder flocks. North Carolina and Ohio reported the use of H1 vaccines in breeder flocks.
## Table 1. Avian influenza serotypes isolated from turkeys, chickens and other domestic fowl in the U.S. or based on serology (1964–1993).

<table>
<thead>
<tr>
<th>State</th>
<th>Year First Identified</th>
<th>Hemagglutinin Antigens Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TURKEYS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>California</td>
<td>1964</td>
<td>H1,H5,H6,H9</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1965</td>
<td>H6</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1965</td>
<td>H1,H2,H5,H6,H9</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1966</td>
<td>H1,H2,H3,H4,H5,H6; H7,H8,H9,H10,H13; 1993:H1,H4,H5,H6,H7</td>
</tr>
<tr>
<td>Washington</td>
<td>1967</td>
<td>H6</td>
</tr>
<tr>
<td>Oregon</td>
<td>1970</td>
<td>H6,H7</td>
</tr>
<tr>
<td>Iowa</td>
<td>1971</td>
<td>H1,H2,H4,H5,H6; 1993:H1</td>
</tr>
<tr>
<td>Colorado</td>
<td>1972</td>
<td>H1,H5,H7,H9</td>
</tr>
<tr>
<td>Ohio</td>
<td>1975</td>
<td>H1</td>
</tr>
<tr>
<td>South Dakota</td>
<td>1978</td>
<td>H1</td>
</tr>
<tr>
<td>Texas</td>
<td>1979</td>
<td>H5,H7,H9</td>
</tr>
<tr>
<td>Indiana</td>
<td>1980</td>
<td>H1,H2,H4,H10; 1993:H1</td>
</tr>
<tr>
<td>Missouri</td>
<td>1980</td>
<td>H1</td>
</tr>
<tr>
<td>Kansas</td>
<td>1990</td>
<td>H1</td>
</tr>
<tr>
<td>North Dakota</td>
<td>1990</td>
<td>H5; 1993: H6</td>
</tr>
<tr>
<td>Arkansas</td>
<td>1981</td>
<td>H1</td>
</tr>
<tr>
<td>North Carolina</td>
<td>1981</td>
<td>H1,H4; 1993: H1</td>
</tr>
<tr>
<td>Virginia</td>
<td>1982</td>
<td>H1,H2,H4,H5,H10; 1993:H5</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1983</td>
<td>H1,H5; 1993: H5</td>
</tr>
<tr>
<td>Michigan</td>
<td>1985</td>
<td>H1,H8; 1993:H1</td>
</tr>
<tr>
<td>Utah</td>
<td>1985</td>
<td>H6,H4,H10</td>
</tr>
<tr>
<td>Nebraska</td>
<td>1988</td>
<td>H1</td>
</tr>
<tr>
<td>New York</td>
<td>1988</td>
<td>H9</td>
</tr>
<tr>
<td>Illinois</td>
<td>1991</td>
<td>H1</td>
</tr>
<tr>
<td>Florida</td>
<td>1991</td>
<td>H9</td>
</tr>
<tr>
<td>Maryland</td>
<td>1994</td>
<td>H5</td>
</tr>
<tr>
<td><strong>CHICKENS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alabama</td>
<td>1975</td>
<td>H4</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1976, 88</td>
<td>H6,H9</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1983, 86</td>
<td>H1,H2,H5; 1993:H5</td>
</tr>
<tr>
<td>Maryland</td>
<td>1983, 84</td>
<td>H5,H9</td>
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<tr>
<td>New Jersey</td>
<td>1983, 86</td>
<td>H5; 1993, H5</td>
</tr>
<tr>
<td>Virginia</td>
<td>1983</td>
<td>H6,H7; 1993: H2,H4</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1986</td>
<td>H5</td>
</tr>
<tr>
<td>New York</td>
<td>1986</td>
<td>H5</td>
</tr>
<tr>
<td>Ohio</td>
<td>1991</td>
<td>H1; 1993: H2</td>
</tr>
<tr>
<td>Michigan</td>
<td>1992</td>
<td>H6; 1993: H1,H6</td>
</tr>
<tr>
<td>Delaware</td>
<td>1993</td>
<td>H5</td>
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</table>
## TRANSMISSIBLE DISEASES OF POULTRY

### CHICKENS - LIVE MARKET

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Virus(s)</th>
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<tbody>
<tr>
<td>Dist. of Columbia</td>
<td>1980</td>
<td>H1; 1984: H5</td>
</tr>
<tr>
<td>Connecticut</td>
<td>1985</td>
<td>H2,H5</td>
</tr>
<tr>
<td>Florida</td>
<td>1986</td>
<td>H5; 1993: H5</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1986</td>
<td>H5</td>
</tr>
<tr>
<td>New Jersey</td>
<td>1986</td>
<td>H2,H5,H6; 1993: H5</td>
</tr>
<tr>
<td>New Jersey</td>
<td>1989</td>
<td>Turkey</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>1986</td>
<td>H5</td>
</tr>
<tr>
<td>Delaware</td>
<td>1990</td>
<td>Duck</td>
</tr>
<tr>
<td>New Jersey</td>
<td>1991</td>
<td>Guinea Fowl</td>
</tr>
<tr>
<td></td>
<td>1992</td>
<td>Pheasant</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1993</td>
<td>H12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H5</td>
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### CHICKENS-DEALER

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Virus(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maryland</td>
<td>1983</td>
<td>H5; 1993: H5</td>
</tr>
<tr>
<td>Ohio</td>
<td>1986</td>
<td>H5</td>
</tr>
<tr>
<td>Georgia</td>
<td>1987</td>
<td>H5</td>
</tr>
<tr>
<td>Maryland</td>
<td>1993</td>
<td>H1,H3,N8,H4</td>
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</table>

### OTHER SPECIES

<table>
<thead>
<tr>
<th>State</th>
<th>Year</th>
<th>Animal(s)</th>
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<tbody>
<tr>
<td>Pennsylvania</td>
<td>1969</td>
<td>Ducks NA,H3,H5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1993: H1,H10</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1974</td>
<td>Geese NA</td>
</tr>
<tr>
<td></td>
<td>1974</td>
<td>Guinea Fowl NA</td>
</tr>
<tr>
<td></td>
<td>1980</td>
<td>Pheasants H3,H7,H8</td>
</tr>
<tr>
<td>New York</td>
<td>1978</td>
<td>Ducks H3,H4,H5,H6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>H11</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1983</td>
<td>Guinea Fowl,Guail H5</td>
</tr>
<tr>
<td>Maryland</td>
<td>1984</td>
<td>Ducks,Guinea Fowl H3; 1993: H5</td>
</tr>
<tr>
<td></td>
<td>1984</td>
<td>Chukar H5</td>
</tr>
<tr>
<td></td>
<td>1985</td>
<td>Ducks H4</td>
</tr>
<tr>
<td>Washington</td>
<td>1985</td>
<td>Pheasant H9</td>
</tr>
<tr>
<td>Virginia</td>
<td>1985</td>
<td>Ducks,Swans,Geese H7; 1993: H2,H5</td>
</tr>
<tr>
<td>Oregon</td>
<td>1986</td>
<td>Quail, H5</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1986</td>
<td>Guinea Fowl,H1,H6,H11</td>
</tr>
<tr>
<td>Georgia</td>
<td>1986</td>
<td>Guinea Fowl,Chukar H5</td>
</tr>
<tr>
<td>(Dealer)</td>
<td>1987</td>
<td>Guinea Fowl H5</td>
</tr>
<tr>
<td>Maryland</td>
<td>1987</td>
<td>Ducks, Geese H9</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1988</td>
<td>Pheasant H9</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1988</td>
<td>Geese H1, 1993:H6, H11,H12</td>
</tr>
<tr>
<td>North Carolina</td>
<td>1988</td>
<td>Ducks H5</td>
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<tr>
<td>Connecticut</td>
<td>1990</td>
<td>Pheasant H4</td>
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<tr>
<td>New Hampshire</td>
<td>1990</td>
<td>Pheasant H10</td>
</tr>
<tr>
<td>California</td>
<td>1990</td>
<td>Quail H4; 1993: H1</td>
</tr>
<tr>
<td>Maryland</td>
<td>1991</td>
<td>Quail H6 or H1,H5,H6</td>
</tr>
<tr>
<td>Arkansas</td>
<td>1992</td>
<td>Quail H5,H6,H10; 1993: H9</td>
</tr>
</tbody>
</table>
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New Jersey 1993 Guinea fowl H5, Duck H3
Pennsylvania 1993 Pheasant H5
New York 1993 Pheasant, Guinea fowl, Duck H5
Michigan 1993 Ducks, Geese H5,H11
Ohio 1993 Muscovy duck H1
Wisconsin 1993 Duck H10

RATITIDES

Texas 1993 Rheas, Emus, H5,H7
North Carolina 1993 Rheas H7
9 States 1993 Serological evidence

NA = Not Available

Table 3. Presence of antibodies in emus and rheas to subtypes of avian influenza virus, multiple subtypes including H5N2 and H7N1 (June – September 1993).

<table>
<thead>
<tr>
<th>State</th>
<th>Rattes</th>
<th>Number of Premises</th>
<th>Antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>Emu</td>
<td>2</td>
<td>H5N2</td>
</tr>
<tr>
<td>Arizona</td>
<td>Rhea</td>
<td>2</td>
<td>H7N1,H7,N1, N2,N4</td>
</tr>
<tr>
<td>Georgia</td>
<td>Emu</td>
<td>2</td>
<td>H5N2,H7</td>
</tr>
<tr>
<td>Illinois</td>
<td>Emu</td>
<td>1</td>
<td>H6N8</td>
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<tr>
<td>Louisiana</td>
<td>Emu</td>
<td>2</td>
<td>H5N2,N2,N7, N9</td>
</tr>
<tr>
<td>Montana</td>
<td>Rhea</td>
<td>1</td>
<td>H5N2</td>
</tr>
<tr>
<td>No. Carolina</td>
<td>Rhea</td>
<td>2</td>
<td>H7N1</td>
</tr>
<tr>
<td>Ohio</td>
<td>Rhea</td>
<td>1</td>
<td>H1N2</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>Rhea</td>
<td>3</td>
<td>H7N1,H5,N2, N7,N8</td>
</tr>
<tr>
<td>Texas</td>
<td>Rhea</td>
<td>6</td>
<td>H5N2,H7N1,H9N2, H5,H7,H9,N1,N2, N4,N7,N8</td>
</tr>
<tr>
<td>Texas</td>
<td>Emu</td>
<td>5</td>
<td>H5N2,H7N1,H6, H7,H8,H9,H12, N2,N5,N7,N8,N9</td>
</tr>
<tr>
<td>Texas</td>
<td>Rhea &amp; Emu</td>
<td>5</td>
<td>H5N2,H6N8,H7N2, H9N2,H1,H3,H4, H5,H7,H11,H12, N1,N2,N4,N5,N6, N7,N8,N9</td>
</tr>
</tbody>
</table>

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TRANSMISSIBLE DISEASES OF POULTRY

2. USDA APHIS VS and NVSL Activities
   a. Dr. C. Grocock, USDA APHIS VS and Dr. J. Pearson, USDA APHIS NVSL, submitted the following report.

   As part of the Veterinary Services (VS) ongoing surveillance activities for avian influenza (AI) virus, subtypes H5N2 and H7N1 were isolated from emus and rheas in Texas, and subtype H7N1 was isolated from a rhea in North Carolina during the summer of 1993. There are no published reports in the scientific literature about AI disease in rheas or emus.

   The AI viruses in Texas were isolated by the Texas Veterinary Medical Diagnostic Laboratory from samples from two premises and were submitted by private veterinarians. The first virus was isolated on June 9, 1993, from an emu chick that was received from an owner in Burnet County; the second virus was isolated on June 15 from a rhea in Brazoria County. Both isolates were referred to the National Veterinary Services Laboratories (NVSL). As a result of the animal disease investigations that resulted from these isolations, the NVSL isolated a third virus (H7N1) from an emu in Travis County, Texas. During this same time period, a fourth virus (H7N1) was isolated from a young rhea in Union County, North Carolina, by the Rollins Veterinary Diagnostic Laboratory in Raleigh and forwarded to the NVSL for identification.

   The NVSL identified the two initial virus isolates as AI, subtype H5N2 on July 6, 1993. The AI virus isolated from a rhea in North Carolina was identified as subtype H7N1 on the same day. Subsequently, on July 20, the NVSL isolated a subtype H7N1 AI virus from surveillance specimens submitted from a third premise in Texas.

   The NVSL began virus pathogenicity studies in chickens for the viruses on July 7 and concluded the studies on July 16. Because some of the ratite premises were in close proximity to commercial turkey flocks, further studies on virus pathogenicity utilizing turkeys were conducted on July 21 and concluded on July 29. The results for these NVSL studies indicate that none of these AI viruses were pathogenic to chickens or turkeys. Samples of both virus subtypes were forwarded to the Department of Virology and Molecular Biology at St. Jude Children's Research Hospital in Memphis, Tennessee, for molecular characterization. Researchers at St. Jude reported the AI subtype H5N2 virus was similar to the AI virus recovered earlier in the year from live poultry markets in the Northeast and the one recovered from sentinel chickens in Miami, Florida. They also reported that the amino acid sequence of the connecting peptide of the hemagglutinin was different than the pathogenic strains of AI viruses.

   Epidemiological investigation of the North Carolina infected premise revealed that the rhea originated from a sale of exotic birds in Harper, Texas. Other rheas in the flock had antibody against subtype H7N1, but no further evidence of the AI virus infection was found in other rhea or turkey flocks in North Carolina. In Texas, it was found that all of the infected ratites had
been purchased through either the Castleberry Exotic Sale in Lampasas, Texas, on May 12-14, 1993, or the Raz Exotic Auction in Harper, Texas, on May 22, 1993. One infected rhea was part of a consignment that went through both the Castleberry and Raz auctions. The affected rhea in North Carolina was purchased at the Raz auction. Sale records indicated the Raz Exotic Auction had 23 in-state buyers and 2 out-of-state buyers; the Castleberry Exotic Sale had 86 in-state buyers, 32 out-of-state buyers, and one buyer from Ontario, Canada. As a result, fourteen states received ratites from the two auctions. These states include: Arizona, Georgia, Illinois, Louisiana, Michigan, Mississippi, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Tennessee, Texas, and Wisconsin.

Veterinary Services (VS) veterinarians contacted all of the ratite buyers associated with either of the two auctions and discovered that many of the birds had changed ownership several times since the sale dates in May. All purchased ratites remaining in the buyer’s care, along with any other bird on their premises, were inspected and tested for AI. Additionally, any ratites that had been in contact with the auction birds were also inspected and tested.

Emu and rhea serum samples were positive for antibody against AI subtypes H5N2 and H7N1. The positive H5N2 samples were submitted from Alabama, Louisiana, and Montana. Avian influenza H7N1 antibody was detected in Arizona, North Carolina, and Oklahoma. Both H5N2 and H7N1 antibodies were detected in Georgia and Texas. In addition, antibody was detected against most of the other hemagglutinin and neuraminidase subtypes. This indicates there is a wide variety of AI subtypes circulating in the environment. Many of the ratites also had antibody against *Chlamydia psittaci* and some were culture positive for bacteria that included salmonella and streptococcus. Several owners who purchased the birds reported that some young emus and rheas died shortly after being transported to their premises. Others reported that the ratites arrived sick but responded to antibiotic treatment and recovered. There has not, however, been any unequivocal evidence of specific disease due to AI virus in the ratite flocks.

Due to VS actions with the AI surveillance program for ratites, 31 states have added requirements for ratites to enter the state. These requirements all demand a premovement inspection and a health permit, and most demand permanent identification and pretesting for AI exposure.

The results of the avian influenza typing conducted at the National Veterinary Services Laboratories (NVSL) are summarized on Tables 1, 2, and 3. Avian influenza virus, subtype H5N2 was isolated from a live poultry market in Florida in March 1993. The last isolation from the Florida live poultry markets was in October 1989. Antibody had previously been detected in sentinel birds that had been put into the facility. The facility was depopulated, cleaned, and disinfected. As shown on the table, there have been few isolations from domestic turkeys this year except those from trace-
outs of the H5N2 virus in Northeastern United States or the H5N2 or H7N1 isolations from ratites.

### Table 1. Avian influenza: Domestic turkeys. October 1, 1992 – September 30, 1993

<table>
<thead>
<tr>
<th>State</th>
<th>Subtype</th>
<th>Month</th>
<th>Isolation/Serology</th>
</tr>
</thead>
<tbody>
<tr>
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<td>H1N1</td>
<td>February</td>
<td>Serology</td>
</tr>
<tr>
<td>IA</td>
<td>H1N1</td>
<td>October</td>
<td>Serology</td>
</tr>
<tr>
<td>MI</td>
<td>H1N1</td>
<td>October</td>
<td>Serology</td>
</tr>
<tr>
<td></td>
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<td>November</td>
<td>Serology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>February</td>
<td>Serology</td>
</tr>
<tr>
<td>MN</td>
<td>H4N2</td>
<td>October</td>
<td>Serology</td>
</tr>
<tr>
<td></td>
<td>H6N8</td>
<td>November</td>
<td>Isolation/Serology</td>
</tr>
<tr>
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<td>Serology</td>
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<tr>
<td></td>
<td></td>
<td>February</td>
<td>Serology</td>
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<tr>
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<td>H1N1</td>
<td>December</td>
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<td>Serology</td>
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<td>H12,N1,N4,N5,N8</td>
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<td>Serology</td>
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<td>NC</td>
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<td>November</td>
<td>Serology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>February</td>
<td>Serology</td>
</tr>
<tr>
<td></td>
<td>H1,H4,N1</td>
<td>January</td>
<td>Serology</td>
</tr>
<tr>
<td></td>
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<td>Serology</td>
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<td>July</td>
<td>Serology</td>
</tr>
<tr>
<td>NJ</td>
<td>H5N2</td>
<td>February*</td>
<td>Isolation</td>
</tr>
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<td></td>
<td>H2N2</td>
<td>February*</td>
<td>Isolation</td>
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<td></td>
<td>July*</td>
<td>Isolation</td>
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<tr>
<td></td>
<td>H7N9</td>
<td>April*</td>
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<td>NY</td>
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</tr>
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<td>3ND</td>
<td>H6N8</td>
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<td>Serology</td>
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<td>December*</td>
<td>Serology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>January*</td>
<td>Serology</td>
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* Traceouts from Positive H5N2 cases
## Table 2. Avian influenza: Birds other than turkeys. October 1, 1992 – September 30, 1993

<table>
<thead>
<tr>
<th>State</th>
<th>Species</th>
<th>Subtype</th>
<th>Month isolation/ Serology</th>
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</thead>
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<td>Emu</td>
<td>H5N2</td>
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<tr>
<td></td>
<td>Emu</td>
<td>H5N2</td>
<td>August* Serology</td>
</tr>
<tr>
<td>AZ</td>
<td>Quail</td>
<td>H9N2</td>
<td>March isolation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>May</td>
</tr>
<tr>
<td></td>
<td>Rhea</td>
<td>H7N1, H7, N1, N3, N4</td>
<td>August* Serology</td>
</tr>
<tr>
<td>CA</td>
<td>Quail</td>
<td>H1N1</td>
<td>July Isolation</td>
</tr>
<tr>
<td>DE</td>
<td>Mixed</td>
<td>H5</td>
<td>March Serology</td>
</tr>
<tr>
<td>FL</td>
<td>Chicken</td>
<td>H5N2</td>
<td>December Serology</td>
</tr>
<tr>
<td></td>
<td>Chicken</td>
<td>H5N2</td>
<td>March Isolation</td>
</tr>
<tr>
<td></td>
<td>Chicken</td>
<td>H5</td>
<td>June* Serology</td>
</tr>
<tr>
<td>GA</td>
<td>Mixed</td>
<td>H9N2</td>
<td>May Serology</td>
</tr>
<tr>
<td></td>
<td>Emu</td>
<td>H5N2, H7</td>
<td>July* Serology</td>
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<tr>
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<td>Emu</td>
<td>H5N2</td>
<td>August* Serology</td>
</tr>
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<td>Emu</td>
<td>H5N2</td>
<td>September* Serology</td>
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<td></td>
<td>H5N2, N2, N7, N9</td>
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<tr>
<td>MD</td>
<td>Chicken</td>
<td>H5N2</td>
<td>January* Serology</td>
</tr>
<tr>
<td></td>
<td>Guinea</td>
<td>Fowl</td>
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</tr>
<tr>
<td></td>
<td>Chicken</td>
<td>H1, H3, H8, N4</td>
<td>February* Serology</td>
</tr>
<tr>
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<td>Mixed</td>
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<td>May* Serology</td>
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<td>Chicken</td>
<td>H6, N2, N6</td>
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<td>Chicken</td>
<td>H1</td>
<td>July* Serology</td>
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<td>September* Serology</td>
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<td>Rhea</td>
<td>H7N1</td>
<td>June* Serology</td>
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<tr>
<td></td>
<td>Rhea</td>
<td>H7N1</td>
<td>July* Serology</td>
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<td>Virus Type</td>
<td>Details</td>
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<td>------------</td>
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<td>Chicken</td>
<td>H5N2</td>
<td>February*Isolation/Serology</td>
</tr>
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<td>H2N2</td>
<td>February*Isolation</td>
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<td></td>
<td>Guinea Fowl</td>
<td>H5N2</td>
<td>March*Isolation</td>
</tr>
<tr>
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<td>Chicken</td>
<td>H5N2</td>
<td>January<em>Isolation/Feb</em>Isolation/March<em>Isolation/April</em>Isolation</td>
</tr>
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<td></td>
<td>Guinea Hen</td>
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<td>February*Isolation</td>
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<tr>
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<td>Pheasant</td>
<td>H5N2</td>
<td>March*Isolation</td>
</tr>
<tr>
<td></td>
<td>Environment</td>
<td>H9N2</td>
<td>March*Isolation</td>
</tr>
<tr>
<td></td>
<td>Chicken</td>
<td>H2N2</td>
<td>March*Isolation</td>
</tr>
<tr>
<td>OH</td>
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<td>H2, H5, N2</td>
<td>January*Serology</td>
</tr>
<tr>
<td></td>
<td>Chicken</td>
<td>H2N2</td>
<td>February*Isolation</td>
</tr>
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<td>Rhea</td>
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<td>September*Serology</td>
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<tr>
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<td>Rhea</td>
<td>H5</td>
<td>July*Serology</td>
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<td></td>
<td>Rhea</td>
<td>H?, N2, N7, N8</td>
<td>August*Serology</td>
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<td>Chicken</td>
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<td>May*Serology</td>
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<td>Pheasant</td>
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<td>Environment</td>
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<td>April*Isolation</td>
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<tr>
<td>TX</td>
<td>Rhea**</td>
<td>H5N2</td>
<td>June*Isolation</td>
</tr>
<tr>
<td></td>
<td>Emu**</td>
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<td>Emu</td>
<td>H7N1</td>
<td>August*Isolation</td>
</tr>
<tr>
<td></td>
<td>Emu/Rhea</td>
<td>H5N2, H9N2, H1, H3, H8, H7, H9, N2, N8</td>
<td>July*Serology</td>
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</tbody>
</table>
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<table>
<thead>
<tr>
<th>Species</th>
<th>Subtype</th>
<th>Month/Isolation/serology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhea &amp; Emu</td>
<td>H5N2, H7N1, H9N2,H4, H5,H7,H8, H11,H12, N1,H3,N4, N5,N6,N7, N9</td>
<td>August/Serology</td>
</tr>
<tr>
<td>VA Chicken</td>
<td>H2N3</td>
<td>December/Serology</td>
</tr>
<tr>
<td>Chicken</td>
<td>H4</td>
<td>January/Serology</td>
</tr>
</tbody>
</table>

* Traceouts from H7N1 or H5N2 positive cases
** Isolated by the Texas Veterinary Medical Diagnostic Laboratory
*** Isolated by the Rollins Animal Diagnostic Laboratory, NC.

Table 3. Avian Influenza: Waterfowl
October 1, 1992 - September 30, 1993

<table>
<thead>
<tr>
<th>State</th>
<th>Species</th>
<th>Subtype</th>
<th>Month/Isolation/serology</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD</td>
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<td>February/Serology</td>
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<tr>
<td>MI</td>
<td>Duck</td>
<td>H5N9</td>
<td>July/Serology</td>
</tr>
<tr>
<td></td>
<td>Ducks &amp; geese</td>
<td>H11N9</td>
<td>April/Serology</td>
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<td>July/Serology</td>
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<td>NJ</td>
<td>Duck</td>
<td>H5,H9,H10,H11,N2, N5,N6,N7,N9</td>
<td>May/Serology</td>
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<td></td>
<td>Duck</td>
<td>H3N8</td>
<td>February/Isolation</td>
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<td>March/Isolation</td>
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<tr>
<td>NY</td>
<td>Duck</td>
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<td>February/Isolation</td>
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<td>PN</td>
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<td>January/Isolation</td>
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<td>February/Serology</td>
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<td>Goose</td>
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<td>April/Serology</td>
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<td>Duck</td>
<td>H10N7</td>
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<td>Geese</td>
<td>H11N8, H12,N5</td>
<td>September/Serology</td>
</tr>
<tr>
<td>VA</td>
<td>Duck</td>
<td>H5N2</td>
<td>February/Serology</td>
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<tr>
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<td>Duck</td>
<td>H2N7</td>
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<td>Duck</td>
<td>H5,N1,N2,N8,N9</td>
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<td>WI Duck</td>
<td>H10N7</td>
<td>July-Serology</td>
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<td>H1,H4,N9, N10,H11,H12,H13, N2,N6,N7,N8,N9</td>
<td>September-Serology</td>
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</table>

* Traceouts from positive H5N2 cases.

b. The following report was submitted by Dr. S. Trock, USDA-APHIS-VS concerning avian influenza in the northeastern states.

Although my talk refers to avian influenza we need to also discuss the live bird marketing system, because of its link to avian influenza. Our most recent experience with AI was this past winter and spring.

Even though we like to think of the live bird markets as being supplied by backyard flocks it was a commercial turkey flock that was first reported to us with positive evidence of AI. This is a lay out of the farm operation. Although many of the buildings were empty, some housed turkeys. Buildings 1 and 3 are used for young birds which are then moved to the grow out houses - such as these along your right. Birds in buildings 6, 7, and 9 were 14-week-old birds. These were the birds that the owner noticed higher than normal death losses. The shaded line is what the owner reports to be expected death losses - 4 to 6 birds a day. The points on the graph are what he actually experienced. As you can see he began having some problems in mid-December. This is the plot for house 6. Again note the death losses. What we had in late December was the knowledge that we had AI seropositive birds with higher than normal death losses. Culture results were pending at that time.

One of the things which concerned us is the tracing of movements onto and off of this commercial operation. We found that manure was hauled to New Jersey and spread on fields there, dead birds were picked up by a renderer, and there were several movements of partial load-outs of turkeys. One of the people who bought some of the turkeys was identified as a dealer in the live bird marketing system.

Here you see the turkey farm. This is the dealer who moved birds from the turkey operation into the live bird marketing channels. Notice all the other sources for birds into the terminal which purchased the turkeys. Also there was a direct link to the dealer's relative who ran a live bird market in New Jersey. State and Federal personnel began tracing movements and sampling in markets, terminals, auction markets, dealers, haulers, and farms.

While continuing to trace and sample birds near the commercial turkey flock, the week of January 4, other personnel focused testing on the
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live bird markets. We recovered virus from some of the markets in New Jersey, New York, and Pennsylvania. When we find virus we initiate tracing of all birds in the market at the time the virus was recovered. Here is an example of what one of those traces would look like. We ask the market owner: "Where did you get the birds you have in the market"? This market received birds directly from 3 sources. Then we go to these sources and ask: "Where did you get the birds"? We then contact and sample these sources if they have any birds left. As you can see there are many farm sources.

Here's one more example of what a traceback looks like. This is a large dealer who supplied 6 of the positive markets in New York. As you see he purchased birds from several auction markets. We then would approach the auctions to determine the source of the birds. When I last counted I think there were 97 farm sources which fed into this traceback.

A summary of the testing and where the live bird markets are located show that there are 10 live bird markets in New England. There are 5 auction markets in these States. Pennsylvania has 6 live bird markets and 25 auction markets, although only about 6 of these auction markets sell any volume of live birds. Pennsylvania also stepped up their surveillance. There are 4 company farms which contract or own 126 farm premises. These farms supply almost exclusively to the live bird markets in New York and New Jersey. Also the haulers in Pennsylvania continue to be licensed and sampled. New Jersey has 28 live bird markets. Because they had a positive backyard flock they, like Pennsylvania, instituted circle testing around the positive flock. They also conducted several rounds of sampling in the auctions, dealers, and terminals. New York is often viewed as consumer of these birds. They have one large terminal and 43 live bird markets. Two new markets have opened in the past 6 weeks.

Seropositive birds were identified in Pennsylvania in show flocks, backyard duck flocks, one dealer/hauler flock, and the commercial turkey flock. New Jersey identified one seropositive flock during the circle testing. Maryland, Virginia, and Michigan also identified seropositive flocks.

Pennsylvania recovered virus from one live bird market, twice from the same market, and from one dealer/hauler premises. New York recovered virus from 8 of the live bird markets on the first round of testing. When a market was found to be positive it was allowed to depopulate then it had to clean and disinfect before they were allowed to place birds again. These positive markets were then re-sampled after birds were placed. There were three rounds of all market testing. New Jersey recovered virus from 5 of their markets. All markets were again retested and found to be negative. Lest you think these live bird markets are basically squeaking by and are getting birds haphazardly, there is an organized business like method to transportation and marketing through the live bird marketing system.
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There is a large volume of birds which trafficks through these live bird markets. One terminal does an estimated $9 million dollars a year in business. They handle 80 to 100 thousand birds a week. Small trucks deliver birds from the terminal to the live markets in the city.

Inside these markets you find racks of cages. You find white and grey rock broilers and roasters. You also find spent fowl which came from a commercial operation. You will find an assortment of birds in these markets, including some small quail or baby guineas, silkie chickens, etc. Here are some red fowl. And mixed in with all the other birds are the waterfowl. In this case - ducks and geese.

All these birds are available to the demanding consumer who wants to come in and choose their own bird. It's the same as us pointing to the lobster in the tank when we go into a seafood restaurant. The birds are weighed and sales are based on live weight. Remember how I said earlier that two new markets had opened in New York? Well here's why it's profitable:

In the live bird marketing system, chickens sell for about 50 cents/lb from the farm, the middleman, dealer or terminal charges about 75 cents/lb to the live bird markets. And the consumer is willing to pay $1.15 – $1.35/lb, live weight from the market. Other specialty birds cost varying amounts, with spent fowl selling for $1.00 – $1.25/lb. Silkie chickens sell for $8.00 a piece; ducks for $2.25/lb., guinea fowl sell for $3.00/lb.

These markets and this marketing system is not going to go away. There is a large volume of birds trafficking this system and a tidy profit to be made here.

In the wake of the recent AI outbreak the USDA and the involved states are planning on sampling in these markets in October and December this year and February and April next year.

c. Dr. Groocock reported that, at the request of the poultry industry and diagnostic laboratories, the NVSL rescinded plans to initiate charges for avian influenza reagents. It was believed that charging for these reagents would drastically curtail surveillance.

V. INFECTIOUS LARYNGOTRACHEITIS

1. Infectious Laryngotracheitis Eradication Subcommittee – Dr. Darryl Johnson, USDA APHIS VS, submitted the following report.

The "Guidelines for the Eradication of Infectious Laryngotracheitis Encompassing the Broiler Industry, Table Egg Industry, Exhibition, and Backyard Poultry" program that was adopted by the USAHA in 1990 has not been adopted by any state. There continues to be interest and requests for copies of the program.

Clinical outbreaks continue to occur in several states. It is believed most outbreaks have been of vaccine origin by direct contact or careless
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humans carrying virus on their person from a newly vaccinated flock to a non-vaccinated flock.

VI. MYCOPLASMA

1. Mycoplasma Subcommittee – Dr. Duncan McMartin, University of California, Davis, submitted the following report.

The sub-committee recommended at Louisville in 1992 that a national conference should be held: on the one hand, to resolve long-standing and frustrating questions with regard to availability of appropriate diagnostic testing reagents and quality control in testing laboratories; and on the other, to anticipate the implications of new live vaccines for diagnosis and potential control strategies in avian mycoplasmas.

During 1992-93, this recommendation was further explored by the sub-committee enhanced with additional expertise from several co-opted members. The group promoted a well-attended open discussion in Sacramento in association with the Western Poultry Disease Conference in February 1993. Stemming from this and other activities of several individuals and organizations, considerable progress has been made in defining the diagnostic reagent needs of testing laboratories and how these will be provided.

With regard to new live vaccines, there is insufficient confirmed information on host-vaccine interactions in various species and categories of birds, and on where and how these products will be used, to make a national conference valuable meantime.

The group therefore recommends that a national conference is unnecessary at the present time. However, it is clear that a major communication gap had developed between several of the key components involved in the process of national mycoplasma control, and this should not be allowed to re-occur.

A summary from Dr. Otis Miller, Jr. on relevant National Poultry Improvement Plan information on mycoplasmas follows.

2. Mycoplasma Outbreaks in commercial Flocks in 1993 – Dr. Otis Miller, USDA APHIS VS gave the following report on behalf of the National Poultry Improvement Plan.

In conjunction with a survey of the Poultry Health Status of commercial poultry flocks in the United States during 1993, a request was made for the number of known outbreaks of M. gallisepticum, M. synoviae, and M. meleagridis in breeding and production flocks. The questionnaire was sent out to known resource individuals who are responsible for or who are involved in the diagnosis of a major portion of the nation's turkey, broiler, and egg producing flocks. Almost all of the resource individuals responded to the request. Most of the resource individuals are directly involved with integrated operations. Several resource respondees represented diagnostic laboratories however, and some duplication of outbreaks may have been

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reported.

A total of 107 Mycoplasma outbreaks were reported in 1993. No primary breeding flocks were involved. These outbreaks were reported by 12 states. The southeast, northeast and midwest were responsible for 66% of the outbreaks.

Broiler Industry

There were 12 outbreaks of M. gallisepticum infection reported in broiler breeding flocks and seven outbreaks reported in broiler flocks. One integrator kept infected multiple-age breeding flocks and consequently all of the growout flocks receiving chicks from this source should also be included as an outbreak flock. There is no significant difference at the 40% level between multiplier and production flocks in the change from 1992 to 1993.

There were 20 outbreaks of M. synoviae reported in broiler breeding flocks and no outbreaks reported in broiler flocks. There is a significant difference at the 5% level between multiplier and production flocks in the change from 1992 to 1993.

Turkey Industry

There were no outbreaks of M. gallisepticum reported in turkey breeding flocks, and four outbreaks in production flocks. There is no significant difference at the 10% level between multiplier and production flocks in the change from 1992 to 1993.

Ten outbreaks of M. synoviae were reported in turkey breeding flocks and six outbreaks reported in production flocks.

Thirty outbreaks of M. meleagridis were reported in production flocks.

Egg Industry

One outbreak of M. gallisepticum was reported in egg-type chicken breeding flocks. As many of the commercial laying flocks are known to be infected with M. gallisepticum, the status of these flocks are not reported.

Six outbreaks of M. synoviae were reported in an egg-type chicken breeding flock and six outbreaks reported in commercial laying flocks. There is no significant difference at the 40% level between multiplier and production flocks in the change from 1992 to 1993.

Committee Resolution – The Committee submitted two resolutions on mycoplasma to the Resolutions Committee.

VII. MIGRATORY BIRD HEALTH and RELATED ISSUES


This paper summarizes migratory bird mortality reported to the National Wildlife Health Research Center (Center) and cooperating state and
AVIAN CHOLERA

Twelve avian cholera events were reported this year, 7 from California. This is considerably less than previous years (eg 1992 = 20). Large-scale epizootics similar to the 2000–6000 birds mortalities of last year were absent. The largest event in 1993 was mortality of 1,500 waterfowl (1,300 tundra swans) at Klamath Basin NWR, CA.

The Pacific flyway experienced the most avian cholera mortality. The central valley of California had three die-offs at Butte Sink NWR, Sacramento NWR and Colusa NWR with avian cholera mortality of 1,200, 250 and 1000, respectively. The Butte Sink mortality was unusual in that the predominant species affected was wood duck. We have only one other record in our files where wood ducks died in such numbers. Salton Sea, California, lost an estimated 500 ducks to avian cholera. This was the site of large-scale loss to eared grebes last year from unknown causes. Other areas in California experiencing mortality were Merced NWR (800 ducks) and the Modesto Oxidation ponds (300 waterfowl). In Oregon, Sauvie Island reported avian cholera mortality of 280 birds, primarily waterfowl but also including several owls and crows.

The Rainwater Basin, Nebraska, is a cholera–endemic area. Last year's mortality was typical with losses exceeding 6,000 waterfowl (primarily snow geese). In 1993 losses were considerably less (1,400) and included primarily white–fronted geese. Mortality was restricted to the USDA's Meat Animal Research Center. Considering a waterfowl population of 250,000, mortality was relatively low.

Other sites in the Central flyway had considerably less avian cholera than last year. The Texas Rice Belt reported mortality in snow geese from over 40 different areas but only 700 geese died from a population of over 500,000. Avian cholera also killed 44 snow geese at McFaddin NWR in Texas. Bosque del Apache NWR (New Mexico) lost 520 snow geese, sandhill cranes and mallards. This is the first time a substantial part of the mortality occurred in mallards (over 10%) even though the Refuge has always had a large mallard population. Avian cholera mortality was not reported from the northeast Missouri and southwest Iowa area where over 5,000 geese died last year.

BOTULISM

Twenty seven botulism type C outbreaks were reported during 1992–
1993, similar to the 24 reported last year. The largest outbreaks occurred in the upper midwest where flooding was widespread. The cool summer temperatures and increased habitat led us to believe fewer botulism die-offs would occur. However, flooding of new habitat may have produced conditions conducive for botulinum toxin formation. The largest single outbreak occurred at Mud Lake, SD, where over 6,000 various duck species, coots and shorebirds died in flooded fields after the lake was drawn down for flood control. At this writing, Swan Lake, SD, is experiencing a botulism outbreak with mortality exceeding 1,200 as of October 1. Over 2,600 ducks and coots died on a wetland in North Dakota. This area is usually a small seasonally flooded wetland but grew to over 3,000 acres with 6-8 feet of water this year because of heavy midwest rain. Audubon NWR complex, ND, and Cheyenne Bottoms, KS, also lost over 1,000 and 500 birds, respectively, under conditions of higher water levels than normal.

Botulism mortality was also heavy at Sabine Pass, TX, this year. An estimated 4,300 ducks died. Control consisted of hazing birds from the botulism site. Mortality slowed considerably following this action.

In the west over 2,100 birds died from botulism at Bear River Migratory Bird Refuge. Bear River is a botulism endemic area and typically has outbreaks this magnitude or higher. The mortality represents a small proportion of the over 1,000,000 ducks and shorebirds that were on-site during the outbreak.

Several small sites in and around Sutter NWR, CA, reported botulism. Losses were low with the worst site reporting 500 dead.

The eastern seaboard had six reported botulism outbreaks. These were generally small. The largest occurred in Virginia Beach, VA, in a residential stream with very poor water quality where about 300 birds died. Species involved included mallards, muscovy ducks and some passerines.

LEAD POISONING

Six lead poisoning epizootics were reported this year, identical to the number reported last year. The largest event occurred at Lower Klamath NWR, CA, where over 1,000 waterfowl died. Species included mallards, pintails and white-fronted geese. As is typical with epizootic-level lead poisoning large numbers of sick birds were observed. A large raptor population (500+) was scavenging dead waterfowl however lead poisoning was not observed in the raptors.

Lead poisoning associated with trap and skeet ranges continues to be a contentious issue. In Hancock County, OH, and Woodstock, CT, 15 and 50 geese, respectively, died near skeet and/or trap ranges. Over 100 geese died from lead poisoning in Stark county, OH. Historical use of the site is unknown but shot recovered from dead bird gizzards were consistent with sizes used in trap and skeet. During the last several years trap/skeet ranges have come under increasing pressure to discontinue operation or design
ranges not to shoot over wetlands.

DUCK PLAGUE (DVE)

Six duck plague die-offs were reported this year. Typically these events involve muscovy ducks often in captive or feral duck situations. One exception this year occurred in a captive exotic duck collection in New Enterprise, PA, where 30 birds died none of which were muscovies. Another private duck collection in Kingsville, MD, lost several ducks to duck plague. Although the site had over 30 species of waterfowl one of the species that succumbed was muscovy. The owner understood the seriousness of the disease but was reluctant to euthanize potential carrier birds. Instead he agreed to life-time quarantine. Bird holding facilities and ponds were disinfected and covered to prevent wild waterfowl access.

The duck plague outbreak at Venice Canals near Los Angeles, CA, became an extremely sensitive and confrontational situation involving litigation. Following confirmation of the duck plague virus, depopulation of remaining birds and site decontamination were recommended. The site was quarantined prior to conducting disease control measures. A vocal group of residents protested the depopulation and California Department of Fish and Game (CDFG) biologists were prevented from action by a temporary restraining order (TRO). In violation of the quarantine, private citizens moved birds to Kern County while the TRO was in effect. At the hearing the judge found no basis for restraint and lifted the TRO. CDFG personnel completed the cleanup of the site, including depopulation of 360 waterfowl, and removed and euthanized birds from the Kern County site. A subsequent duck plague outbreak occurred in the San Diego, CA, suburb of Chula Vista on a residential lake. Immediate waterfowl depopulation was conducted with the support of the local homeowners association.

TOXICOSIS

Thirty-seven die-offs associated with toxins were reported this year. Reporting bias probably accounts for the higher prevalence of toxicosis in the east states. Typically these types of incidents are small, involving less than 50 birds, and are the result of pesticide application. Eleven of these 37 are on-going legal cases. Only 5 of the 37 events had mortality in excess of 100 birds.

The largest die-off was a suspect toxicosis in Chandler, AZ, where 315 doves, grackles and Brewer's blackbirds died acutely. A toxin was suspected based on a history of starlicide use and absence of findings to support other factors. Starlicide was not isolated but this chemical is difficult to detect because of its rapid degeneration. Another starlicide was involved in the mortality of an estimated 75 ring-billed gulls. These gulls died after inadvertently eating french fries laced with DRC-1339 which had been legally placed to control a large population of starlings.
Strychnine caused the death of 134 common crows from Kearney, NB. Because the estimated 500,000 crows that winter in the Kearney area are often viewed as a nuisance it is suspected the birds were illegally poisoned.

Organophosphorus compounds continue to be one of the major pesticides involved in unintentional poisonings. Diazinon was the cause of mortality in four separate die-offs. The largest involved an estimated 50 grackles found in a three block area of Port Wentworth, GA. There was no history of pesticide application, however diazinon was detected in the stomach contents of dead birds. Dursban, a commonly used home and garden pesticide, was found in the stomach contents of robins from Gulf Breeze, FL. Approximately 250 robins died in this event. The Dursban may have been placed in the lawn for cricket control. In another unintentional poisoning, parathion killed 69 Canada geese, mallards, teal and a ring-necked duck in a flooded winter wheat field.

**MISCELLANEOUS**

Salmonellosis was involved in several large epizootic mortalities this year. Several areas in Washington, Oregon and northern California reported mortality in pine siskins, purple finches and grosbeaks during the winter. Total mortality exceeded 6,000 birds and *Salmonella typhimurium* was isolated from carcasses submitted for examination. Most of the deaths were associated with bird feeders. The heavy snow and rain that occurred on the west coast at this time may have concentrated the birds at the feeders and exacerbated the problem. British Columbia reported similar mortality in November but mortality was estimated to be around 10,000.

Over 50,000 common murres died in the waters around Valdez, Seward and Sitka, AK. Diagnostic workup on numerous specimens suggested the cause was unlikely to be infectious organisms or contaminants. Biotoxins were considered but preliminary results do not suggest these as a possibility. All birds examined were emaciated and starvation is suspected as the cause of the mortality. In another diagnostic puzzle, over 1,000 cattle egrets have died in Canton Lake, OK. The cause is undetermined at this time but is significant because mortality is occurring in poultry yards and residences where chickens and people may come into contact with sick and dead egrets.

Climate and weather can have significant impacts on wildlife. An estimated 1,500 waterfowl were killed in a severe lightning storm in Yuba county, CA. Mortality occurred in a one mile by 8 mile area. All examined birds died of trauma. At Chase Lake, ND, and Medicine Lake, MT, white pelicans died in association with inclement weather. Production was significantly reduced at Chase Lake. At Medicine lake 785 pelicans were found dead and grouped together in one area of the nesting colony. These mortalities were carefully examined because of the Newcastle disease.
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mortality in pelican and cormorant colonies last year. Newcastle disease virus was not isolated and lesions consistent with the virus were not detected.

VIII. NATIONAL POULTRY IMPROVEMENT PROGRAM

National Plans Status Report – Dr. A. Rhorer, USDA APHIS VS NPIP gave the following report.

Pullorum–Typhoid Status

In Calendar Year 1992, there were 30 isolations/outbreaks of Salmonella pullorum reported to the Poultry Improvement Staff. There have been no isolations of S. gallinarum since 1988. These isolations/outbreaks were reported by 10 States. Three States reported 65% of the isolations/outbreaks.

One State shipping many chicks by mail was responsible for 10 isolations. Investigations of these shipments, where transmission occurred at a high rate, were reported as pullorum disease if high mortality occurred or reactors were found even without isolation of the organism.

There were no additional isolations of S. pullorum from the operation of an integrated producer of broiler/roasters which occurred in 1991; The last isolation was reported in October of 1991.

During the 1993 calendar year from January to October 1st, there have been 10 isolations of S. pullorum and no isolations of S. gallinarum. None of the isolations were obtained from commercial poultry flocks.

NATIONAL POULTRY IMPROVEMENT PLAN

The Biennial Conference of the National Poultry Improvement Plan (NPIP) was held in Colorado Springs, Colorado, in June 1992. Changes in the NPIP were approved by the voting delegates from participating States. Several changes included improvements in the culturing or testing of disease organisms involved in the NPIP. Changes in the "U.S. Sanitation Monitored" program for egg-type chicken breeding flocks included a change in the name to "U.S. S. Enteritidis Monitored", environmental culturing at an earlier age (2 to 4 weeks of age), and use of a federally licensed SE bacterin in environmental negative flocks as an acceptable preventive practice. A change approved at the Conference eliminated the provision which allowed two generations to go without testing for pullorum.

IX. BACKYARD FLOCKS AND RELATED HEALTH ISSUES

Dr. E. Mallinson, University of Maryland, gave the following report on Proactive Avian Influenza Strategies for Producers of Backyard and Specialty Poultry.

An August, 1993 meeting for producers of backyard and specialty poultry titled, "Understanding Emergency Poultry Diseases," disclosed not
only many areas of concern, but also many proactive strategies to help alleviate AI risks. Proceedings of this meeting are available from the Mid-Atlantic Cooperative Extension (MACE) Unit (Dr. John Schwartz, 717-394-6851, FAX 394-3962). These concerns and opportunities were further sharpened at the September Meeting of the Mid-Atlantic Poultry Health Council in Williamsburg, Virginia.

Producer Concerns
The following topics characterize the concerns voiced by backyard and specialty producers: inconsistent AI quarantine and quarantine release policies and variable regulations for interstate movements of fowl; a sense of isolation from regulatory agencies in terms of recognition and rapid exchange of disease control "intelligence"; cooperators penalized while "outlaws" exploit their plight; and, finally, absence of an identifiable trade organization for poultry auction owners and dealers.

Proactive Opportunities
The Northeastern live auction market system and its small flock supply network, is a $9 million a year business. The following items were suggested as ways to begin reducing the risks of AI to this system and to the billion-dollar commercial industry with which it interfaces. These include, but are not limited to: initiatives by regulatory agencies fostering development of "preferred sources" of fowl for auctions and live markets; targeted activities by commercial feed and poultry companies that "encourage" and/or ensure more biosecure management among small producers; establishment of two-way information transfer telephone HOT LINES; and Cooperative Extension initiatives that promote and provide recognition for producers with improved AI prevention practices (e.g., Master Poultry Farmer Program, etc.).

Committee Resolution – The Committee submitted a resolution regarding biosecurity educational material to the Resolutions Committee.

X. SUBCOMMITTEES
A. Avian Influenza: R.A.Bancowski; C.Beard; D. Halvorson; J.E.Pearson; I.Peterson; R.J.Eckroade, Vice Chair; B.S.Pomeroy, Chair
B. Definition of Avian Influenza: B.E.Easterday; C.Beard; J.E.Pearson; B.S.Pomeroy; R.Webster; R.A. Bankowski, Chair
C. Infectious Bronchitis: C.Beard; R.Eckroade; H.Lasher; M.Opitz; D. Infectious Laryngotracheitis Eradication: F.Hoerr; H.Lasher; D.McMartin; C.Weston; W.Baisley; E.Odor; T.Holder; H.M.Gori; D.C.Johnson, Chair
E. Mycoplasmosis: D.Johnson; S.H.Kleven; E.T.Mallinson; H.O.Opitz;
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B.S. Pomeroy; I. Peterson; W. Towers; R. Yamamoto; D. McMartin, Chair

F. Paramyxovirus Evaluation: C. Beard; I. H. Kahan; C. Weston; R. A. Bankowski; J. E. Pearson, Chair

G. Model State Program for Pet Birds: S. Clubb; D. J. Ligda; E. T. Mallinson; M. Meyers; L. Phillips; H. Kahan, Chair

H. Broiler Industry: T. Holder, Chair

I. Table Egg Industry: G. Waters, Chair

J. Turkey Industry: Y. Ghazikhanian, Chair
ASSESSING THE POTENTIAL OF THE PSEUDORABIES ERADICATION PROGRAM: CONSIDERATIONS FOR PREDICTING PRV PREVALENCE

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The first component undertaken for the benefit-cost analysis of the national pseudorabies virus (PRV) eradication program was to develop an epidemiological model for predicting the number of PRV infected herds in the US. Data reported by the Swine Health Staff in their quarterly PRV reports were used in conjunction with estimates made by an expert panel for modeling the movement of herds through various categories of PRV infection status.

Traditional methods of developing epidemiological models were not viable. The data, to support complicated epidemiological models which can account for important risk factors which have been shown to be important for PRV, were just not available. Ideally, factors such as herd size, type of housing, density of swine herds, type of herd (farrow-to-finish, feeder pig finisher, feeder pig producer, breeding stock producer, etc), prevailing wind patterns, level of biosecurity, type, and proportion of herd plans written for infected herds, herd vaccination status, virus circulation in the finishing herd, producer commitment to the program, economic circumstances of the producers, etc should be accounted for in an epidemiological model attempting to predict herd PRV status. Given that decisions about the program must be made, even in the face of this lack of data to support ideal models, a reasonable alternative was the use of expert panel estimates for assessing the probability of movement of herd status over time.

The core of the epidemiological model revolved around the estimates made by the expert panel. The panel had university and regulatory representation. Time series data of herd numbers were also used to predict number of swine herds between 1992–2012. Funding levels of the program were assumed to vary. In order to have a baseline comparison for the impact of the eradication program, a scenario of no eradication program was also modeled.

Results

Projected numbers of PRV infected herds depended primarily on current prevalence of PRV in the state (high, moderate, or low) and on assumed funding level for the program. Even a 25% increase over current funding did not result in achieving PRV eradication (Figures 1–4).

Although all of the figures look similar in their shape, it is important
to notice the scale differences by region for the percent of infected herds. The Western region of the US has the smallest percent of infected herds under any scenario (Figure 1). Even under no eradication program, this region is predicted to have only 5% of herds infected by 2012. While the current program appears to affect the percent of infected herds more dramatically in the Western region than in other regions, the actual number of infected herds eliminated is small relative to other regions.

The current program appears to be having the most impact in decreasing number of infected herds in the Central region, in that projected prevalence without an eradication program there approaches 30%, while the current program should decrease that projected prevalence by roughly half (Figure 2). Also, because the prevalence in some of these states is quite high, and the density of herds is high, an eradication program can more markedly decrease numbers of infected herds.

Discussion

Given these results, a major reassessment of the eradication program funding should be made. The amount of funding actually necessary to achieve eradication needs to be determined. If achieving eradication is the paramount goal, then obtaining this level of funding becomes absolutely essential. This study suggests current funding levels are not adequate for eradication.

If sufficient funds can be obtained, there are still a large number of considerations and decisions to be made. The best way to allocate these increased program funds will need to be determined. For example, the best allocation of program funds for spending at the national, regional, state, and field levels needs to be determined. The appropriate amount of money to support the USDA structure, vs the amount that will be filtered down for increased field personnel to write herd clean-up plans, etc. must be assessed. The best way to spend the funds retained and used at each level should be examined. The allocation of state government support and how these monies will contribute to the program will need to be addressed, as well as how producer spending can best contribute to the program.

Footnotes

*The authors thank the individuals (Drs. J. Annelli (USDA, Swine Health Staff – Hyattsville, MD), R. Burkholder (USDA – Greenville, OH), E. Ebel (USDA – Boise, ID), J. McKeen (University of Iowa – Ames, IA), R. Morrison (University of Minnesota – Minneapolis, MN), R. Taft (USDA, Swine Health Staff – Hyattsville, MD), D. Thawley (University of Minnesota – Minneapolis, MN), and D. Weaver (USDA – Calumet, IA)) who served on the expert panel.

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ASSESSING PSEUDORABIES ERADICATION PROGRAM

Figure 1  Predicted PRV prevalence - Western Region

■ = no eradication program
$ = current eradication program
△ = increased funding
+ = optimistic model
Figure 2 Predicted PRV prevalence - Central Region

- ■ = no eradication program
- $ = current eradication program
- ▲ = increased funding
- + = optimistic model
ASSESSING PSEUDORABIES ERADICATION PROGRAM

Figure 3 Predicted PRV prevalence - Northern Region

= no eradication program
$ = current eradication program
$ = increased funding
+ = optimistic model
Figure 4 Predicted PRV prevalence - Southeast Region

- ■ no eradication program
- $ = current eradication program
- ▲ = increased funding
- + = optimistic model
Aujeszky's disease (AD) or pseudorabies was first reported in the United States in 1813 as "mad itch of cattle." The swine industry began to see AD as a disease causing serious losses in the early 1960's. Discussions about its potential eradication began as early as 1975. Between 1974 and 1984, the percent of surveyed swine demonstrating the disease on serologic testing rose from 0.56 percent to 8.78 percent. Pilot projects were initiated in Illinois, Iowa, North Carolina, Pennsylvania, and Wisconsin to determine the feasibility of eradication. Their success led to the 1987 decision by the National Pork Producers Council Executive Committee to approve a national budget and eradication plan to eradicate AD from all domestic swine in the United States by the year 2000.

The national State–Federal–Industry Cooperative Pseudorabies Eradication Program began January 1, 1989. Since then it has been a model of producer and government teamwork. The guidelines for this eradication campaign are called the Pseudorabies Program Standards. These Program Standards were developed jointly by the U.S. Department of Agriculture, State regulatory officials, and swine industry leaders. Participation in, and therefore funding for, the Program requires each State to form an AD Advisory Committee consisting of swine producers, animal scientists, veterinarians, State and Federal regulatory officials, and other representatives of the swine industry. Incorporating the Program Standards into each State's regulations is also required for full participation in the Program.

Program Status

All 50 States plus Puerto Rico and the U.S. Virgin Islands are participating in and receiving federal funds for this industry-initiated program. Progress in the Program is measured by advancement through each of five stages (fig. 1). Stage V (Free) requires having no infected herds and maintaining adequate surveillance and testing at least 10 percent of the breeding swine in the State annually, for the previous 2 years. Once Stage V is achieved, statewide surveillance can be reduced to 5 percent of the breeding swine. Alaska, Connecticut, Maine, New York, and Utah have already attained Stage V status. Additionally, 10 States have achieved Stage IV (Surveillance). Mandatory cleanup of infected herds is the requirement of the 17 States in Stage III. Stage II is the control phase of the Program, and eight States are at this level. The preparation stage, Stage I,
UNITED STATES AUJESZKY'S DISEASE ERADICATION PROGRAM

is the entry level of the Program. All eight States, Puerto Rico, and the Virgin Islands that are still in this preliminary category (with the exception of Iowa) already qualify for Stage II but have not yet applied.

Tremendous progress is being made in all States in only this fourth year of the program. Arizona, Hawaii, and North Dakota have already eradicated AD. Twenty-four States do not have any AD infected herds. Currently, the disease is present in only 26 States, and 13 of them have less than 20 infected herds (fig. 2).

It is expected that all states in Stage I except Iowa will be advancing to at least Stage II by the end of 1993. States with fewer than 20 infected herds will move rapidly toward eliminating the virus from these herds and be eligible for advancement to Stage IV shortly.

Surveillance of breeding swine is conducted either (1) on farms, by testing all herds in a State or a statistically valid sample of herds; (2) at slaughter; or (3) at first point of concentration. Whichever method is chosen, the minimum standard for adequate surveillance is 10 percent of the breeding swine in that State with successful traceback of at least 80 percent of the positive samples to the pigs' herd of origin (fig. 3). Surveillance in all States was sufficient to newly identify 2,354 infected herds in 1992. Of these, only 9 became infected as a result of contact with infected feral swine (fig. 4). During 1992, 2,193 herds were cleaned up and released from quarantine. At the end of 1992, of the 7,480 herds remaining infected, 81 percent, had official herd-cleanup plans in place (fig. 5). Overall, 28 percent of the swine herds in the United States have known AD status, and the rest are monitored through random surveillance.

Future Goals

Short-range goals for the AD Program call for all States to be in Stage II or higher and 22 States at least Stage IV by the end of 1993. By 1995, all States except Iowa should be in Stage III or higher and 40 States should be in Stage IV or V. In 1998, all States except Iowa should be in Stage IV or V by 2000, all States including Iowa should be free.³

Program performance monitors indicate that the 1993 goals can be met or even exceeded with continued State, Federal, and industry support and cooperation. Current trends demonstrate a decline in the total number of infected herds throughout the United States (fig. 6). But the Program goal of having all domestic swine herds in the United States free of AD by 2000 may be threatened by feral swine. The risk posed by the existence of infected feral swine throughout the Southern States appears minimal but is being addressed through the establishment of pilot projects in four States.
References


Figures

Figure 1. Number of pseudorabies infected herds and current Program Stage, United States, Puerto Rico, and the U.S. Virgin Islands.

Figure 2. Number of infected herds in States that have infected herds and the proportion of those herds that have herd clean up plans.

Figure 3. Percentage of breeding swine surveyed in each region and the United States.

Figure 4. Source of new herd infections, 1990–92.

Figure 5. Pseudorabies prevalence, incidence, and cleanup, 1992.

Figure 6. The trends in pseudorabies prevalence, by quarters. 1988 (actual) through 1999 (projected).
UNITED STATES AUJESZKY'S DISEASE ERADICATION PROGRAM

Program Stages and Number of Infected Herds
May 1, 1993

Figure 1

States With Infected Herds*

Infected herds

*Iowa reported 3,993 infected herds (3,358 with cleanup plan)

Figure 2
UNITED STATES AUJESZKY'S DISEASE ERADICATION PROGRAM

Prevalence, Incident for 1992

Herds

<table>
<thead>
<tr>
<th></th>
<th>Infected herds</th>
<th>Cleanup plans</th>
<th>Herds cleaned up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>7,387</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During</td>
<td>2,354</td>
<td>2,615</td>
<td>2,193</td>
</tr>
<tr>
<td>Ending</td>
<td>7,480</td>
<td></td>
<td>6,061</td>
</tr>
</tbody>
</table>

Note: Due to reporting errors, the sum is off by 68 herds.

Figure 5

Prevalence Trends

Thousand infected herds

Quarterly report dates

- With Iowa
- Without Iowa
- 12-Month trend
- 6-Month trend

Figure 6
Chairman: Mr. Don D. Gingerich, Parnell, IA
Vice Chairman: Dr. George W. Beran, Ames, IA

J. Alumbaugh, IA; J. Annelli, MD; C.C. Black, GA; N. Black, MN; P.E. Bradshaw, IL; D.R. Bridgewater, CO; J. Dallaire, CA; R. Dykhuis, MI; G.C. Edwards, NC; C.Y. Erbel NC; W.D. Felker, IA; T.W. Freas, IN; M.L. Frey, IA; D. Galbreath, MD; A.M. Gallina, IA; L.M. Granger, MI; T.J. Hagerty, MN; E. Hahn, IL; M. Hammer, NC; J.A. Hennessey, MO; H.T. Hill, IA; D. Hoogestraat, SD; I.H. Huff, ND; R.D. Hull, IL; J.P. Huntley, NY; D.D. Hupe, KS; O. James, MT; C.L. Kanitz, IN; J.P. Kluge, IA; W. Korsmeyer, IL; J.H. Lang, WI; B. Lautner, IA; J. Leafstedt, SD; J.L. Lindstrom, TX; H.E. Little, CA; B.D. Marsh, IN; C. Massengill, MO; T.J. McGinn, NC; I.L. McPhail, OH; W.L. Mengeling, IA; H.F. Moberly, IL; A.D. Moles, MO; R.B. Morrison, MN; F.J. Mulhern, MD; R.R. Ormiston, MD; D.H. Person, MN; N. Pfeiffer, NE; J.R. Ragan, TN; J. Schnell, IA; H.B. Schroeder, WI; R.L. Sharpee, NE; G.P. Shibley, KS; M.L. Snyder, ME; T.E. Socha, NE; P.L. Spencer, MO; C.E. Starkey, AR; J. Stocker, NC; A.C. Taft, MD; D.G. Thawley, MN; D.L. Thompson, CA; E. Thurber, NE; J.W. Van Buren, MI; J.A. Vansickle, MN; W.H. Waldo, NE; D.L. Weiss, MN; L. Williams, NE;

Forty committee members were in attendance. There were more than 50 guests.

Don Gingerich presented the National Pork Producers Council report. He indicated an unprecedented time of opportunity in pork production. Along with opportunity, the industry faces a period of change, such as North Carolina moving to the number three state in total inventory.

Dr. Joe Annelli gave the USDNAPHIS report of program progress and future objectives. Federal funding for FY '94 will be $8.653 million which is about 50% of the dollars indicated in the original cost–benefit study to be needed during 1994. However, tremendous progress is being made in all states just four years into the program. APHIS program goals for the program include;

*Having all states at stage II or higher by the end of 1993
*Having at least 22 states advancing to stage IV by the end of 1993
*By 1995, all states except Iowa, should be in stage III or higher and 40 states should be in stage IV or V.
*By 1998, all states, except Iowa should be in stage IV or V
*By 2000, all states, including Iowa should be free.

Dr. Gay Miller addressed the committee regarding the Ohio State University cost–benefit study for the program. This study suggests the current funding levels are not adequate for eradication.

Dr. Howard Hill updated the committee on new technology. New vaccines are continually being developed along with diagnostic technology such as PCR and PCIFA. Dr. Hill also discussed an aggressive approach to
REPORT OF THE COMMITTEE

effective herd clean-up in acute outbreaks. The report of the differential
diagnostics and biologics subcommittee was given by Dr. Gene Erickson. The
subcommittee continued its review and evaluation of differential
diagnostic kits this year by conducting a national survey of state diagnostic laboratories. They also surveyed 45 infected herds from 9 states in an effort
to evaluate factors affecting the elimination of PRV from heavily infected herds. Their subcommittee developed several recommendations from the
infected herd survey.

An update on the Iowa program was given by Dr. Bernie Curran. Iowa has the largest program and the highest infection rate in the country. However, the infection rate has dropped for 27.8% a year ago to 19.5% as of October 1, 1993.

Dr. Ned Hahn gave the Feral Swine Advisory Committee Report. Control studies are in progress in 4 states. Over 800 feral pigs responded well to vaccine. Dr. Tommy Dees reported the prevalence studies in each of the four states.

The Control Board Report was given by its Chairman Phil Bradshaw. The board took action with 11 states' status.

Dr. Jim McKean reported on surveillance in high density areas. He discussed inter and intra–herd transmission patterns, based on a study of 12 counties in Iowa.

Dr. Paul Anderson discussed quality control for the national PRV database. He urged consistency and simplification for all the herd records entered.

A swine I.D. update was given by Dr. Arnold Taft. He stressed the importance of identification for food safety, disease control, foreign market development and product improvement.

Dr. Larry Williams explained the Nebraska testing program. This program has enabled all but the northeast quarter of the state to move into stage III.

Dr. Lee McPhail discussed the Ohio market swine identification program. Ohio uses slaughter surveillance to identify new infections. The herds found to be infected are quarantined in 1.5–3.0 months. Their state's infection rate is <1.0%

Nancy Robinson discussed the market sectors role in the national program. The markets strongly suggest that the process of defining a livestock market be simplified. She also addressed 4 critical areas needing attention:

*The regulations should provide adequate controls without unnecessarily impeding their business.

*Feeder pigs accepted for sale by livestock markets should come from monitored herds.

*Feeder pigs should be unloaded, penned and sold apart from other classes of swine in the market on sale day.
PSEUDORABIES

*Swine from known infected herds will not be sold at markets that do not provide separate facilities or sale days for feeder and breeding swine.

Dr. Tom McGinn reviewed a project undertaken by North Carolina to concentrate infected herds into smaller, more manageable areas. The program emphasizes regulatory, practitioner and producer support.

Dr. Dick Hall and Dr. Brent Marsh discussed recognizing program status from a split status state.

Dr. Tom Hagerty gave the report on the Program Standards Sub-Committee. After discussion, the committee voted to approve the sub-committee report, as amended.

Minutes PRV sub-committee on Program Standards (as amended by PRV committee of USAHA Oct. 27, 1993)

The Program Standards sub-committee met Sept. 27-28, 1993 in St. Paul, MN, with all members present (Hagerty, Beran, Gingerich, Annelli, Freas and Black) plus observers Beth Lautner and Arnold Taft.

The following recommendations for changes in the Program Standards were approved (all references to Program Standards dated Jan. 1, 1993):

Page 3, Approved feeder pig market—amend first sentence to reads as follows:

"A livestock market selling feeder pigs in which no animals from known infected herds are accepted for sale on the same day, in accordance with" etc., continuing as it now reads.

Add the following to No. 4—"In a herd of single-source pigs in which no sows remain, the state veterinarian may require a negative test of an official random-sample (95-5) of the remaining pigs before sale."

Add after point 4 the following:

"Additional requirements may be imposed as deemed necessary by state veterinarians to limit the possibility of disease spread through the market."

Add the following provision:

5. Cleaning and disinfection must be done after all other classes of swine have been removed and before feeder pigs are offered for sale.

Page 5, Official pseudorabies serologic test—strike the word "nonvaccinated" and add the world "official" between the words "any" and "test."

Page 5, Definitions, insert the following new definition:

Official random-sample test (95/20)

A sampling procedure utilizing official pseudorabies serologic tests which provide a 95% probability of detecting infection in a herd in which at least 20% of the swine are seropositive for pseudorabies. Each segregated group of swine on an individual premises must be considered a separate herd and sampled as follows:
REPORT OF THE COMMITTEE

Test all up to 14 head.

Page 6, Oversight Committee—strike the word "Oversight" and substitute the words "Swine Health".

Page 8, Surveillance index, strike "3. Samples collected on farms, etc."; strike the first sentence of the paragraph beginning: "A random system for infirm testing", and ending "known status." Add the following to the sentence: "Data of the following types" and ending "calculations": "unless cull sows and boars from herds tested for other purposes, such as feeder pig monitoring, circle testing, etc., can be eliminated from the population being tested at slaughter or first point, in which case the number of sows in such herds can be deducted from the population to be sampled for surveillance.

Page 10, add the following:

H. Other Movements

The state veterinarian may, upon request in specific cases, permit the movement of livestock not otherwise provided for in these program standards to prevent the spread of pseudorabies. It is the intention of these standards that such authority be used only in situations and under circumstances presenting problems that could not have been reasonably anticipated in advance and in unique situations. It is not the intention that such authority be used repeatedly to cover the same problem, but that the program standards be amended to conform with needed changes as they come to light.

Page 15, Stage III standards—

Amend 3. Surveillance to read:

3. A. Surveillance by slaughter or first point testing:

Strike c. under 3 "Samples collected on farms, etc."

Strike the paragraph beginning: "Data from samples collected, etc." and insert in lieu thereof the following:

"If cull sows and boars from herds tested for other purposes, such as feeder pig monitoring, circle testing, etc., can be eliminated from the population being tested at slaughter or first point, then the number of sows in such herds can be deducted from the population to be sampled for surveillance. Applications for status for states/areas taking advantage of this provision must explain how this is being accomplished."

Add the following new section:

3. B. Surveillance by herd testing:

a. The population subject to the surveillance system will be all herds not tested within the past 12 months for feeder pig monitoring, circle testing, qualified negative status, qualified negative vaccinated status, or surveillance.

b. The surveillance requirement will be:

1) in states/areas in which all herds have not been tested within a 12-month period—one-third of the herds not tested within the past 12 months must be selected at random and tested annually with either a 95/10 or a monitored herd test; or
PSEUDORABIES

2) in states/areas in which all herds have been tested at least once during a 12-month period 25% of the herds not tested within the past 12 months, selected at random, must be tested annually with a 95/10 or monitored herd test, or one-third of the herds not tested within the past 12 months, selected randomly, must be tested with a 95/20 test; or 3) 10% of the breeding animals in the herds not tested within the past 12 months must be tested using the 95/10 or the monitored test.

Page 16, Stage III, D. Duration of Status

In the paragraph beginning "Twelve to 14 months: after the word the word "initially," insert the following:

"and demonstrate progress in herd cleanup consistent with the goal of eradication by the year 2000" and continuing, "or (2)"

Page 17, 3. c. (1) strike all the words after feedlot: "and not through an all-class market."

Page 18, Stage V--Free, B. 2. amend to read as follows:

2. Surveillance of breeding herds continued at one-half the rate required for Stage III.

Page 18, Stage V--Free C. Duration of Status.

In the second sentence strike the word "outbreak" and substitute the word "case" and in the same sentence strike everything after the words "revert to" and insert in lieu thereof "Stage III until 60 days following cleanup of the last known infected herd, whereupon the state will be eligible to advance to Stage IV and a year later, if no new cases are found and surveillance is maintained at the Stage III standard, to Stage V, except that if a state chooses to depopulate the infected herd within 14 days and test all herds within five miles of the infected herd and any other exposed herds twice within 60 days of depopulation of the herd (the first test as soon as possible and the second not less than 30 days later), the state may regain Stage V status upon completion of such testing if all tests are negative.

Page 19, Part IV, Subpart 1--The Qualified Negative Herds, A.

Establishment of a qualified pseudorabies negative (QN) breeding herd, insert the following:

3. Any breeding herd in a Stage IV or V state/area is recognized as a Qualified Pseudorabies-Negative Herd.

Page 21, Subpart 1--The Qualified Pseudorabies-Negative Herd, D. Establishment and maintenance of QN growout premises on Herd B, add the following to the sentence starting "QN status may be attained" and continuing, "or (2)"

"and in the same sentence strike everything after the words "initially," insert the following:

"of eradication by the year 2000" and continuing, "or (2)"

Page 21, Subpart 1--The Qualified Pseudorabies-Negative Herd, D. Establishment and maintenance of QN growout premises on which no adult breeding swine are maintained.

Herd B, add the following to the sentence starting "QN status may be attained" and ending "of the herd": "except in all-in/all-out units one test of 50 head is required of each group."

Herd C, add the following to the sentence starting QN status may be maintained" and ending "at least 30 days": "except in all-in/all-out units one test of 50 head is required of each group."

The following motion regarding the program standards, which did
not originate from the sub-committee, was adopted by the committee: Page 17, E. 3. Feeder Pigs – Strike c. (4) and (5)
This meeting marks the half-way point of the ten PRV Eradication Program. USAHA is a time to gather the many players of this national program together to report progress and plan future direction. The progress of the past year is significant and encouraging. All states are either actively cleaning up infected herds or have initiated plans to move ahead immediately. The awareness of the economic benefit of PRV free herd is the driving force.

Urgency is the word. All states must now think and plan for how they will complete eradication in the next two or three years so that they can deal with the final problem herds and break-backs that will likely occur. There is no substitute for producer support and both state and federal animal health agencies to maintain this program as a highest priority.

The program here at USAHA the next two days will be focused on the economics of the eradication program and how it effects economics of the business of pork production nationwide. We will address other issues such as new technology, surveillance in high density areas, feral swine, sow and boar identification for major packer surveillance and the ever important Program Standards that need our attention to keep us abreast of the needs of the industry. All these subjects have a direct impact on the economics of swine production. Nothing happens until business takes place and we want the PRV Eradication Program to enhance this business in every way possible. We will hear the first report of the Economic Impact Study directed by Dr. G.Y. Miller and her associates from Ohio State University today. This study will serve as a basis for many of our decisions for the remainder of the program.

Most of the industry statistics that I will present for you today have been provided by Dr. John Lawrence of Iowa State University. These statistics will exhibit the very important trends of the industry. First it is essential to know of the continued concentration that started back in 1960 and continues today. The number of producers in 1960 was two million. The number has been reduced by half each decade until now the nation has around 200,000 producers today producing more and better quality animals than they were three decades ago.

The pork industry has led the nation in the ability to redefine the ground rules for an entire industry. I believe we may well be entering a time of unprecedented opportunity, where value added food sectors (like pork) can truly become job generating growth industries.

I'd like to discuss the structure of agriculture and the future of the hog business. It may be troubling to some to know that we have lost such a large number of our pork producers in the last three decades but the same thing has happened in most of the other industry in the United States at the same time. Of the 200,000 producers now in business 13,000 produce 60
per cent of the hogs. In 1981 only four plants processed more than 1.5 million head per year and now there are 23. Of the four largest pork packers just ten years ago, only one is in the top four today. I think it shows that agriculture is really not much different than most other pieces of American business. Many of our largest hog farmers started out small and grew because they did things a little better and a little more efficiently than the person down the road. Herd health is an essential ingredient of the recipe to success in the hog business. As we think of the effect of this National PRV Eradication Program we must be aware of how the rules and regulations affect the movement of pigs and the procedures of Pork Producers doing business.

Pork Production has natural forces leading to the midwest section of the United States. Over 30 per cent of the hog slaughter capacity is in Iowa. Iowa has the capacity to slaughter all of it's 23 per cent of the nations production as well as at least one of it's neighbor states. This fact results in the most competitive and highest hog prices in Iowa. Feed grain prices are lower in Iowa and surrounding states which is another reason more pigs are finished in the mid–west. Other states have advantages, particularly the southern regions, with a more moderate climate. This encourages the farrowing and nursery stages to begin in the south and move towards the lowest cost feed and highest prices available in the midwest. These economic factors must be given consideration while states are thinking about interstate regulations regarding the movement of swine. It is an absolute that state and federal regulators grant the modern producer the ability to move their pigs wherever they need without undue penalty or sacrifice as long as the PRV Eradication Program is not jeopardized.

Pork Producers have continued to reduce the cost of production while at the same time improved their product. This has resulted in a better buy for the consumer and improved pork's competitive position in the food market place. The average price of live hogs has been reduced in each of the last three years and at the same time allowed at least an opportunity for a modest profit for Pork Producers that have been in the upper third of the most efficient farms. Pork Producers have enjoyed the opportunity to earn a profit in 35 of the past 42 months. I don't need to tell you how important herd health is to the ability to staying in business. There is a most startling difference in the cost of production between the top third and the bottom third of producers in the 1992 Iowa State University Enterprise Summary of farrow to finish farms. This difference ranges from a $8.21 Cwt profit on the top third to a $4.01 Cwt loss on the farms in the lower third. Thus it is obvious which of these producers will be around in the year 2000. Think again of how much herd health contributes to a profit situation.

On the average the annual return for operating, ownership and labor on farms producing pork improves in direct relationship with management practices often used on the larger farms. This is not a hard and fast rule but
it tends to favor producers who have made a commitment to place pork production as the highest priority on their farms. The role of any disease eradication program is to improve the opportunity for producers to produce pigs as free of disease as possible to help assure that pork is in a very competitive situation to continue the tradition of leadership in supplying the United States and the world with high protein food.

The National Pork Producers Council remains committed to reaching our goal of complete eradication of PRV by the year 2000. The producers of the United States appreciate all of you here today and want to say thank you for your interest and hard work to this point. This project has been an example to the world of industry and government working together for the good of everyone. I can safely say that working together has helped each of us fulfill our responsibility better. The final word is keep up the intensity and we can get it done on time.
A meeting of the Feral Swine Committee was organized by Dr. Delorias Lenard of USDA/APHIS/SH to share information about feral swine projects underway in several states. A report of that meeting is provided to the USAHA PRV Committee as information pertinent to the goals of the Committee.

**Georgia**

Dr. Stallknecht reported on progress made during the second year of the vaccine trial on Ossabaw Island. Prevalence of PRV was obtained by age and sex. Age differences in prevalence were confirmed; differences in PRV prevalence between sexes were seen only in breeding-aged pigs. The overall prevalence rate was 31% positive for PRV. After vaccination with a live recombinant vaccine, good correlation was seen among assays (serum neutralization, latex agglutination and ELISA). Some interference in 2 week-old pigs was observed which was attributed to an effect of maternal antibody. Slight changes in seroprevalence of wild type infection was attributed to the effect of vaccination in that group. More differences are expected as the observation period continues. In a large sampling population (n = 793), tonsilar and trigeminal ganglia were tested for virus isolation by simple cell disruption. All samples tested were negative for PRV, suggesting that free virus is not readily shed in the population. Studies of aerial baiting are continuing. An experiment with tetracycline indicated that 60% of pigs took the baits at a distribution rate of 5 baits/hectare. The experiment will be repeated with another biological marker.

**Texas**

Dr. Don Davis reported on progress of their *Brucella* vaccine. Infection with $10^{11}$ *Brucella neotoma* organisms significantly protected domestic pigs from abortions caused by challenge with *Brucella suis*. After examining the host range of the attenuated vaccine strain, the group will consider design of a field trial. A concern by Dr. Vic Nettles about spread of the vaccine organism to non-swine species during live baiting was acknowledged and will be checked.
Louisiana

Studies at LSU are proceeding with RB51, an attenuated strain of Brucella. Experiments have been performed to determine how well pigs can handle this strain. Dr. Enwright reported that when the vaccine organism was given by a parenteral route of inoculation, no isolation could be made after 7 days. When given orally in pecans, bacteria could be isolated from lymph nodes and pigs were shown to have stimulated immunity.

California

A study lead by Dr. William Utterback was reported concerning PRV in a population of feral swine on Catalina Island. Under an agreement with a land conservancy, estimates have been made that the island contains 7,000 swine. The conservancy wants to eliminate the swine and has hired a veterinarian and a trapper. Studies are progressing on occurrence of diseases, on the possibility of exposure to sea mammals and on investigation of the 30–40% prevalence of PRV. The investigators want to set up a domestic swine facility to test if transmission to domestic swine can occur. The California State pork producers are supporting a census of domestic and feral populations. Only a single PRV-positive herd was found that converted some time ago.

Florida

Dr. Tommy Dees reported on work by Dr. Barbara Holligan on studies being conducted at the Avon Park Bombing range and the MacArthur ranch, both near Sebring, FL. The goal in these areas is to estimate population size and PRV prevalence. Counts of feral swine are being made at different points to determine population dynamics. Blood taken by hunters at the Avon Park check station have been tested along with samples taken from live feral swine trapped at MacArthur. A total of 391 pigs have been killed. Of these, 26% were positive for brucellosis; 55% were found to be positive for PRV. Tissue samples are now being taken for virus isolation and PCR at the University of Florida and University of Illinois.

Dr. Paul Gibbs discussed the transmission of PRV from feral swine to domestic swine under controlled conditions. Experimental design approximated the conditions of natural contact and movement to market of the two types of pigs. Feral swine, which were positive for PRV, were trucked and caged together with domestic pigs for up to 13 weeks. Additionally, domestic pigs were housed in fenced enclosures in areas where feral pigs were prevalent. Neither of these experiments has resulted in transmission and seroconversion of the contact domestic swine. Numerous swab samples, taken from hunted feral pigs, were checked for shed virus. All were negative. It was concluded that the transmission of PRV from feral to domestic swine was not a probable occurrence, at least under the conditions studied in the experiments.
Transmission biology of PRV strains in both feral and domestic pigs is being studied by Drs. E. Hahn and G. Scherba using PRV strains of both domestic and feral origin. Feral pigs, provided by collaborators at the University of Florida, were used to establish a small breeding herd at the University of Illinois. Challenge experiments with a virulent domestic strain of PRV indicated that 12 week-old feral pigs were severely affected by PRV infection compared with domestic pigs. Feral swine exhibited more respiratory disease at the age tested. Weanling feral pigs, however, resisted the fatal disease caused by the domestic virus infection of similarly aged domestic pigs.

Strains of PRV, presumed to be of feral pig origin, were compared by restriction endonuclease digestion with domestic strains. All strains but one were provided by Drs. William Mengeling and Gene Pirtle of the National Animal Disease Center, Ames. A PRV strain, from a Florida panther was provided by Dr. J. Evermann at Pullman, WA. Three feral strains from Hawaii were similar in terms of their restriction endonuclease patterns. The isolates from Florida were less homogeneous, except for the panther isolate which was very similar to an isolate obtained from the same area in Florida, ten years earlier. The FL81 (17000) strain was used to challenge both feral and domestic pigs. It proved to be very attenuated in both types of pig. Clinical disease was almost nonexistent. Sera taken at 8 and 17 days after infection were sent to the Illinois State Diagnostic Laboratory and tested for serum neutralizing titer and for the gl and gX antibodies by differential test. In spite of normal SN titers at both sampling times, sera from the infected feral and domestic pigs were only sporadically positive for gl and gX antigen. It was concluded that the attenuated feral strain was poorly immunoreactive with respect to the diagnostic antigens or that the differential test does not work well with feral virus.

Conclusions

Studies are underway in several states to address questions of the threat to domestic swine of enzootic pseudorabies and brucellosis in feral swine. Research into conventional and unique measures for control of these agents in the wild swine populations will capitalize on what is learned from these studies and the needs of the industry.
Domesticated swine were first introduced to North America by Hernando de Soto in 1539. Feral swine populations have been established due to escape and free-range management practices. The European wild boar ("Russian Boar") was introduced into North Carolina in 1912 as stock for a shooting preserve. These animals escaped and as they dispersed they interbred with feral swine. Trapping and dispersal to game management areas and shooting preserves has established populations of feral/wild swine in many states.

Today feral/wild swine occur in at least 18 states (AL, AZ, AK, CA, FL, GA, HI, KY, LA, MS, NM, NC, OK, SC, TN, TX, VA and WV). The feral/wild swine population in the United States is estimated to be 1 to 2 million and growing. Florida alone is thought to have at least 500,000 to 600,000 feral/wild swine. Hog hunting, trapping and related activities is estimated to be an 8 million dollar per year industry in Florida.

Feral/wild swine impact natural ecosystems by rooting, wallowing and trailing activities that degrade populations of native plant species and create an environment that favors proliferation of exotics. Depredation of certain forest tree seedlings and agricultural crops by feral/wild swine is a major concern in regions where these animals are endemic. Feral/wild swine can have a negative impact on native wildlife through predation, competition for food and habitat destruction.

There is increasing interest in the role of feral/wild swine as potential reservoirs of disease for domestic animals and native wildlife. Foreign animal diseases for which feral/wild swine could serve as reservoirs include African Swine Fever, Foot and Mouth Disease and Hog Cholera.

At the October 1991 USAHA meeting in San Diego, California concerns were raised about the impact that infected feral/wild swine might have on the Swine Brucellosis (SB) and Pseudorabies (PRV) eradication programs. This concern led to the following resolution:

The Feral Swine Subcommittee recommends to APHIS, NPPC and the Southeast Wildlife Disease Research Center that pilot studies be undertaken in states of high feral swine population with the objectives of developing effective, practical methods for prevention of transmission of Pseudorabies and swine Brucellosis between feral and domestic swine and for control/elimination of infection from feral swine. Suggested states for study are Florida, Georgia, Texas and California.

APHIS held a Feral Swine Pilot Project Planning meeting in May 1992. State, Federal, University and industry leaders from the four pilot
states were present. In September 1992 there was a follow up meeting of APHIS Regional Swine Epidemiologists and Area Epidemiologists to formalize the Pilot Project plans. In October 1992 the Feral Swine Technical Group met to review and finalize the Pilot Project proposal. The objectives of the Feral Swine Pilot Projects are:

1. Describe the distribution/density of feral/wild swine populations in the study states.
2. Describe the distribution/density of domestic swine populations in the study states.
3. Determine areas and extent of contact (overlap) between the feral/wild and domestic swine populations.
4. Determine the prevalence of disease in both the feral/wild and domestic swine populations.
5. Determine the extent to which domestic herds currently become infected as a result of contact with feral/wild swine. Explore the possible intervention strategies that may prevent this infection.
6. Characterize the excretion/transmission of PRV from feral/wild swine to domestic swine under natural and experimental conditions.
7. Quantify the risk that feral/wild swine pose to infect domestic swine with SB and PRV.
8. Compare virulence of PRV strains.
9. Assess management pressures on disease prevalence.
10. Future control programs
   a. Development of species and target host specific immunocontraceptives.
   b. Investigate potential natural genetic resistance of feral/wild swine.
   c. Develop practical delivery systems for a vaccine (cost effective and species specific).
   d. Develop an efficacious oral vaccine for PRV and SB.
11. Education

FERAL SWINE PILOT PROJECTS:

California (Dr. Cyrus Elmi, Coordinator)

California swine operators are being surveyed regarding contact with feral/wild swine. This survey will help to identify the areas of potential commingling of feral/wild and domestic swine. Serologic sampling will be conducted on both ferals and domestics in such areas.

CATALINA ISLAND: Catalina Island, off of the coast of California, has feral/wild swine and other wildlife. Blood and tissue samples from these feral/wild swine will be tested for several diseases (PRV, Brucellosis, San Mugiel Sea Lion Virus, Plague and Trichinosis). Sixty percent of the samples tested thus far are serologically positive for PRV. Fifty-three percent are positive for San Mugiel Sealion Virus.
Texas (Dr. Dick Ferris, Coordinator)
There is a cooperative effort with USDA, TAHC, Texas A&M extension, ADC, and the Parks and Wildlife service to collect samples for serology from wildlife refuges on the gulf coast. Texas is surveying feral/wild swine at slaughter plants. Questions concerning exposure to feral/wild swine have been incorporated into investigations on infected domestic herds. Garbage feeders have been surveyed about their management practices and contact with feral/wild swine. Those having contact with feral/wild swine are being tested for SB and PRV.

Georgia (Dr. David Larimer, Coordinator)
During FY 92 and 93 Georgia state and federal personnel in cooperation with the Georgia Game and Fish Commission and Southeastern Cooperative Wildlife Disease Study (SCWDS) personnel have surveyed several wildlife management areas by collecting blood from hunter-killed feral/wild swine. Ten and one-half percent of 337 samples were seropositive for PRV and 3.4% were seropositive for Brucellosis. Feral/wild swine were trapped in the vicinity of known PRV infected domestic herds that have documented feral-domestic interaction. Thirty-seven percent of these samples were seropositive for PRV and 9% seropositive for SB.

OSSABAW ISLAND: This 24,000 acre barrier island is managed by the Georgia Department of Natural Resources. A vaccine study is being conducted here by Southeastern Cooperative Wildlife Disease Study (SCWDS). After determining the baseline seroprevalence of PRV, a part of the population was vaccinated with a commercially available gene deleted PRV vaccine. Sampling conducted this year suggests that seroprevalence in younger animals in the vaccinated population is lower than the baseline levels measured on this age group prior to herd vaccination. Herd vaccination will be conducted again this year.

The SCWDS group has also conducted an oral bait trail on Ossabaw Island. Ninety-five percent of the animals were reached by a single bait application. The incorporation of oral vaccine into such a bait could potentially immunize feral swine populations over a broad geographic area.

Florida (Dr. Barbara Holligan, Coordinator)
AVON PARK AIR FORCE RANGE FERAL SWINE PROJECT: Avon Park Air Force Range (APAFR) is a 106,110 acre public wildlife management area located in central Florida. The feral/wild swine population of the installation has apparently increased over the past decade. The seroprevalence of PRV and SB in the feral/wild swine on APAFR is being determined by hunter/check station blood collection. APAFR biologists are estimating the index of abundance for the feral/wild swine population for the next several years in order to determine trends in feral/wild swine population density on APAFR. The objective of this project is to determine if population management through hunting pressure has an effect on seroprevalence of PRV and SB.
FERAL SWINE REPORT

Three hundred and ninety-one hogs were killed during the 1992-1993 hunting season. Blood samples were collected from 54% of these with a 12% seroprevalence for SB and 50.5% seroprevalence for PRV. The APAFR feral swine project is ongoing during the 1993-1994 hunting season.

BUCK ISLAND PROJECTS: Seventy samples were collected from trapped hogs on this South Central Florida ranch disclosing a 10% seroprevalence for SB and a 53% seroprevalence for PRV. Dr. Paul Gibbs at the University of Florida is currently collecting samples for serology and nasal swabs for virus isolation. Transmission studies between feral/wild swine and domestic pigs are being conducted here as well.

ST. VINCENT ISLAND: St. Vincent Island is a barrier island off of the north west coast of Florida. It is a national wildlife refuge controlled by the U.S. Fish and Wildlife Service. Serologic sampling of the feral/wild swine population has been conducted on this refuge over the last decade. No Brucellosis has been found. Seroprevalence for PRV is 16 to 17%. This island is a possible site of future release of the oral PRV and immunocontraceptive vaccines.

FERAL/WILD SWINE DISTRIBUTION/DENSITY MAP: Southeastern Cooperative Wildlife Disease Study at the University of Georgia is currently updating the feral/wild swine distribution/density map of the study states.

VACCINES: An oral swine pox vector vaccine is being developed by Dr. Paul Gibbs at the University of Florida. Animal Damage Control is currently working on a species specific target host specific immunocontraceptive.

CHARACTERIZATION OF PRV VIRUS STRAINS: Dr. Ned Hahn at the University of Illinois is looking at the virulence of various strains of PRV. He is also investigating the possible genetic resistance of feral/wild swine to PRV.

EDUCATION: Several educational aids addressing feral/wild swine issues are being developed by USDA. Examples include the Feral Swine Pamphlet (Agricultural Information Bulletin #620) and a video on feral/wild swine.

These pilot projects and related research will continue until the issues concerning feral swine are resolved.

*presented at the USAHA by Dr. Tommy Dees, Southeastern Regional Swine Epidemiologist, USDA, VS.
The National Pseudorabies Program is progressing toward its targeted completion date. Much has been learned about the spread of pseudorabies virus (PRV) during the initial phases of this eradication process. The major factor in spread of PRV is the movement of infected swine. The ability for PRV to be transmitted between adjacent production units without animal movement has been documented. Therefore, infected herds represent a calculable risk factor to nearby herds without animal movement. In areas of low swine density, the potential for lateral spread between herds is diminished because of the improbability that an infective dose of virus will survive and be transmitted over large geographic areas. In these geographically dispersed herds the movement of infected animals becomes the most likely transmission method. These infected herds do not represent a significant threat to other herds unless they directly introduce infected swine. Therefore, with appropriate movement controls, these herds may remain infected for extended periods without significantly impacting the eradication effort. This situation reduces the urgency of finding and eliminating the infected animals or herds, and is analogous to experiences with the Bovine Brucellosis and Tuberculosis eradication programs. In this scenario traditional surveillance to identify new herds is an effective strategy.

In contrast is the newly infected herd in a high population swine area of any size -- county, district, state or region. Such herds represent an immediate and on-going risk to surrounding swine units through area spread of PRV by wildlife or airborne routes. Unless such herds are found in a timely fashion, they may actively spread PRV in spite of effective swine movement restrictions. This situation significantly changes the measures for eradication success. Timeliness and efficiency of detection for new infected herds become more important than does monitoring of current status for all herds. These programmatic characteristics are particularly important in high PRV prevalence areas.

High prevalence areas represent enhanced opportunities for inter-herd transmission of PRV irrespective of animal movement patterns. In order for PRV prevalence to be reduced, infected herds must be identified, virus circulation minimized, and herd clean-up initiated. During the clean-up period a reduced, but palatable, risk of inter-herd transmission to neighboring herds exists. This risk generates pressures to find newly infected herds rapidly. Without timely identification PRV will smolder in the area, reinforcing high risk herds (those near infected herds) at a similar or greater rate than herd clean-up efforts reduce prevalence. This scenario may result in a
SURVEILLANCE IN HIGH DENSITY/HIGH PREVALENCE AREAS

stagnant eradication effort with discouraged producers and regulatory officials, and the expenditure of substantial funds and efforts to find and clean-up reinfected herds without reducing prevalence.

Traditional animal disease eradication programs have contained a strong surveillance component from their inception. However, a distinct difference between PRV and organisms found in traditional eradication programs is the potential for inter-herd spread of PRV virus without animal movement. In most other animal disease eradication where spread is principally by movement of carrier animals, early detection of newly infected individuals or herds is not a prerequisite for a successful elimination strategy. Infected herds which are not detected for years do not contribute to significant disease spread provided animal movement is restricted. Therefore the major limitation is a delay in institution of a herd clean-up plan. With PRV eradication these same rules may apply in low density areas, where area spread is minimal. However, in high density/high prevalence areas, such a strategy will not stop the inter-herd movement of PRV. Therefore, prevalence must be reduced by non-traditional methods.

Traditional surveillance methods require a selection of herds to be tested based upon random methods or whole population (first point, annual certification, or down the road) tests. To reduce program expenditures population tests are generally multiple year projects based on random sampling principles. This strategy works well in situations where infected herds are not a nidus for spread of local infection. Such surveillance activities may document the spread of PRV to new herds but are often not timely in stopping lateral area virus movement. By testing herds under a traditional eradication regimen, producers and veterinarians may reduce efforts to voluntarily classify newly infected herds because of thoughts that "the program" will eventually find the herd anyway. Particularly in high prevalence areas, this change of attitude will reduce the effectiveness of the PRV eradication effort by leaving high risk herds unidentified for prolonged periods of time.

With these factors in mind, the Iowa PRV Advisory Committee and state APHIS-VS personnel devised a demonstration project to evaluate the relative effectiveness of two sampling schemes to identify newly infected herds in counties where 100% of herds had been initially classified for PRV status. A traditional eradication random sampling program regimen to test 33% of non-infected herds per county annually and a veterinary practitioner and regulatory official selection process, non-random, for high risk PRV herds were compared in twelve (12) counties which had completed a 100% initial test within the preceding 12 months. The counties were paired into two treatment groups based on swine density, geographic location, and known PRV prevalence then blocked into two treatment groups. In Group I counties, herds to be tested were selected by random draw (computer pick) equal to 1/3 of all non-infected herds. Group II county herds were selected
by veterinarians as high risk, non-infected herds. This information was transmitted to district veterinary medical officers. After initial computer selection in Group I, herds awarded a negative test status within 12 months were exempted from the process. Veterinary practitioners were given preprinted test charts to identify all selected herds in both county groups, and a statistical sampling of the breeding animals for each herd was requested.

Group I county populations ranged from 180 to 744 total herds/county, average = 375 herds; infected herd prevalence of 10.4 to 37.6%, average = 18.5%; and herd density of 0.129 to 0.336 herds/km², average = 0.223 herds/km². Group II county populations ranged from 239 to 525 total herds/county, average = 364 herds; infected herd prevalence of 12.9 to 24.7%, average = 17.3%; and herd density of 0.163 to 0.378 herds/km², average = 0.253 herds/km². In Group I counties 28.8% (64/222) of herds selected and not exempted did not complete procedures during the allotted period. In Group II counties, 13.2% (50/379) of herds selected were not tested. Producer refusal to test and no swine at time of retest request in selected herds, were two common reasons for not completing the test procedure. Group I counties tested a total of 158 herds, ranging from 14 to 58 herds/county. The rate of newly infected herds detected ranged from 0.00–28%, with an average of 7%. Three of six counties detected no new herds from a total of 61 herds tested. The highest infected herd rate found was 28% (7/25) in the highest density (0.336 herds/km²) and prevalence (37.6%) county within the six Group I counties. In Group II 329 herds were tested, ranging from 32 to 68 herds/county. The rate of new infections detected ranged from 1.7 to 23.8% with an average of 12.1%. No counties had zero new herds detected. Two of six counties identified one (1) infected herd from 32 and 58 herds tested, respectively. These counties had the lowest PRV prevalence and herd density levels of the six counties in Group II. The highest detection rate was found in the highest density but mid-prevalence (16.8%) county.

The Group II sampling technique found a higher ratio of newly infected herds (12.7% vs 7.0%) compared to Group I. The costs for finding newly infected herds was $1196.00/herd for Group I and $711.00/herd for Group II. The large number of herds exempted in Group I (354/576) because of a previous negative test within 12 months may have skewed the Group I results. Because of the small (12 counties) sample size, statistical comparison of the two selection regimens at the 95% confidence level did not demonstrate a difference between these two groups. However, a trend favoring the Group II sampling technique as more efficient in finding newly infected herds was observed. The Group II procedure detected more infected herds to place in clean-up plans and found infected herds at 41% less cost/infected herd identified than did the random surveillance protocol.

During 1994 this demonstration project will be continued in the same 12 counties to determine if the initial year results can be replicated and
implementation procedures refined. Additionally, in the Group I (computer drawn) counties a mandatory test procedure for all herds within a 2.5 km radius of a newly infected herd will be examined to determine whether such a strategy will increase the effectiveness of the random draw mechanism.

The veterinarians and producers involved in this project expressed general acceptance of the selection method which they experienced. Veterinarians readily accepted receiving the preprinted test charts to identify herds to be tested. Some practitioners expressed relief that through use of the preprinted test charts, they were not required to directly identify herds to be tested. At this point the selection of high-risk herds by veterinary practitioners and district veterinarians appears to be more efficient than computer-based surveillance methodology in detecting newly infected herds. This observation casts doubts about the appropriateness of instituting traditional surveillance processes in high-density areas until prevalence levels have been significantly reduced.
Mr. Chairman, I appreciate the opportunity to present to this committee the livestock markets perspective on our role in the control and eradication of pseudorabies as well as our views on animal identification.

It is largely because of recent events related to the movement of feeder pigs from markets in a stage II state into a stage IV state and APHIS' intentions to promulgate new pseudorabies regulations that I am here today. The marketing sector, in response to these events, has begun to reassess our position within the structure of the pseudorabies eradication program. Thus, I wish to visit with you about how we (meaning the markets) believe the pseudorabies eradication program can best work for the markets and how the markets can best work for you in controlling and eradicating this serious swine disease.

It is somewhat difficult to know where to begin in this very complex issue. But, since the beginning in the federal regulations and the pseudorabies program standards is the definitions, that is where I will start. In those definitions, you will find five, count them, five separate definitions of a livestock market. There is the approved livestock market, the approved all-class market, the approved feeder-pig market, the approved slaughter market and the pseudorabies-restricted feeder-pig market. If all these different definitions of a market don't confuse you, I can assure you they do the operators of those markets. As one market operator recently put it, "When you strictly define a market, for instance as a feeder-pig market, you usually are leaving a lot of things out that are happening at that market." His point is well taken as very few markets around the country are strictly a feeder-pig market or a sow and boar market or a slaughter hog market. Rather, as you well know, markets are most often selling various classes of swine and even other species in the same facility on the same day.

Therefore, we would strongly suggest that the whole process of defining a livestock market in this and other animal health programs be simplified. We can do this by the simple act of establishing a single definition of an approved livestock market. And then allow the standards or regulations to specify the requirements for selling the various classes or status of swine in that approved market. This we believe would remove the inclination to try to fit round pegs into square holes and to regulate by definition.
This idea of consolidating the market approvals is also expected to come up in a comprehensive review of the animal health rules and regulations for markets that APHIS expects to launch soon. The idea, we are told, is to take all the market approvals that are currently sprinkled throughout the federal regulations and see if they can be consolidated to provide greater consistency and ease of administration by APHIS. Thus, I would hope that as new federal pseudorabies regulations are drafted that this committee will support the markets desire to see the market approval process simplified in this manner.

As to what the criteria for the markets should be in controlling the spread of pseudorabies, at a recent meeting with APHIS swine health staff, several market operators and LMA staff, it was agreed that there are four critical areas from the market's standpoint in controlling the disease. One, the regulations or standards should provide effective controls without unnecessarily impeding the markets in doing business. Two, feeder pigs accepted for sale by the livestock markets should come from monitored herds. Three, feeder pigs should be unloaded, penned and sold apart from other classes of swine in the market on sale day. And four, swine from known infected herds will not be sold at markets that do not provide separate facilities or sale days for feeders and breeding swine.

Of course, within these four critical areas, there exist any number of subtexts or issues. Some of these are: how we can maximize control of the disease at the markets without forcing the marketing of swine into less regulated channels. Do we need to establish some kind of restricted sale for feeder pigs from quarantined herds? How do we regulate the sale of breeding swine from herds not known to be infected? How should the markets handle sows and boars with a negative test from farrow to finish operations where there is an ongoing state surveillance program? Obviously, time does not permit a full discussion of all these various issues today. However, for the purpose of future discussions, it is important that they be considered in the development of pseudorabies regulations and standards which are workable, reasonable and effective for all concerned.

Now I'd like to turn to some specific concerns we have with the current pseudorabies program standards. Many of these issues have come to light very recently as several states have moved into higher stages of pseudorabies control and eradication. Also, we are finding that experience with the program over time has brought to light some unanticipated problems or concerns.

Most of our concerns with the program standards relate to stage IV surveillance and the swine import requirements for feeder pigs. For instance, E.3.(c) (1) of the standards requires that one of the conditions for allowing entry of feeder pigs into a stage IV state is, "That the swine enter on permit directly to a designated feedlot and not through an all class market." It is our understanding from talking to individuals familiar with
the standards that the intent of this language was to restrict feeder pigs sold in the II or III stage from being sold again through a market in the stage IV state. Instead this provision is being interpreted by some as restricting the sale of feeder pigs through markets in the originating stage II or III state. It may be reasonable to be concerned with, let us say for argument's sake, a dealer who buys feeder pigs in a market in the stage II or III state and in turn sells them again through a market in the stage IV state, thus, resulting in there identity or status being less certain. However, for the markets in the stage II or III states, as long as all other rules for interstate movement are observed, there is no practical reason in our view for not permitting the entry of feeder pigs from those markets into a stage IV state.

Another condition for entry under that provision is "That the swine originate from an approved feeder pig market." The problem here is the term "feeder pig market" and exactly what that means, particularly for the market traditionally selling other classes of swine in the same facility. Putting the term "feeder pig market" aside, let us look at this from purely the should and should nots in marketing feeder pigs.

Markets handling feeder pigs should provide well constructed and well lighted, imperviously surfaced pens, alleyways, etc., that are kept clean and in good repair. Facilities used for marketing feeder pigs should be separate from that used for breeding or slaughter swine; or, if the facility is used for other classes of swine on days other than when feeder pigs are sold, it should be cleaned and disinfected prior to its use for feeder pigs; or, where the facility is used for both feeder pigs as well as other classes of swine, the feeder pigs should be kept separate and apart from those other classes of swine. Separate and apart should be defined as meaning that feeder pigs will be unloaded at separate chutes, moved through separate alleyways, penned in separate facilities or separate pens from other classes of swine. Feeder pigs should be sold first before other classes of swine, or the sale ring thoroughly cleaned and disinfected after being used by other classes of swine and before feeder pigs are sold through the same ring. And lastly, feeder pigs should be loaded out using separate loading chutes. I should say here that we do not ascribe to the idea that separate and apart should also mean a ceiling to floor wall or anything in between. Anyone familiar with a livestock market can appreciate the ventilation problems a wall would give us. Because we know of no evidence of transmission of the disease in a market where steps have been taken to maintain separation of the different classes of swine, we feel strongly that the requirements I have just outlined are more than sufficient to minimize the risk of spread of the disease in the markets.

The final issue I wish to discuss with you--animal identification--has obvious implications for the pseudorabies program as well as other animal health and food safety programs. This issue and in particular the question of who should apply the identification again has become a major
issue for the livestock industry with USDA Secretary Espy's call for mandatory ID as part of the Department's pathogen control program. So what is the market's position on animal ID and in this case swine ID?

I'm sure it will come as no surprise that the markets support the application of animal ID on the farm, ranch, or wherever livestock are maintained for extended periods of time. But why is this really? You might assume that by encouraging on-farm identification we are simply trying to relieve ourselves of the costly burden of applying the identification at the markets. And, yes, to some degree, you would be right. But, more importantly, you have to look at the dramatic changes in the marketing of livestock over the past 20 years to more fully appreciate why our position makes infinite good sense.

For a good many years, livestock markets were the predominant outlet for a producer's livestock. Thus, the markets, as the first point of concentration or commingling, were rightfully looked to as the logical location for the control, identification and traceback of violative residues and animal diseases of human concern. Also, let us be candid, it simply was easier to have the markets apply the identification than to come up with a whole new system for on-farm distribution and application.

Today, however, slaughter or fed livestock are moved predominantly direct from the farm or feedlot to slaughter. And, in the case of slaughter hogs, a large percentage are moved to the packing plant through dealers or packer buying stations which have little or no veterinary regulation or oversight. Also, it is important to note that some livestock may move several times before and after they are marketed and ultimately slaughtered. Thus, the potential for an animal to lose its identity once it leaves the farm, as you can see, is considerable.

So, given these changes in the marketing structure for livestock, isn't it time we quit expending time and effort and money on devising new and better systems of livestock identification at the markets and set our sights on how we can get ID applied at the point of origin where it rightfully belongs. If we are truly interested in providing an identification system that provides the greatest reliability in application and traceback, as well as, providing a potentially valuable management tool for producers, our only real option is to begin devising an ID system that begins with the producer. The USAHA Animal Identification Committee recognized this in a limited fashion a couple of years ago when a resolution was passed recommending that an official feeder pig tattoo be approved that would be applied at the premises of origin.

My comments in support of identification at the premises of origin however are in no way intended to abrogate totally the markets responsibility in animal identification and traceback. The livestock markets obviously continue to provide a vital link in the marketing chain and thus in the traceback process, particularly for certain classes of animals. Thus, regardless of the system of identification, it will remain important for the
markets to keep a careful record of the animals and their origins as they move through their facilities.

In the final analysis, however, what the markets think and even what you may think personally about who should apply the ID may be out of our hands already. Given the public's present fervor over the issue of safety of the meat supply, the only real regulatory option being discussed appears to me to be a mandatory ID program that begins at the premises of origin. So, we can either get on board this moving train and make it work or we can continue to look at piecemeal solutions to our animal ID concerns. I prefer the former, what about you?

Again, I thank the chairman and you for letting the marketing sector bring our concerns and views on the pseudorabies and animal ID programs to your attention. We look forward to working with this committee in the future on these critical issues.
NORTH CAROLINA PRODUCER'S INITIATIVE FOR SWINE HEALTH

October 20, 1993

Thomas J. McGinn, III, D.V.M., North Carolina Department of Agriculture, Veterinary Division, Assistant State Veterinarian; Christopher C. Brooks, D.V.M., North Carolina Department of Agriculture, Veterinary Division, Veterinary Medical Officer; David W. Wray, M.A., North Carolina Department of Agriculture, Veterinary Division, Geographic Information Coordinator

As North Carolina continues its drive to eradicate pseudorabies (PRV), each year brings new challenges which can only be resolved through producer driven cooperation and commitment. Producers are motivated to scale these economically important obstacles by the ever growing global demand for pork products.

Three years ago North Carolina identified and resolved one such challenge. Vertical spread of pseudorabies was identified as the primary cause of new quarantines. The disease was traveling from nucleus herds to sow farms to finishing floors. Having identified the problem, the North Carolina PRV Advisory Committee (an open door problem solving group made up of industry leaders, producers, state and federal officials, and private practitioners) developed and implemented the following plan for solution:

1. Testing of breeding swine prior to movement from one farm to the next.
2. Vaccination of breeding swine prior to movement.
3. Control of movement of all infected animals.
4. Emphasis on biosecurity.
5. Vaccination of exposed pigs moving onto finishing floors.

With these steps in place, the incidence of new quarantines due to vertical spread dropped dramatically. When PRV has spread vertically, there has usually been some lapse in this procedure.

1993 is a new year and has once again introduced new challenges. Since December of 1992, we have experienced a dramatic rise in the horizontal spread of Aujezsky's Disease. Off-site finishing floor breaks which could not be traced back to the sow farms or nurseries of origin began to increase rapidly. Co-mingled feeder pigs spread disease to susceptible adjacent farms. The two counties most affected by this problem were Duplin and Sampson which are among the most rapidly growing pork producing counties in the nation. The PRV Advisory Committee identified two contributing factors to this spread:

1. The rapid increase in the density of non-vaccinated off-site finishing floors in the infected areas.
2. A tendency for less exacting biosecurity on finishing floors.
NORTH CAROLINA PRODUCER'S INITIATIVE

Since our infected finishing floors are scattered throughout eastern North Carolina, they frequently infect other herds in this densely populated area. Sampson county is currently ranked as the number one pork producing county in the country. Duplin, while currently ranked number seven, according to our updated statistics, has become the number two county this year. North Carolina has moved from seventh in hog production to third in the nation in three short years. If Duplin and Sampson counties were considered a state, they would be ranked eighth in the country.

**Breeding Premises**

<table>
<thead>
<tr>
<th>COUNTY</th>
<th>NUMBER PREMISES</th>
<th>TOTAL SOWS</th>
<th>% VACCINATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplin</td>
<td>392</td>
<td>91,701</td>
<td>62.9%</td>
</tr>
<tr>
<td>Sampson</td>
<td>435</td>
<td>128,829</td>
<td>81.5%</td>
</tr>
</tbody>
</table>

* 25.2% of Duplin County breeding premises are strictly sow farms with 55.2% of all breeding animals located on them.
* 31.4% of Sampson County breeding premises are strictly sow farms with 63.5% of all breeding animals located on them.

**Finishing Premises**

<table>
<thead>
<tr>
<th>COUNTY</th>
<th>NUMBER PREMISES</th>
<th>TOTAL HOGS</th>
<th>% VACCINATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplin</td>
<td>670</td>
<td>990,330</td>
<td>24.5%</td>
</tr>
<tr>
<td>Sampson</td>
<td>568</td>
<td>803,183</td>
<td>36.9%</td>
</tr>
</tbody>
</table>

* 56.2% of Duplin County finishing premises are strictly feeding farms with 90.1% of all finishing animals located on them.
* 47.5% of Sampson County finishing premises are strictly feeding farms with 82.7% of all finishing animals located on them.

These statistics include 236 separate premises with only sows and boars, 81 separate premises with only nursery pigs and 564 separate premises that have only finishing swine.

Recognizing the need to protect the health status of the non-infected population that makes up the majority of these two counties' producers, North Carolina's options were limited to continued vaccination of quarantined finishing floors as well as to the vaccination of all non-quarantined finishing floors at most risk in an affected area. Unfortunately, given the 231 scattered quarantined finishing floors that cover the entire region, most of the 330 negative finishing herds in Duplin and Sampson counties were at risk. Blanket vaccination of finishing swine in both counties was needed requiring 4.5 million doses of vaccine annually.

A plan was therefore needed to limit the exposure of the non-infected population and decrease virus circulation and spread by the PRV positive/exposed population in order to decrease this overwhelming vaccine.
requirement. We needed a solution to keep down the cost of vaccines and, subsequently, to maintain the competitive price of our pork.

To accomplish this plan, concentration of quarantined finishing space to a limited area would be needed. This concentration would decrease the number of negative producers that were put at risk, thereby, decreasing the number of negative producers required to vaccinate. Instead of blanket vaccinating Duplin and Sampson counties, only the concentrated area would be totally vaccinated, thereby, reducing the annual vaccine requirements for finishing floors to 1.5 million doses (a 3.25 million doses a year savings).

The seventy-nine, 25 square mile blocks within Duplin and Sampson counties were evaluated. Of the 79 Blocks, 65 presently contain PRV positive finishing herds. The objective of this plan was to concentrate quarantined premises into the fewest number of blocks possible.

The first step was to prioritize the blocks available and determine which were the most and least suitable to have positive concentrations of animals. Criteria used to determine each block's priority were:

1. Areas of lowest sow farm concentration (minimize risk to breeding herds).
2. Positive finishing space already present (minimize movements needed).
3. Available/usable finishing space (sites to place quarantined swine moved out of other areas).

A five hour drafting session was then held during which each producer was given a map of all his premises and their PRV status. The producers went through their maps evaluating their positive and negative available spaces block by block. By trading their positive farms in less infected areas for spaces in more suitable areas, the original 65 blocks (84% of the two county area) containing positive space were decreased to just 14 blocks (20% of the two county area). When fully implemented, these 14 blocks will contain 89% of the positive animals.

All producers not in attendance at the drafting session who were affected by this plan were solicited for their input and cooperation.

We are presently implementing this solution. The plan will cause an initial rise in the number of quarantined premises while newly established quarantined space is filled and the old positive space is emptied, cleaned and filled with clean pigs over the next six to seven months.

The overall benefits of this program to this point have been:

1. Ever increasing cooperation of the members of the industry to invest in and accomplish community minded animal health programs.
2. Concentration of risk into smaller, more manageable areas.
3. Concentration of prophylactic (preventative) vaccination, and more efficient use of area wide vaccination recommendations.
4. Concentration of 80% of quarantines from 89% of area to 20% of area.
5. Reduction in area spread of finishing floor breaks.
6. Education in finishing floor outbreaks.
NORTH CAROLINA PRODUCER'S INITIATIVE

7. Utilization of medical geography by North Carolina industry to solve our challenges.

ACKNOWLEDGEMENTS

We greatly appreciate the assistance of the North Carolina pork industry in their cooperation to help expedite the removal of pseudorabies from our state. Also, a special thanks to the North Carolina Department of Agriculture, Statistics Division and Veterinary Services staff.
NEBRASKA DOWN-THE-ROAD TESTING PROGRAM
ON-FARM TESTING

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To analyze Nebraska's current pseudorabies surveillance program, it is necessary to review the evaluation of the program considering the intent of the Nebraska swine industry and ethic of how PRV eradication should be implemented and enforced.

Early on, the collective goal of the swine industry and the Bureau was to move toward PRV eradication as quickly as possible with as little disruption to the industry as possible. Although those phrases seem to be contradictory, we believe we have been successful in that regard. We have always tried to keep in mind the impact regulation would have on the producer, auction market, and others involved in the swine industry.

Overhead #1 - Nebraska Down-the-Road Testing

Summary of Events

Nebraska's PRV Program

October, 1987 ................. PRV law became effective
- Breeding swine to be tested or qualified negative
- Quarantine rules

January, 1989
- Feeder pigs
  - Tested or monitored

October, 1990 ................. Down-the-road testing began

October, 1992 ................. Completion of assessment period
- 700 herds were found to be infected

March, 1993 -
June, 1993 ................. Surveillance I (2,482 herds selected)

November 1, 1993 -
June, 1994 ................. Surveillance II (2,791 herds selected)

Nebraska's current PRV on-farm surveillance program evolved following the two-year assessment program. Assessment was the term we used to designate the period of time during which all herds were required to be tested for pseudorabies. We used the monitoring requirements for testing these herds and the testing was done at the producer's expense.
The assessment occurred between October, 1990, and October, 1992. Some stragglers did not meet that deadline; however, all herds were tested or qualified for depopulation by March of 1993.

This assessment testing enabled us to do an accurate job of finding infected herds and to begin the job of cleaning up infection. Because of that testing, we are now able to submit a proposal for an area of Nebraska to be considered for Stage III classification.

Overhead #2 – Proposed Stage III (Map)

We had believed that after the assessment period, we would be able to move to slaughter surveillance. However, because of the large number of quarantined herds and the large amount of pseudorabies vaccine being used, especially in northeast Nebraska, we concluded that surveillance by down-the-road testing would be more feasible for our state. As we began to develop the program, we soon realized that the program standards were more appropriate for slaughter surveillance than for on-farm testing. As we worked with our AVIC and regional epidemiologist, we determined that by placing emphasis on surveillance of herds rather than on a percent of breeding swine, we would alleviate the problem we were having in making the numbers fit the program standards.
As we developed an on-farm testing plan, we were encouraged by swine officials to submit a proposal to the program standards subcommittee for their review. We did, and some of the proposed changes that you see in the program standards regarding surveillance is a reflection of that proposal.

We want to thank the subcommittee for hearing our proposal and we congratulate them on keeping the PRV program standards flexible enough that changes can be made on a timely basis to meet the ever changing needs of the pseudorabies eradication program.

Our surveillance is very simple. All herds which have not had a statistical sample (equal to or greater than a monitoring sample) tested in the previous 12 months are eliminated from the pool from which on-farm surveillance herds will be selected. Feeding herds are also included in the surveillance pool.

Sixty to sixty-five percent of the herds in Nebraska in both the Stage II and Stage III areas have been tested for pseudorabies during the previous year. Our plan is to annually select one-half of the untested herds in the Stage II area and one-third in the Stage III area for surveillance testing. We have also proposed that testing a 95/20 random sample per segregated group gives an adequate level of confidence in finding infected herds. By reducing the number of animals tested per herd, we are able to test more herds with the same level of funding.

Some time after northeast Nebraska is eligible for Stage III status, we should be able to move towards slaughter surveillance. We estimate that time should be in 1996.

Overhead #6 – PRV Quarantined Herds Issued and Released By Quarter (Bar graph)
If we could be so optimistic as to believe that the decline in quarantined herds will follow the current straight line trend, we could be applying for Stage III for northeast Nebraska as soon as a year from now.
It has long been recognized that nonhuman primates (NHPs) can carry and transmit diseases to human contacts. Indeed, because of the phylogenetic closeness, a great many human pathogens can be transmitted to and studied in nonhuman primates far better than in any other species. This has led to a great demand for nonhuman primates in research, and has contributed to the establishment of captive breeding centers where many of the species which are suffering loss of natural habitat are preserved and propagated.

At present, many NHPs in the United States are wild-caught, rather than captive-bred. The speed and efficiency of modern transportation systems allows wild-caught NHPs to arrive in the United States only a few weeks after capture. Many of these animals are from areas where infectious agents not frequently encountered in the United States are found. For example, some species may be asymptptomatically infected with viruses that are highly pathogenic for humans, such as herpes B virus. In addition, NHPs may be exposed to human-origin infectious agents such as tuberculosis, shigellosis, and cholera while still in their country of origin. Although numerous diseases pass readily between man and nonhuman primates, this paper will focus on three: *Herpesvirus simiae* (also known as "Herpes B" or "monkey B virus"), tuberculosis, and the filoviruses, which are rare viruses known to cause rapidly fatal hemorrhagic fevers in man, rhesus, cynomolgous, and African Green monkeys.

Role of the CDC's Division of Quarantine

Although regulation of nonhuman primate importation activities was first prescribed in 1948, the Division of Quarantine (DQ) has recently assumed an increasingly important role in regulating the importation and quarantine of NHPs in order to prevent the introduction and transmission of serious human pathogens. This role has required restricting the uses for which NHPs may be imported. In particular, it has necessitated the implementation of a special permit process for importation of rhesus, cynomolgous, and African green monkeys; the registration of approved
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quarantine facilities; the inspection of arriving shipments of these NHP species at ports of entry into the United States; and the supervision of post-inspection quarantine procedures.

Prior to 1975, regulation of NHPs from endemic or epidemic yellow fever areas was of primary concern. In 1975, regulations were promulgated to address emerging concerns regarding rare hemorrhagic fevers, tuberculosis, and other zoonotic diseases of new or resurgent importance. Since 1975, importers of nonhuman primates must be registered with CDC, and are required to report the presumptive or confirmed diagnosis of specific diseases of potential public health importance to CDC within 24 hours of recognition.

The Division of Quarantine maintains inspectors at 8 major ports of entry into the U.S.; these approximately 40 inspectors are charged with inspecting immigrants and refugees, dogs, cats, turtles, etiologic agents, and human remains upon their arrival at a port of entry, as well as nonhuman primates. All other nondomestic species of animals are inspected by US Fish and Wildlife inspectors only.

Filovirus in Quarantined Cynomolgous Monkeys (1989/1990)

The imported filovirus events of 1989–90 amply demonstrated the need for these regulations.1 Four separate shipments of monkeys from the Philippines to an East Coast laboratory animal facility experienced outbreaks of acutely fatal hemorrhagic fevers, were found to be infected with filovirus, and had to be destroyed using Biohazard Level 4 (maximum) containment techniques because aerosol transmission was apparently occurring. Rigorous disinfection procedures (including formaldehyde fumigation) were necessary.

The outbreak was originally thought to be caused by Ebola virus, a closely–related rare hemorrhagic fever virus known to have caused two human disease outbreaks in Africa with associated mortality rates of 70%–90%.1 By late 1990 it was apparent that this particular strain was not pathogenic for humans, but the investigation amply demonstrated the potential for the importation and rapid spread of such diseases.1

To address this, specific disease control requirements, including requirements for the handling of all primates during transit were added to 1975 regulations.1 It was at this point that a special permit procedure for the importation of three of the most common research primate species (rhesus, cynomolgous, and African green monkeys) was instituted.

Transportation requirements

The 1975 regulations affected air carriers in that: a) cargo shipments could only be accepted from registered importers and b) individuals could no longer import primates for use as pets.

Since then, only occasional animals have had to be seized by
inspectors at ports of entry, generally from private citizens who are unaware of these regulations. There were and are, of course, other agencies and regulations which address species preservation, animal welfare, and transport (IATA, USDA, USF&W, CITES, etc.)

Guidelines which were developed early in the filovirus investigation emphasized the importance of safe handling of primates during transit, including the containment of potential contamination, protection of other cargo, provision of training and protective clothing for transport workers, limitation of personnel access to the animals, and expeditious clearance and transfer processes. These measures are consistent with, and supplement, the existing International Air Transport Association (IATA) standards and other regulations. Although CDC communicated with IATA during the investigation and upon requiring implementation of updated guidelines, the responsibility for verifying arrangements for compliance has necessarily remained with the registered importers.

Surveillance (1990 – present): Imported Tuberculosis

In the course of the filovirus investigation and subsequent to it, the Division of Quarantine has monitored the handling of approximately 250 arriving overseas shipments of nonhuman primates, involving over 43,000 individual animals. The vast majority of these shipments have been in substantial compliance with IATA and CDC requirements. When deficiencies have been identified, the importers and the air carriers have worked together to resolve the problems.

There have been 16 shipments within the past 3 years in which tuberculosis-positive animals have been identified, although there have been no reported outbreaks of other zoonotic diseases since 1990. One shipment became the subject of a CDC investigation during the fall of 1992 because of the failure of the tuberculin skin test to identify most of the infected animals during the quarantine period. This resulted in the spread of TB+ animals to facilities in six states.

One of the most disturbing discoveries to come out of the 1992 investigation was the general lack of federal and/or state agency oversight for disease surveillance and control in nonhuman primates. Had it not been for cooperative voluntary reporting by import facilities to the Division of Quarantine, there would have been no way for CDC to know about the existence of any of these cases, because at the time no other agency required routine reporting of all TB test results, or of confirmed TB disease in nonhuman primates.

The American Association for Accreditation of Laboratory Animal Care (AAALAC), which provides a voluntary accreditation process for laboratory facilities, requires at minimum annual TB testing of nonhuman primates. However, the USDA Official TB Test form is not used, and results are not reported to USDA or state authorities, even when necropsies are
performed and culture-confirmed cases are identified by the National Veterinary Services Laboratory at Ames, Iowa. CDC has only monitored TB skin tests and filovirus serology results during the initial 31-day quarantine period, and has not required further reporting. Many of the cases in this outbreak were identified months after release from quarantine.

How common are positive tuberculin skin test results in nonhuman primates? Susan K. Wells et al, reporting in the 1990 AAZV Proceedings, indicated that as many as 63% of orangutans may show positive skin test results. Although only 69% of the 249 orangutans in North American zoos had evidence of ever being tested for tuberculosis, 60% of TB+ animals reacted to mammalian tuberculin, and 66% reacted to avian tuberculin. In lab animal species, skin test reactors are euthanized; however, positive skin test reactions in individuals belonging to rare, valuable, and/or endangered species (e.g., zoo collections) presents a special case where treatment and long-term medical monitoring are an appropriate alternative. Although there are many problematic issues related to interpretation of TB skin tests, these numbers indicate that the prevalence of suspicious or positive tuberculin skin test reactions is high enough to warrant public health interest and actions.

Active surveillance for TB in nonhuman primates is needed. Funding is needed for research into the specificity and sensitivity of the various types and doses of tuberculin used for intradermal testing. The USDA continues to play an integral role due to their role in licensing and testing of the tuberculin products used, and their expertise in the intricacies of tuberculin skin testing, based on the extensive bovine TB eradication program.

A diagnosis of tuberculosis in any species, and on any premises, should be a reportable disease. Reportable to whom? Ideally, the information would go to a central point and be disseminated from there, but certainly CDC, USDA, and the state animal disease control authorities all need to be notified. Increased scrutiny of health certificates for interstate shipment of nonhuman primates is needed, with authority for trace-back investigation to the facility of origin. Compliance could be linked to USDA-accreditation status, with increased use of the permit process for interstate shipments.

So far, occasional lapses in procedure during transit are not known to have led to development of disease in humans, although skin test conversions indicative of mycobacterial exposure do occur infrequently. One employee at an import quarantine facility did convert to a positive TB skin test during 1991 and was placed on preventive therapy, following exposure to a group of TB+ cynomolgous monkeys.

**Herpesvirus simiae**

Of great potential concern is the almost universal infection of rhesus and cynomolgous monkeys with *Herpesvirus simiae*, also known as "Herpes B" or "monkey B virus". Although causing only mild disease in these
species, untreated infections in humans have been universally fatal in confirmed cases. Herpes B causes an ascending meningoencephalitis, very similar to rabies in its presentation. Exposure to the virus constitutes a major occupational hazard for animal handlers, both during and post–quarantine, and one for which there is no protective vaccine available. 4–10

In macaques, Herpes B is transmitted by bite wounds and by the venereal route. It causes superficial mucosal ulcers, similar to those caused by Herpes simplex 1 in humans. Approximately 90% of adults macaques have demonstrated seropositivity in a number of published studies. Although breeding colonies free of Herpes B are being established, at present the prevalence rate is so high that it must be assumed to be present in all macaques. Because of the extremely high prevalence, testing for Herpesvirus simiae has not been a part either of routine quarantine procedures or of testing prior to interstate shipment.

**Occupational health – Animal BioSafety Level 3**

Specific occupational health protection and routine surveillance measures are necessary recommended for anyone whose job requires direct contact with nonhuman primates. General recommendations include annual intradermal skin testing and biennial chest radiographs for tuberculosis, annual serum banking, the provision of and proper training in the use of appropriate protective clothing and equipment, and training in the potential risks of zoonotic diseases common to man and nonhuman primates.

All personnel whose jobs involve actual handling of macaque species should routinely use Animal Biosafety Level 3 precautions (latex gloves, dust/mist "respirator" face mask, face shield or goggles, disposable coveralls or lab coat, metal–reinforced leather gauntlet gloves for animal handlers, and chemical restraint of all macaques prior to physical handling of them).12 Because of Herpesvirus simiae, a special protocol for handling bite, scratch, or mucosal splash exposures should be in place at all facilities which house macaque species.

At present only one laboratory routinely cultures and isolates Herpesvirus simiae under an NIH grant. Facility protocols for macaque bite–exposure incidents should include provisions for sending human and animal specimens to the Southwest Foundation for Biomedical Research (512/674–1410), according to their established investigational protocols.13 In addition, Dr. Louisa Chapman, of CDC’s Division of Viral and Rickettsial Diseases, should be notified immediately at (404/639–3747) if neurologic symptoms develop.

**Proposed Regulations**

While recent inspections indicate that disease control practices in the industry are much improved, it is important to note that the emergency measures implemented in response to the filovirus events of 1989–90 were
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never intended for permanent application. CDC is developing proposed new regulations and technical standards for the importation of nonhuman primates which will serve to codify the practices that have evolved over the past 3 years through government and industry cooperation. In an effort to incorporate input from the importer community, the proposed technical standards were distributed for comment to registered importers and the American Association of Zoological Parks and Aquariums (AAZPA) in August, 1992. There will be another opportunity for input from a wider audience when the Notice of Proposed Rulemaking (NPRM) is published in the Federal Register.

Conclusions

Since 1987, tuberculosis, *Herpesvirus simiae*, and filovirus outbreaks have become recognized as serious public health issues associated with nonhuman primates. Traditionally, federal authorities have not required reporting of these diseases of nonhuman primates to USDA or to state animal disease control officers, and CDC has only begun intensive monitoring of quarantined special permit species of NHPs since 1990. In this brief period, it has become apparent that serious diseases transmissible to man may be present at high rates in individual shipments of imported NHPs, that the intradermal tuberculin test method is not adequately sensitive or specific, that interstate shipment of potentially infectious animals is not well-controlled.

Although there are numerous potential public health risks associated with the importation of nonhuman primates, they can be imported, transported, and handled safely when all parties involved follow the recently established standards for worker protection and containment of potential pathogens. The Division of Quarantine is deeply appreciative of the constructive working relationship that we presently enjoy with the current 45 registered importers (including 8 zoos), 11 special permit quarantine facilities, the commercial air carriers, and the other federal agencies involved. I thank you for the opportunity to participate in this meeting, and I look forward to working with our sister agencies in the federal government, the state animal disease control agencies, and other public health authorities on future nonhuman primate disease control issues.

REFERENCES

4. Wells SK, Sargent EL, Andrews ME. Tuberculosis and


ASSESSING POTENTIAL RISKS TO ANIMALS AT HAZARDOUS WASTE SITES
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INTRODUCTION

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) establishes the national program for responding to releases, or threatened releases, of hazardous substances that may endanger human health or the environment. The National Oil and Hazardous Substance Pollution Contingency Plan (NCP) establishes the overall framework for implementing CERCLA by outlining the process for developing and evaluating appropriate response actions for Superfund sites. The mandate of the Superfund program is to protect human health and the environment (including domestic animals and wildlife) from current and potential threats posed by uncontrolled hazardous substance releases.

Because the distribution of hazardous waste sites is somewhat ubiquitous (e.g. may be located in rural, urban, and National Parks), it is not unusual that animals may potentially be impacted from releases of hazardous substances. Institutional controls (e.g., zoning regulations, deed restrictions, fences, or prohibition of domestic water use) may prevent human exposures to potential toxic chemicals found at hazardous waste sites, such controls may be ineffective in preventing exposures to animals.

The U.S. Environmental Protection Agency (EPA) has developed risk assessment guidance that clearly outlines the procedures to address public health concerns (EPA 1989a); however, similar guidance for environmental (ecological) assessments is still in the formative stages (EPA 1989b; EPA 1992a,b,c). Although there are some similarities to human health risk assessments, ecological risk assessments, because of their nature, must consider exposure of populations, communities, and ecosystems to chemical and nonchemical stresses acting individually or in combination (EPA 1992a). Ecological systems can be very complex and their interactions with anthropogenic and natural stress can present unique challenges for risk assessors. Because the guidance for ecological risk assessments is less developed than that for humans, the risk assessor frequently must develop alternative procedures, based on established human health risk assessment techniques, to estimate potential hazards to nonhuman receptors. Described below is a general approach used for assessing potential risks to animals. For the purpose of this paper, the term "ecological risk assessment" will be used to identify the approach.
ECOLOGICAL RISK ASSESSMENT

Qualitative and quantitative methodologies can be employed to assess potential risks to animals from chemicals associated with hazardous waste sites. The methods described below are in context of performing a baseline risk assessment for nonhuman receptors as part of the remedial investigation phase of a Superfund site assessment; however, these same techniques could be used outside of the Superfund process. The term "baseline" implies the estimation of potential risks on the basis of current conditions at the site. The major components of an ecological risk assessment include the following; conceptual site model, assessment and measurement endpoints, chemicals of concern and toxicological profiles, exposure assessment, and risk characterization.

Conceptual Site Model

The formulation of a site conceptual model on the basis of existing data is one of the initial steps in performing an ecological risk assessment. A thorough characterization of the physical, chemical and biological nature of the site is necessary to complete the site conceptual model. The site conceptual model identifies all potential or suspected sources of contamination, types and concentrations of contaminants detected at the site, potentially contaminated media (e.g., soil, surface water, sediment), and potential exposure pathways, including receptors (Figure 1). Frequently, the site conceptual model identifies data gaps that must be addressed before the risk assessment can progress.

Assessment and Measurement Endpoints

The purpose of ecological risk assessment is to provide input to the decision making process regarding hazardous waste sites. Thus, the results of the ecological risk assessment that best fulfill the input needs to the decision making process are the descriptions of the relationship of the pollutants to the ecological endpoints selected for evaluation. Two major classifications of endpoints are frequently utilized; assessment endpoints and measurement endpoints (EPA 1989c). A brief discussion of ecological endpoints is provided below. Several EPA documents (EPA 1989b,c; EPA 1992a,b,c) have more detailed presentations.

Assessment endpoints are defined as the formal expressions of the actual environmental values that are to be protected. They are the environmental characteristics, which, if found to be significantly affected, would indicate a need for remediation (i.e., clean-up). Assessment endpoints must be valued and of such a nature to be objectively assessed. Characteristics of good assessment endpoints include the following; social relevance, biological relevance, unambiguous operational definition, measurable or predictable, susceptible to the hazard being evaluated, and...
Examples of potential assessment endpoints as related to animal health would include possible population effects, specifically, extinction, abundance, yield/production, age/size class structure, and massive mortality (EPA 1989c).

A measurement endpoint is defined as a quantitative expression of an observed or measured effect of the hazard; it is a measurable environmental characteristic that is related to the valued characteristic chosen as an assessment endpoint. Occasionally, the measurement endpoint may be the same as the assessment endpoint (EPA 1989c). Measurement endpoints can be quantified in the field or laboratory. Field measurements collected from monitoring or survey programs indicate what effects are occurring on a hazardous waste site. Measurements obtained from laboratory studies can be used to predict field effects or to provide evidence of causality for observed field effects.

Characteristics of good measurement endpoints include the following; corresponds to or is predictive of an assessment endpoint, readily measured, appropriate to the scale of the hazardous waste site, appropriate to the exposure pathway, appropriate temporal dynamics, low natural variability, diagnostic, broadly applicable, standard, and existing data series (i.e., background levels, trends) (EPA 1989c).

Potential measurement endpoints for animal health evaluation may be classified by four major categories (individual, population, community, and ecosystem) and include the following: 1.) individual; death, growth, fecundity, overt clinical signs, biomarkers, tissue concentrations, and behavior; 2.) population; occurrence, abundance, age/size class structure, reproductive performance, yield/production, frequency of gross morbidity, and frequency of mass mortality; 3.) community; number of species, species evenness/domination, species diversity, pollution indices, community quality indices, and community type; and 4.) ecosystem; biomass, productivity, and nutrient dynamics. A full discussion of these endpoints is beyond the scope of this paper; however, the reader is referred to EPA 1989c and EPA 1992a,b, and c for more information.

**Chemicals of Concern and Toxicological Profiles**

Exiting analytical data are reviewed to select chemicals of concern for ecological evaluation. Criteria that may be considered when making the selection of chemicals include the following; relative toxicity to biota, persistence in the environment, exceedance of regulatory criteria, relative concentration to background, and bioaccumulative properties. Other site-specific criteria may be considered as well.

Profiles summarizing the known and potential toxicological properties of each of the chemicals of concern are prepared for use in the risk characterization phase of the risk assessment. The profiles are constructed
Exposure Assessment

The objective of the exposure assessment is to estimate the type and magnitude of exposure (intake) to the chemicals of concern at the site. The results of the exposure assessment are combined with chemical-specific toxicity criteria (toxicity endpoints) to characterize potential risks.

EPA defines exposure as "the contact of an organism with a chemical or physical agent" (EPA 1989a). The magnitude of the exposure is determined by estimating the amount of a chemical agent at biological exchange boundaries (i.e., the lungs, gut, skin) during a specified duration. Exposure assessment is the estimation (qualitative or quantitative) of the magnitude, frequency, duration, and route of exposure (EPA 1989a).

For human health risk assessments, EPA has established exposure factors (e.g., amount of fish consumed by average adult, amount of water consumed by children and adults, amount of soil ingested by children) and exposure equations to quantify exposure (EPA 1989a,d). However, for estimating exposure to animals, the risk assessor must search the literature or conduct field studies to identify appropriate parameters. Some of the parameters that are used in ecological exposure assessments include: bioconcentration factors (BCF), bioaccumulation factors (BAF), and biomagnification factors (BMF); dietary fractions of specific food items, assimilation and depuration rate constants; body weights; home and foraging ranges; and feeding rates. If species-specific exposure factors are not available, then surrogate species must be identified and factors extrapolated to represent the receptor (target animal) being evaluated.

Various models are frequently used to quantify exposure once the exposure concentrations have been determined and the exposure factors identified. Food web modeling can be used to estimate exposure to bioaccumulative chemicals (e.g., chlorinated hydrocarbon pesticides). On the basis of the site conceptual model, representative food webs can be constructed, as illustrated in Figure 2, and used with the appropriate parameters (BAF, BMF, dietary fractions, etc.) to estimate exposure. Food web models can be very complex, especially when top predators that feed from both terrestrial and aquatic ecosystems are involved.

For example, to estimate the dose to a receptor feeding solely from the terrestrial ecosystem, the following equation would be used:
Dose = SC(∑ F_j*BMF_j)+(F_soil))R

where:
Dose = daily dosage (mg/kg-bwt/day)
SC = soil concentration of chemical (mg/kg)
F_j = dietary fraction of the j^{th} prey (food) item (unitless)
BMF = biomagnification factor for the j^{th} prey item (unitless)
F_{soil} = dietary fraction of soil for the target animal (unitless)
R = feed rate for the target animal (kg/kg-bwt/day)

In addition to estimating dose, the tissue concentration of a specific chemical can be predicted for a receptor if a species/chemical-specific BMF exists. For example, to predict the tissue concentration (TC) of DDT in an American kestrel at a hazardous waste site having measured concentrations of DDT in soil, the DDT BMF for the American kestrel (preferably site-specific) is multiplied by the soil concentration (SC) of DDT (i.e., TC = BMF*SC).

Equilibrium partition models may be used to estimate concentrations of chemical contaminants in vegetation, meat, milk, and eggs. These models assume that the crops or livestock have bioaccumulated chemicals from the environment and exhibit equilibrium tissue concentrations in response to the levels of chemicals in the soil, feed, and/or water. Plants are known to bioaccumulate chemicals from the soil and through the roots from aqueous solutions (e.g., irrigation water). There is considerable evidence that bioaccumulated chemical residue levels vary across distinct plant tissues (e.g., reproductive tissue, leaves/stems, and roots/tubers). Equilibrium model equations can be set to estimate chemical concentration in edible portions of plants. Grazing animals at or near a hazardous waste site may bioaccumulate chemicals through direct ingestion of contaminated vegetation as well as through the consumption of contaminated surface water or ground water.

Complex food web and equilibrium partition models are continuously being developed and computerized to assist with site-specific quantitative exposure assessments for animals at or near hazardous waste sites. However, for these models to be effective, they must be carefully calibrated to site conditions and preferably validated with actual site or field data. Additionally, the uncertainty associated with these models, particularly the input parameters, must be characterized, including the likelihood or over- or underestimating exposure.
Risk Characterization

Risk characterization is the final phase of the ecological risk assessment process. At this phase, the likelihood of adverse ecological effects occurring as a result of exposure to contaminants are estimated and interpreted with respect to the assessment endpoints. The potential risks are discussed by considering the types and magnitude of effects estimated and, if appropriate, the spatial and temporal extent of the effects are also noted. Generally, risks are described as potential occurrences assuming no remediation (clean-up) is performed. When characterizing potential risk resulting from chemical exposure, the quotient method is frequently used.

The method commonly used is similar to the hazard quotient method used in human health risk assessment to characterize the potential noncarcinogenic health effects resulting from exposure. A hazard quotient (HQ) is calculated by comparing the estimated dose (exposure intake) of a specific chemical to a reference dose (RD) (generally considered a "safe" or benchmark level) for the same chemical (i.e., HQ = Dose/RD). An HQ greater than unity (one) indicates a potential risk on the bases of the exposure and toxicological assumptions.

The EPA has determined human reference doses (RfDs) for hundreds of chemicals (these values can be found in EPA's Integrated Risk Information System [IRIS] database); however, for wildlife and domestic animals, these values frequently must be derived from field and/or laboratory studies. Methods are being developed to establish reference doses for use in ecological assessments. Because good data are frequently lacking for the target animals of interest, laboratory data generated using surrogate animals species must be extrapolated. Such a process may result in great uncertainty in the final value.

HQs may also be determined by comparing either a measured or predicted tissue concentration for a particular receptor to a known or derived "acceptable tissue concentration" (a concentration, like a reference dose, that is considered to be without harmful health effects).

Because animal receptors are likely to be exposed to multiple chemical contaminants at a hazardous waste site, the risk characterization usually assumes chemical additivity to evaluate total chemical exposure. Cumulative potential risk is represented by a hazard index (HI) which is calculated by summing the individual chemical HQs for the receptor being evaluated. Like the HQ, an HI greater than unity indicates potential risk from the cumulative exposure.

Finally, the HQs and HIs are discussed in context with the assessment endpoints identified at the beginning of the ecological risk assessment. The findings of the ecological risk assessment are then used to make decisions regarding risk management, which in some cases may entail extensive clean-up of chemical contamination and/or control measures to minimize exposure (e.g., habitat management, preventing grazing).
The overall uncertainty associated with the risk assessment is analyzed and summarized at the conclusion of the risk characterization phase. The uncertainty may be described in qualitative and quantitative terms. The uncertainty analysis is very important and provides useful information on how the risk estimates are to be interpreted for risk management decisions.

SUMMARY

This paper has only touched the surface of ecological risk assessment. The process is very dynamic and new methods of assessment are being developed at a rapid pace. Unfortunately, standard or uniform guidance has not be clearly developed for assessing risk to animals as it has been for human health; therefore, extreme caution must be used when making exposure assumptions and characterizing risks.

REFERENCES


Figure 1
Hazardous Waste Site Conceptual Model for Biota Receptors

Prepared by: Ebasco Services Incorporated
Epidemiology and risk assessment are both important disciplines which include well established techniques to assess risks. Each of these disciplines is valuable and effective. However, epidemiology and risk assessment have different purposes and different approaches to the assessment of risks.

Epidemiology is an important scientific discipline. The field of epidemiology encompasses multiple application areas and utilizes many different epidemiologic methods and techniques. In addition, it is an integrative science. It integrates and uses knowledge and techniques from other scientific, medical, and mathematical disciplines. Epidemiology utilizes information and/or techniques from many disciplines including the biological sciences (i.e. ecology), clinical medicine, preventive medicine, logic, and statistics. Epidemiology incorporates unique epidemiologic methods with components of these widely divergent fields of knowledge into one discipline. It utilizes specific epidemiologic methods to collect and evaluate information about populations. Some of these important epidemiologic methods are designed and used to estimate risks for individuals and populations.

Risk assessment is an applied scientific field. The discipline of risk assessment originated from the need to organize and interpret scientific data and information to make well informed management decisions. The use of risk assessment is driven by this need to make informed and timely management decisions. Appropriate decisions for managerial action or inaction in both industry and government regulatory activities must be made on a regular basis. Frequently these decisions must be made despite quite limited scientific data and information. Risk assessment can be effectively employed to interpret the available scientific data and information, incorporate professional and/or scientific assumptions where information is unavailable, and integrate and translate the information and professional judgement into detailed estimates of risks.

Epidemiology

Epidemiology is the study and practice of population medicine or medical ecology. Epidemiology has been defined as "the study of the distribution and determinants of diseases ... in ... populations." The following working description of epidemiology was provided by Ronald Smith: "Epidemiology may thus be considered as the study of health and disease
The scientific field of epidemiology includes various application areas and related approaches. These include preventive medicine and herd health, medical ecology, descriptive and analytic epidemiology, investigational (or etiological) epidemiology, and clinical (experimental) epidemiology. Many of the results of epidemiologic activities and studies provide information about the health and disease status of populations, indicate and implement appropriate disease control and health maintenance programs, determine associations and causes for disease events, establish the efficacy of treatment regimes, and estimate various risks to individuals within populations.

Epidemiologic methods estimate risk by gathering and analyzing data from populations. The data are collected through the use of well designed epidemiologic studies. Data may be gathered and analyzed to determine the prevalence and/or incidence of diseases in populations and subpopulations. It may also be obtained to explore potential risk factors and risks to populations. This type of information is valuable in determining potential associations between diseases and causal factors, predicting risk within populations, and in preventive medicine or herd health efforts.

Epidemiologists commonly employ several types of risk estimation methods including Relative Risk, Odds Ratios, and Attributable Risk. All of these epidemiologic methods for estimating risk require the collection and analysis of data from study populations. The Incidence of a condition expresses the risk of acquiring the condition (becoming a case) during a specified period of time.

The Relative Risk may be calculated by first determining the incidence of a condition in a subpopulation exposed to a particular risk factor and the incidence of the condition in a subpopulation that was not exposed to the same risk factor. The Relative Risk is then calculated by dividing the incidence of the condition in the exposed persons or animals by the incidence of the condition in unexposed persons or animals. The Relative Risk provides a sense of the degree of the association between the risk factor and the condition.

In situations in which the incidence is unknown, another epidemiologic method must be used to approximate the Relative Risk. The Odds Ratio method is used to provide an approximate estimate of the Relative Risk when it is not possible to obtain the incidence of diseases or conditions in populations.

Attributable Risk is another effective epidemiologic method used in the estimation of risks. This method provides an estimate of the incidence of the diseases or conditions associated with the risk factor since any incidence related to other factors is removed from the estimate. The Attributable Risk is calculated by subtracting the incidence of the condition in the unexposed individuals from the incidence in the exposed individuals.
Attributable Risk may also be multiplied by the prevalence of the risk factor to calculate the Population Attributable Risk. This calculation indicates the portion of the disease or condition in the population related to the risk factor.

Epidemiologic methods include different methods to estimate risk directly from the measurements of diseases and conditions in populations. These methods are based on calculations performed on data that was collected from the study populations.

**Risk Assessment**

The discipline of risk assessment has evolved from the need to effectively evaluate and manage risk. Risk assessment has become well established in the United States. Risk assessment is a complex, formal process that organizes and interprets scientific information, including the acknowledgment and documentation of uncertainties; estimates the risk for specific scenarios; and presents findings in concise, organized formats to facilitate informed decision making. Thus, this formal scientific process provides a sound foundation for management decisions and for effective communication of the rationale for regulatory decisions to the interested parties.

The following definition of Risk Assessment was provided in the 1989 National Research Council of the National Academy of Sciences (NAS) book *Improving Risk Communication*:

"Risk Assessment: The characterization of potential adverse effects of exposures to hazards; includes estimates of risk and of uncertainties in measurements, analytical techniques, and interpretive models; quantitative risk assessment characterizes the risk in numerical representations."

Risk Assessment is the process of gathering, evaluating, and interpreting scientific data and information into detailed characterizations and estimations of risk. This is in contrast to the phase known as Risk Management which includes a consideration of the scientific risk assessment with information about social, economic, and political factors; the selection of an appropriate management option; and the implementation of the selected option.

In 1983, the NAS established that a risk assessment must include four definitive components. The four components of a risk assessment are: hazard identification; dose–response assessment (or hazard characterization); exposure assessment (or exposure characterization); and risk characterization.

Information is consistently incomplete when risk assessments are performed. This fact is recognized, accepted, and documented in risk assessments. Risk assessors and risk managers realize that available
information is not complete at any given point in time. New data and information is continuously developing. Decisions, however, must be made based upon the data and information available at the time of the decision. The great advantage of risk assessment is that it is a formal scientific process which can coalesce and interpret the available scientific information, incorporate reasonable scientific assumptions, and produce acceptable estimates of the risk. These estimates are frequently expressed as probability distribution estimates of risks.

Again, management decisions must be made. Decision making cannot be indefinitely delayed awaiting complete scientific information for specific concerns. Risk assessment is a formal system to interpret scientific information and related uncertainties into a useful form to inform decision makers of the risk for a specific risk scenario. It is used to facilitate informed decision making.

Risk assessments are performed for specifically described scenarios. Appropriate detailed scenarios related to specific potential hazards are developed. The scenarios are developed through the use of either one of two generally accepted risk assessment approaches. First, very specific and detailed narrative descriptions of appropriate scenarios may be developed to be assessed. Or, second, detailed scenario trees (with branches representing the possible events) may be developed for use in the risk assessment process.

Scientific information is obtained to permit estimates of the risk related to the hazard for each part of the scenario. This information may come from a variety of sources including the available scientific literature, past scientific studies, or newly conducted studies to acquire needed data. The information must be gathered, evaluated, and interpreted to estimate the risk. The risk must be estimated for each part or branch of the risk scenarios. Then these estimates are properly combined in the completed risk assessment estimates. As a result of incomplete information, it is necessary to incorporate appropriate scientific assumptions in one or more parts or branches of the risk scenarios. The inclusion of scientific assumptions does not discredit the resulting risk estimates. The use of scientific assumptions is an accepted practice in the field of risk assessment. The assumptions must be clearly stated and the uncertainties and unknowns are described and expressed in each of the risk estimates.

Following the completion of the hazard identification, dose–response assessment, and exposure assessment stages, complete characterizations of the risks are performed for the described scenarios. The risk characterizations and completed assessments include both estimates of the risk and of the associated uncertainties and unknowns.

The process of risk assessment should be a readily understandable process that is reflected in the resulting risk assessment documents. The
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Risk assessments should include complete references for the scientific data and information considered in the risk assessment, the methodology employed, and the assumptions incorporated in the assessment.

Risk assessment employs scientific information to estimate the risk related to specific hazard situations. It may provide risk estimates based on the interpretation of either previously available scientific data and information or a combination of formerly established and newly acquired data and information. By establishing and following reasonable professional guidelines for the use and development of assumptions for data limitations, risk assessors can develop reasonable estimates of risk for specific described scenarios despite the lack of complete information. As a result of the uncertainties related to the risk estimates, completed risk assessments often express the estimated risks in the form of probability distributions.

Conclusion

The use of scientific assumptions in risk assessment to overcome deficiencies in data and information is a key distinction between epidemiology and risk assessment. Epidemiology uses accepted epidemiologic methodology to acquire and analyze data to provide estimates of risk. These risk estimates are based on analytical interpretations of epidemiologic data. Epidemiologic estimates are based upon calculations on population data. In contrast, the process of risk assessment proceeds even without complete population data. It employs scientific assumptions to bridge the gap when information is incomplete.

Risk assessment is a systematic process that includes the development of appropriate, detailed risk scenarios. Estimates of the risk, and the attached uncertainties, must be made for each of the parts or branches of the risk scenarios. Together these risks are combined in the final risk characterization phase of each risk assessment. Thus, risk assessment provides assessments of population risks associated with specific hazards in described scenarios.

Although epidemiology includes the methodology for both prospective and retrospective studies, risk assessment is a prospective discipline. In addition, risk assessments are usually performed immediately, assuming the reasonable availability of appropriate data and information, rather than following the design and implementation of a study to gather new data as in an epidemiologic study. Further, the process of risk assessment is highly responsive to new information from diverse external sources. As new information develops, previously completed risk assessments can readily be modified to incorporate the new information and the updated risk estimates.

The disciplines of epidemiology and risk assessment both provide very useful estimates of risks. These two disciplines, however, use different techniques and methods to estimate risks and employ different reporting methods for risk estimates.
References


The Committee met at 1:30 pm in Room 12, Sahara Hotel, Las Vegas, NV, October 27, 1993. Dr. John New, University of Tennessee, convened the meeting. There were 21 people attending which included 9 Committee members. Dr. New read the Committee purpose and objectives, announced the resignation of Dr. Schwindaman as Vice Chairman, and explained how interested individuals could become members of the Committee.

Dr. Stephanie R. Ostrowski, Office of the Director, Division of Quarantine, National Center for Prevention Services, Centers for Disease Control and Prevention, Atlanta, GA, presented a paper titled "Recent Public Health Issues Associated with Imported Nonhuman Primates". The paper focussed on three agents: Herpesvirus simiae (also known as "Herpes B" or "monkey B virus"), tuberculosis, and filoviruses, which are viruses known to cause rapidly fatal hemorrhagic fevers in humans and nonhuman primates. Dr. Ostrowski's complete paper will be included in the Proceedings.

Dr. Kenneth R. Montgomery, Veterinary Medical Officer, USDA, APHIS, Veterinary Services, Ontario, CA, made a presentation titled "A Survey of California Dairies to Determine Awareness and Implementation of Quality Assurance and Residue Avoidance Plans". A statewide survey was conducted to measure awareness and implementation of residue avoidance plans and simultaneously, a modification of the national plan was developed to deal with the specific needs of the dairy industry in Southern CA. The dairy industry needed to know if deficiencies in responsible drug use and record keeping were occurring so they could be identified and corrected. The survey questionnaire also was designed to validate individual dairy performance in residue avoidance as well as serve as an educational tool. Two hundred and forty herds were randomly selected and a 46 item questionnaire administered, January–February, 1993. Questions dealt with the veterinarian's involvement in decisions on sick cow treatment, sources of advice on avoidance of residues (81% listed the veterinarian as the most
important source), and the dairyman's ability to discriminate between prescription and over-the-counter drugs. Only 53% of dairymen answered correctly when asked "What is required for you as a dairyman to use a drug in an extra label manner?". Extra label drug use not overseen by a veterinarian is a common source of residue violations. Only 67% chose the veterinarian when asked "Who determines the appropriate withdrawal time for extra label use?". This lack of knowledge about extra label drug use may have contributed to the higher rate of residue violations.

Of those surveyed, 27% had not heard of the national quality assurance plan and only 23% had established a valid veterinary-client-patient relationship. More dairymen were aware of the state plan but there appeared to be reluctance to adopt either plan. Other questions dealt with whether treatment records were kept on each sick cow (28% said no), whether the dairymen reviewed their animal treatment record keeping system with a veterinarian, and whether they were aware of and used drug residue (cow-side) screening tests. The survey may be repeated in a year or two but in the meantime, the information has been disseminated to industry, veterinary practitioners and other interested individuals and agencies. During the discussion following this presentation, the federal and state agencies that conducted the survey were commended for the educational component of the survey and the mutually beneficial cooperation of agencies that such a project fostered.

Dr. New provided information on the new AVMA Environmental Affairs Committee. The Committee is an ad hoc committee of the Executive Board and was established in November, 1992. It's objective is to address the veterinarian's role related to environmental interactions with animals, legislative, and regulatory issues associated with the environment, conservation, hazardous and toxic waste, and recycling. Members are appointed by the AVMA Executive Board and the Committee will have it's first meeting in December, 1993. Dr. Everett Macomber is the Committee chairman and staff support will be provided by Dr. Ann Schola Clark and Dr. Karen Wernette. Our USAHA Committee was encouraged to contact Dr. Clark (1-800-248-2862, est. 216) if we have issues or priorities that we would like the AVMA Committee to consider.

Dr. Stan Diesch, University of Minnesota, St. Paul, MN, announced that the VIII Congress of the International Society for Animal Hygiene will be held in St. Paul, MN, September 12-16, 1994. The title of the Congress is "Environmental and Management Systems for Total Animal Health Care in Agriculture". This is the first time that this Congress will be held in the U.S. and many abstracts from other countries have already been received. Abstracts should be submitted by December 15, 1993.

Dr. Fred M. Applehans, Ebasco Environmental, Denver, CO, gave an overview of ecological risk assessment in a presentation titled "Assessing Potential Risks to Animals at Hazardous Waste Sites". Guidance for
ecological risk assessments is less developed than that for humans so alternative procedures often have to be developed to estimate potential hazards to nonhuman receptors. Ecological risk assessment consists of several stages such as developing a conceptual site model, defining assessment and measurement endpoints, selecting chemicals of concern and toxicological profiles, conducting exposure assessment, and finally characterizing risk. Dr. Applehans' complete paper will be included in the Proceedings.

Following Dr. Applehans' presentation, there was a discussion of domestic animals as sentinels of lead poisoning in community environmental health investigations. Several examples were given that documented the role animals (such as dogs, cats and horses) can play as environmental monitors.

Dr. James Quigley, Assistant Commissioner and State Veterinarian, Georgia Department of Agriculture, Atlanta, GA, described events that lead to a project to evaluate the risk to human health from prairie dogs being sold as pets. A new strain of hantavirus was identified in the Southwest earlier this year. Rodents, especially deer mice, are apparently the reservoir. Since human infection with this new strain can result in serious illness and death, and since deer mice may share burrows with prairie dogs, concern was expressed that prairie dogs coming into Georgia in the pet trade may represent a risk to human health. The association of plague and prairie dogs was an additional reason for concern. These concerns resulted in a ban on the sale of prairie dogs. About 400 prairie dogs entered the state of which approximately 100 were tested for hantavirus and plague. Although no evidence of infection by these two agents was found in the prairie dogs tested, the experience resulted in a heightened awareness as to the vulnerability to spread of disease, and damage to the state's ecosystem even from the most unlikely sources. The experience also illustrated the need for multiple agencies to cooperate when such health concerns develop. The situation has resulted in at least one cooperative agreement and importation restrictions (a wildlife permit costing $236 per year and proper habitat must be provided by persons wanting to keep prairie dogs as pets).

"Epidemiology versus Risk Assessment" was presented by Dr. Tari P. Kindred, Science and Technology Program, Food Safety and Inspection Service, USDA, Washington, D.C. Epidemiology and risk assessment are both important disciplines which include well established techniques to assess risks. Each of these disciplines is valuable and effective. However, epidemiology and risk assessment have different purposes and different approaches to the assessment of risks. Dr. Kindred's complete paper will be included in the Proceedings.

During the business meeting, there was a discussion of the continuing problem (potential risk to human and animal health) of wild animals kept as pets. Nonhuman primates (NHP) are a continuing risk to...
owners who keep them as pets and the situation regarding prairie dogs could happen in any state. Consequently, the Committee reaffirmed its support of other human and animal health agencies that strongly discourage the keeping of wild animals as pets.

The Committee felt there was a need for a national surveillance system for tuberculosis in NHP based on the reporting of skin test results and reactions, as well as necropsy and ancillary test results. A resolution was sent forward from the Committee.

The Committee made the following recommendation.

RECOMMENDATION: That the United States Animal Health Association endorse the VIII Congress on Animal Hygiene of the International Society of Animal Hygiene that will be held in St. Paul, Minnesota, September 12–16, 1994. This Congress is being organized in the United States for the first time. Its emphasis is on environmental and management systems for total animal health care in agriculture.

Old business consisted of a discussion of items recommended at last year's meeting. We had recommended that because of the potential seriousness of swine cysticercosis, USDA should initiate or develop a protocol or procedure to report cases of swine cysticercosis to an appropriate agency for follow-up when infected carcasses are detected. Dr. New will contact the chairman of the Cysticercosis Subcommittee to discuss issues and potential speakers for next year's meeting. Dr. New will also contact the USAHA President and the chairmen of selected committees to discuss similarities of committee purposes and objectives and the feasibility of merging committees.

The meeting was adjourned at 5:24 pm.
INTRODUCTION

In order to understand Hawaii's rabies quarantine program, although it is rarely understood or appreciated by people other than residents of Hawaii, a brief description of its evolution is necessary.

The rabies quarantine system was originally recommended for Hawaii in 1905. It was the year that the Division of Animal Industry was created in the Territorial Board of Agriculture and Forestry. The Board appointed Dr. Victor A. Norgaard, a former pathologist with the Federal Bureau of Animal Industry as the first Territorial Veterinarian and Director of the Division. Dr. Norgaard's first assignment was to survey the animal health problems in the islands and to make recommendations for action programs. In reporting the results of his survey to the Board, Dr. Norgaard called attention to the fact that rabies had not yet been introduced into Hawaii and recommended that this fortunate circumstance be protected by establishing a quarantine on imported dogs and cats. The Board failed to take action at that time because the board members did not recognize rabies as a major health problem, having had no experience with the disease.

It was in late 1911 when the need for a rabies quarantine was finally recognized. Dr. Norgaard had been pressing for action since receipt of the Bureau of Animal Industry report for 1909 which contained an article of the nature, cause and prevalence of rabies by Dr. John R. Mohler. Mohler pointed out that up to 1889 rabies was rare in the United States except in Pennsylvania and Massachusetts, and that it was unknown west of the Rockies.

In 1900, rabies made its first appearance in Montana, Wyoming and Colorado; by 1909 it had been diagnosed in all states except Idaho, Utah, Nevada, and Oregon, according to Mohler. When Norgaard reported that the State Veterinarian of California had declared rabies to be enzootic in southern California after a series of outbreaks in Pasadena and Los Angeles, the board finally took action. Hawaii's rabies quarantine law became effective on March 1, 1912.

To illustrate the unpopularity of Hawaii's quarantine law, in Dr. Norgaard's report to the Board of Agriculture and Forestry in 1912, after nine months experience with the then new quarantine regulation, he stated, "The stringent regulation requiring the absolute segregation in quarantine of all dogs and cats for 120 days before admission to the territory, has proven the most annoying problem the division has had to deal with so far,..." His statement 81 years ago is still accurate.

Since its inception, the law has been debated, criticized, and has
been a constant target for change by those who wish to import pets into Hawaii and by those who advocate other methods of rabies prevention. The position of our present administration and of past administrations is stated by our Governor in a letter to a navy admiral who was determined to have quarantine abolished. The Governor wrote, "Hawaii has the special distinction of being the only rabies-free state in the nation (never having a case of rabies), and our rabies quarantine program has permitted us to live in our islands without fear of this dread disease. Although we share your concern for pet owners separated from their pets, we cannot alter existing public health safeguards without scientific corroboration and a commitment to cost reductions on the part of the local taxpayers."

Hawaii's government through several administrations has been consistent in saying that alternatives to the 120–day quarantine are acceptable under the following conditions: that such alternatives can maintain our rabies-free status, there is scientific corroboration, and we do not incur additional costs to the local taxpayer.

The serosurvey described here was undertaken at the recommendations of Dr. George Beran from ISU. Dr. Beran recommended to the 1991 Session of the Hawaii State Legislature that such a survey was necessary as a precursor to any change in the existing quarantine system.

A serological survey of quarantined pets, and mongooses, in Hawaii using the rabies rapid fluorescent focus inhibition test (RFFIT) was conducted through 1991 and 1992. The survey, funded by the Hawaii State Legislature was conducted to determine:

1. The prevalence of antibodies in local wild animals (mongooses) to the rabies virus and/or cross-reacting viruses.
2. The suitability of the RFFIT in determining immunity to the rabies virus for regulatory purposes on individual animals entering the State.
3. The level of immune status of animals entering the quarantine station.

The serosurvey was a joint project undertaken by the Hawaii Department of Agriculture, the Hawaii Department of Health, the University of Hawaii, the Rabies Laboratory at CDC, and Dr. George Beran of ISU. Drs. David Sasaki, Project Director and John Gooch, Serosurvey Coordinator are credited directly for the report itself. This paper has been extracted from the report submitted to the Hawaii Legislature on March 1992.

**Mongoose Serological Results**

714 mongoose sera were tested from the islands of Oahu, Hawaii and Maui. These islands were selected because of the location of major ports of entry on these islands. Of the seven major islands, Kauai and Lanai have no mongooses. All sera were negative for rabies antibodies with the following exceptions: 1. One specimen reacted at a 1:280 titer per CDC results.
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When an aliquot from the same animal was retested, it was found to be negative. Serum leakage occurred during this shipment and was so documented by CDC. Cross contamination of the mongoose specimen conceivably could have occurred from a positive dog or cat specimen.

2. One of the negative samples resubmitted in connection with the 1:280 reaction reported above was also a mongoose sample. It tested positive on the retest at 1:56. However, CDC noted that there was a mix-up between two adjacent specimens with the numbers on the marking tapes on the tubes and numbers written directly on the tubes. Since the mongoose specimen had originally tested negative and the adjacent sample was from a quarantined dog with a history of rabies vaccination, it was concluded that the numbers written directly on the tubes were the correct identifications.

3. Two other mongoose specimens reacted at titers of 1:11 and 1:5. This low reactivity was considered due to non-specific inhibitors. One sample had been in storage for 22 months and evaporation may have been a factor.

Support for the rationale used in resolving the questions raised by these positive mongoose specimens, specifically, would such results indicate that Hawaii's mongoose population is indeed infected with rabies?, is contained in an article written by R.H. Jacobson in the 1991 JAVMA (Reference 1). His article states that when a disease prevalence is low (or absent), a test having sensitivity of 99% and specificity of 99% is a poor predictor of infected animals. A positive test result in those circumstances will be wrong 91% of the time. In addition, all samples from the same area and surrounding areas were all negative.

In similar studies conducted in Grenada, where rabies is endemic in mongooses, as many as 40% of mongooses were found serologically positive utilizing RFFIT. The four positive samples identified in our study, in light of mechanical errors and probable non-specific inhibition are insufficient to conclude that Hawaii's large mongoose populations are infected with rabies. Based on this study, we did conclude that Hawaii's mongoose populations are indeed free of rabies.

Serological Results for Quarantined Pets

440 sera from quarantined pets were tested in this survey. The range of titers were from 0 to 34,800 with IU values from 0 to 556 IU per ml. Of the 440 sera, 33 tested negative. The significance of the titers can be appreciated when we understand that there is an expressed opinion of many rabies experts that 0.5 IU per ml. is highly protective against subsequent exposure to rabies.

Since a vaccination protocol has been advocated as an alternative to quarantine, the distribution of IU per ml. levels for pets with a vaccination history was compared with those of pets whose owners did not present evidence of vaccination. Of the pets with vaccinations records, a comparison
was made with pets vaccinated more than one month but less than twelve months before entry.

Of the 29 pets with no vaccination documentation, 1/4 were negative and in all likelihood were not vaccinated. Those with lower titers may have been due to vaccinations which were not reported or to non-specific test reactions. Those with titers greater than 0.5 IU per ml. were considered due to undocumented vaccinations.

Of the 386 vaccinated pets that responded immunologically, our findings were compared to those of Chomel et al. (Reference 2) who conducted a serosurvey on randomly selected dogs one year after a mass immunization campaign in Peru in 1985. Our findings were also compared to a monumental study of the duration of immunity in laboratory dogs by Sikes et al. (Reference 3) published in 1971. Comparisons to these two studies indicated that our findings were quite similar to their findings.

Determinants of Antibody Levels

A number of factors were analyzed to determine their relationships to antibody levels. These factors were:

1. Titers by time since last vaccination
2. Titers by species
3. Titers by U.S. or foreign origin
4. Titers by number of vaccinations
5. Titers by sex-spay-neuter status
6. Titers by route of vaccine administration
7. Titers by age group
8. Titers by presence or absence of . . parasites
9. Titers by type of vaccine
10. Titers by manufacturer of vaccine

Several factors examined, such as species, sex-spay-neuter status, and the presence of parasites showed a statistically significant relationship to antibody levels as measured by IU per ml. Other factors such as time since last vaccination did not show a significant relationship to antibody levels. To better elucidate the role and relative influence of various factors, the department may attempt multi-factor analysis at a later date with the advice and assistance of project consultants.

1. Titers by time since last vaccination

Since peak titers are reached by the end of the first month following vaccination (Reference 3), we conducted two analyses. The first dealt with antibody levels found during the first month post vaccination and the second dealt with levels for the longer post vaccination periods. There was a positive relationship between days since vaccination and the rising titers during the first month after vaccination and a negative relationship as titers fell during the rest of the study period.

The strength of these relationships were not statistically significant.
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since factors other than length of time since last vaccination must also be related to antibody levels.

2. Titers by Species

A comparison was made of the percentage distribution of antibody levels determined for 29 cats and 239 dogs which had been most recently vaccinated at least 1 month before their samples for testing were drawn. The distribution patterns were similar, although cats had a higher proportion of samples with higher titers. The distribution differences were statistically significant (p<.01) i.e., only 1 time out of 100 would such a difference be due to chance alone. However, some cat and dog samples showed a titer of less than 0.5 IU per ml., the "protective" level suggested by WHO.

3. Titers by U.S. or Foreign Origin

Serological results were available on 65 pets of foreign origin (including Guam) and 374 pets originating from the continental U.S. Documents indicated that 90.8% of the foreign origin pets and 92.7% of the U.S. origin pets were vaccinated. The distributions of IU per ml. titer levels appear quite similar and statistical analysis showed no significant difference. For both groups of pets it appears that about 10% had antibodies below 0.5 IU per ml.

4. Titers by Sex-Spay-Neuter Status

There were 266 pets that were serologically sampled that had been vaccinated more than 1 month prior to sampling and on which there was information on sex-spay-neuter status. The mean and median observations are quite different for the different sex groups, with neutered males and spayed females having the highest values. Upon analysis, the differences between sex groups are statistically significant (p<.02), meaning that only 2 times out of 100 would such a difference occur by chance alone. The data again demonstrates that some of each group except spayed females did not have detectable antibody as shown by titers of 0.0 IU per ml.

5. Titers by Presence or Absence of Parasites

It has been hypothesized that the presence of internal parasites can lessen the magnitude and shorten the length of the immune response to rabies vaccination (Reference 2). Of the 440 pets in the survey, internal parasites were found in 50 (11.4%). Thirty of the infestations were found in pets that had been vaccinated more than 1 month previously. The serological findings in those 30 pets are compared with the findings on 269 pets vaccinated more than 1 month prior which were parasite free. Those pets with parasites had lower mean and median titers than those for the pets that were free of parasites and the differences were statistically significant. To look at the effects of parasites on the duration of significant immunity levels, the titers by months since vaccination of 30 parasitized and 269 parasite-free pets have been studied by trend analysis. The trend line for the pets with parasites crossed the horizontal axis at about 11 months whereas the line for pets without parasites crosses at 40+ months. This
suggests that the parasite infestations may shorten the period of effective immunity.

**Epidemiological/Risk Analysis Questionnaire Results**

The following data was obtained from questionnaires sent to 465 pet owners in the statistical sample chosen for the survey. Response rate was 50%. The data included the following areas:

1. 12 month residence history
2. Neighborhood type
3. Presence of potential vectors in neighborhood
4. Total number of rabies vaccinations
5. History of fighting or playing with wild animals
6. History of bite from animal later found rabid
7. Presence of an unexplained wound or cut
8. History of pet missing for more than 24 hours
9. Pet on a lead or in a pen when outside
10. Pet inside at night
11. Pet used for hunting
12. History of foreign travel

Data from these questionnaires were compared to data from a similar analysis on U.S. dogs and cats dying of rabies in 1988 (Reference 4). Many differences are apparent.

1. The median age of the animals contracting rabies was 1 year while the median age of quarantined pets was 3.6 years.
2. A high proportion of the quarantined pets had been neutered and a low proportion of rabies cases had been neutered.
3. A significant proportion of rabid dogs and cats were not owned.
4. Over 80% of the rabies cases lived in rural environment but only 7% of quarantined pets originated from rural areas.
5. Almost all quarantined pets had records to show that they had received veterinary care, whereas only 57% of the rabies cases had received veterinary care.
6. Almost all quarantined pets had records or serological evidence of vaccination. 62% of the rabies cases had never been vaccinated for rabies.
7. 88% of the rabies cases came from the 27 states reporting the greatest number of dog and cat rabies in 1988 and 1989, (Reference 3), whereas for quarantined pets 40% came from those same high-incidence states. The 1988 study identified the states to be in the mid and south Atlantic, north and south Central areas of the U.S.

From this comparison, it is apparent that the quarantined pets are not a high risk group for developing rabies. To say more than that is not possible with the data presently available. However, it should be pointed out that a very small risk associated with an individual pet, when multiplied by
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the 4,000 plus pets entering quarantine year after year can become large enough to become a risk of genuine concern.

Implications for the existing quarantine program

1. Vaccination rate of quarantine pets

   The vaccination rate of quarantined pets is very high. However, on entry, approximately 10% of the vaccinated pets did not demonstrate an antibody response that equalled the WHO stated level of 0.5 IU per ml. to indicate a protective titer.

   The data in this study showed that for over 50% of the pets, the most recent vaccination was given within 2 months preceding arrival in Hawaii. Such animals which were vaccinated for the first time may have only been resistant to rabies exposure for only a matter of days or weeks before arrival in Hawaii.

2. Significance of Antibody levels in Quarantined Pets

   With the technology available at the time of this study, it was not possible to determine whether antibody levels demonstrated in quarantined pets were results from previous vaccination or incubating rabies from a previous exposure.

3. RFFIT

   The RFFIT is widely accepted and productively used in many situations. Our tabulations of antibody response in groups of vaccinated animals by time since last vaccination are remarkably similar to those reported by CDC and investigators in Peru. This is a testimony to the usefulness of the test for group studies.

   However, the wide variability within grouped data and in reported variations in titers of identical specimens tested on different days suggest that the test is not suited for precisely and reliably determining antibody levels in a single dog or cat on one test.

   Until further data is compiled, we do not believe that the RFFIT is suitable for regulatory purposes.

4. Risk Analysis Survey

   The risk analysis survey showed many differences between the quarantined pets and the 1988 rabies cases in U.S. dogs and cats. The quarantined pets are not a high risk population for the development of rabies. However, as a group, they are not without risk.

   Many originate from areas where wildlife rabies is endemic. Many neighborhoods of previous residences were reported to have wildlife vectors. Monoclonal antibody studies of rabies viruses isolated from recent mainland dog and cat cases have almost always shown the viruses to be typical of those isolated from wildlife reservoirs.

5. Research

   Little scientific research is reported on quarantine systems. Critics
of this study may be correct in their comments that the study could be better. However, we suggest that in the face of such criticism more research on this form of disease prevention should be encouraged.

6. **Length of Quarantine**

This study indicated that apparently there is a lack of understanding by owners and veterinarians of the reasons for the length of quarantine. The variability of the incubation period is not clearly understood and often confused with the period of time an infected animal is capable of transmitting the virus before death.

**Implications for Suggested Alternatives to Existing Quarantine**

1. **Economic Implications**

   At the time of the study, costs for conducting serological testing for individual animals as an alternative to quarantine was estimated at approximately $35 to $40 per test. This is exclusive of staff time to collect, prepare and ship specimens.

   Compared to quarantine costs, this alternative is acceptable from an economic perspective.

2. **Administrative and Operational Concerns**

   Some of the problems encountered during the study could be troublesome to a regulatory program which adopted the RFFIT as an alternative to quarantine. Some of the problems encountered in this study were:

   a. Lost specimens in a laboratory.
   b. Same animal identification number assigned to two different specimens in another laboratory.
   c. Labels switched between adjacent tubes in the project office.
   d. Tubes apparently switched once during testing in another laboratory.
   e. Recording and reporting errors.
   f. Tubes leaked during shipment. Some tubes empty upon arrival at laboratory. Cross-contamination of sera between tubes.

   If a system of serological testing, pre-entry vaccination requirements and health documentations were to be adopted as an alternative to quarantine, it must be realized that the delivery of instructions to cover all contingencies would be more complex than the single message that quarantine is required. From a regulatory standpoint, the more complex the instructions become, the greater possibility of frustration for the owners and the regulators. Cooperating parties such as air and sea carriers, other inspection agencies may also become frustrated if the regulations are too time consuming or burdensome. The resulting outcome would be a
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diminished effectiveness of a rabies prevention program.

3. **RFFIT Method**

The RFFIT results in this study were very useful in studying quarantine pets and local mongooses. However, test variability would seem to preclude use of the test to assess the immune status of individual animals for regulatory purposes. Test variability may be due to:

A. Biological Variations
   1. In the test system.
   2. In the animals whose sera are tested. However, further analysis is necessary to understand the variability due to age, sex, parasites, etc.

B. Temporal Variations
   1. Different results on identical samples tested on different days.

C. Test Measurement Errors

D. Variations due to administrative complexities including identification, labeling, specimen transfer, record keeping, and shipping of specimens.

4. **Antibody Levels**

Most of the pets surveyed had significant levels of antibodies, but as much as 10% of the pets had levels, on arrival below the 0.5 IU, the level suggested by WHO as the protective level.

**Summary**

It is our assessment that the survey results were very enlightening and helpful in many respects. However, it has also cast significant doubt about the suggested use of the RFFIT for regulatory purposes. The regulatory concerns included sample identification, processing and record keeping. Such problems could inhibit efficient, effective and equitable administration of a system based, in whole or in part, on serological testing.

From Hawaii's perspective in managing a regulatory program, a change from the existing quarantine system to an alternative system which may involve serological testing, vaccinations and documentation is the choice of the residents of Hawaii, either by their vote or by the action of their elected officials. Basic to this decision, it is the wish of the current administration that any alternative to quarantine:

1. Offer no less assurance in protecting our residents from rabies than quarantine.
2. Incur no additional cost to the residents of Hawaii.
3. Have scientific corroboration.

The decision to change must include objective scrutiny of scientific data as well as attention to regulatory concerns. Although the scientific arguments have become more sophisticated in the recent years, such arguments have often not addressed the regulatory concerns. Our state government is charged with the responsibility to detect and exclude the one animal which is incubating the disease. Serological testing has application
to group studies and has not satisfied the regulator in its capability to detect
the single incubating animal.

We are hopeful that further advances in the area of diagnostics will
allow us to change to an alternative system of rabies prevention. Until such
time, we concur with the recommendations of the 1992 Report of the Expert
Committee on Rabies of WHO which states in part:

"11.5 International transport of dogs and cats from rabies-infected
countries to rabies-free countries or areas"
"It is recommended that dogs and cats be quarantined at the country
of destination for 4-6 months in facilities approved and supervised
by the government veterinary service...."

REFERENCES

1. Jacobson, R.H.; How well do sero diagnostic tests predict the
campaign against rabies: Are dogs correctly protected? The
duration of immunity studies in dogs. JAVMA 1971;159:1491.
Epidemiologic factors, clinical findings, and vaccination status of
rabies in cats and dogs in the United States in 1988. JAVMA 1990,
197(2):201.
5. Hawaii Department of Agriculture: Rabies Serosurvey of
Quarantined Pets and Mongooses. Presented to the 16th State
REPORT OF THE COMMITTEE ON RABIES

Chairman: Dr. Nancy A. Frank, Lansing, MI
Vice Chairman: Dr. Robert E. Miller, Gaithersburg, MD

D.J. Briggs, KS; H.M. Chaddock, MI; D.S. Davis, TX; E.P. Gibbs, FL; K.N. Haffer, IA; S.K. Harris, IA; R.E. Hill, Jr., IA; O. James, MT; J.C. New, TN; C.E. Rupprecht, GA; L.H. Russell, TX; L. Swango, AL; J.C. Wright, AL

The Committee on Rabies met at 1:30 pm on Monday, October 25, 1993, in the King Tut Theater of the Sarah Hotel, Las Vegas, Nevada. Seven committee members and eleven guests were present.

Dr. Calvin W.S. Lum, Hawaii Department of Agriculture, gave a presentation entitled "Rabies Serosurvey of Quarantined Pets and Mongooses". This was a summary of a study done in Hawaii in 1991. Dr. Lum indicated that the 120 day quarantine program for pets entering Hawaii had periodically come under scrutiny since its inception in 1912. In 1990 there was enough controversy about the program that the Hawaii state legislature decided to fund a study to evaluate rabies and the quarantine program in Hawaii. The study looked at the prevalence of rabies antibodies in wild animals (i.e. mongooses), the suitability of RFFIT in determining immunity to rabies virus for regulatory purposes, and the level of immune status of animals entering the quarantine station. The results of the study indicated that Hawaii mongooses are free of rabies virus, that the RFFIT test does not appear reliable for regulatory use on individual animals, and that approximately 10% of imported pets with current vaccination histories did not have adequate antibody levels. As a result of this study, Hawaii is maintaining its quarantine program for imported animals.

Dr. Charles E. Rupprecht, Centers for Disease Control and Prevention, updated the committee on current activities at CDC involving rabies. CDC has been better defining its role in rabies prevention and control and developing a national strategy and specific goals. At a meeting in January 1993, four goals were outlined. These are: one, protect humans from rabies; two, minimize the economic consequences of rabies; three, prevent the spread of rabies; and four, eradicate rabies (i.e., eliminate rabies in areas where this can be done). A national steering committee has been formed incorporating a wide variety of governmental and industry groups.

Dr. Rupprecht presented an example of CDC's role in addressing rabies issues by briefly providing an overview of bat rabies and human mortality in the USA. CDC evaluation has shown that most indigenously acquired human rabies is from bats. In the most recent case (1993), an 11 year old girl in New York died from a disease eventually determined to be rabies. CDC was able to perform PCR analysis on formalinized tissue and identify a bat associated rabies DNA sequence. This was the first time such PCR analysis for rabies had been successfully performed on formalinized tissue. In further analyzing PCR results in cases of human rabies caused by
a bat rabies strain, CDC has found that the most common bat rabies strain is the silver haired bat strain. The silver haired bat is not a common bat and reasons for this strain of rabies being the prominent strain associated with human fatalities in the USA are unclear. CDC has several recommendations for preventing rabies related to bats. These are: increasing public education (i.e., do not handle ill wild animals); companion animal rabies vaccination, especially cats; pre–exposure vaccination for personnel at risk; prompt and proper post–exposure treatment; and bat–human interaction management. Dr. Rupprecht also reviewed CDC's role in oral rabies vaccine programs for wildlife.

Dr. Rick B. Hill, Jr., USDA, APHIS, BBEP reviewed the overall USDA biologics program. He also reviewed his division's role, focusing on the Consumer Reported Problems Program. He then summarized reports about rabies vaccines. Overall, the USDA Veterinary Biologics Program involves three divisions. These are Veterinary Biologics in Hyattsville, MD; Veterinary Biologics Field Operations in Ames, IA; and National Veterinary Services Laboratories also in Ames, IA. Dr. Hill is with Veterinary Biologics Field Operations. His division is responsible for compliance with standards, consumer reported problems, and product monitoring and information.

Dr. Hill reviewed the objectives and procedures for the Consumer Reported Problems Program. The program receives approximately 100 complaints per year. Between 1983 and 1993, 43% of complaints concerned bovine products, 21% concerned canine products, and 11% concerned feline products. Consumer reported problems are placed in one of four categories, namely, hypersensitivity; safety (systemic reaction, local reaction, tumor); efficacy; and other.

Dr. Hill next focused on rabies vaccines. There are currently eight manufacturers of rabies vaccines with 26 products licensed by USDA. In 1992, USDA released 248 serials and 41 million doses of rabies vaccine. There were 13 reactions reported to the Consumer Reported Problems Program. This is 0.3 reactions/million doses. Between 1983 and 1993, there were 92 reports with 49% of reports related to canine rabies vaccine, and 39% related to feline rabies vaccine. Other reports related to equine or bovine, or were from vaccination with multiple products. Of the 92 reports that were received, 58% were classified as hypersensitivity reactions, 24% related to safety (11% systemic reaction, 10% local reaction, 3% tumor), 17% related to efficacy, and 1% were other. Upon follow–up by Veterinary Biologics Field Operations, 25 reports were concluded to be product related. Eighty–four percent of these reports were classified as hypersensitivity problems. In comparing consumer reports of rabies vaccine problems with reports of all vaccine problems, hypersensitivity problems were substantially greater with rabies vaccine. Safety and efficacy problems were less for rabies vaccines compared with all vaccines.
Dr. Hill compared rabies vaccine problems reported to USDA with rabies vaccine problems reported to manufacturers. Manufacturers tended to receive more reports especially regarding local and systemic reactions. Dr. Hill stressed that it is difficult to validly analyze reported problems and interpret reaction rates because there is likely reporting bias, the number of reports is not large, there is a lack of baseline data, products may be inappropriately handled or used, and multiple products are often administered at the same time.

Dr. Hill concluded with a review of consumer reported problems regarding vaccine associated feline neoplasia. Clinically there appears to be about 1-2 cases per 10,000 vaccinations reported. It is not clear however, whether or not there really is an association between tumors and either rabies vaccine or feline leukemia vaccine. Unanswered questions include true incidence, relationship to multiple antigens, relationship to repeated vaccination, relationship to FELV/FIP status, and genetic predisposition. There is more study needed before any conclusions can be reached.

Dr. Robert Miller, USDA, APHIS, BBEP, gave the committee an update on the status of vaccinia vectored rabies vaccine for raccoons. He reviewed the history of the product including the field trials which have been done so far. At this point, the manufacturer has submitted the necessary data for licensing to USDA. USDA is in the process of evaluating the data. It is hoped that a licensing decision will be forthcoming within the next six months. If the product is licensed, it is expected that there will be some restrictions on the license. Dr. Miller also reviewed his agencies risk assessment procedure for biologics, focusing on the recombinant rabies vaccine product.

Dr. John Keller, Animal Health Division, Agriculture Canada, presented an update on rabies in Canada. He stressed that rabies control in Canada generally centers on an Ontario perspective. Currently he sees an Arctic focus and a New York focus in the Canadian rabies program. Historically, in the 1950's, Arctic fox rabies moved down into Ontario. In the 1920's and 1940's canine rabies moved in from New York through the Niagara Falls area. Dr. Keller foresees that raccoon rabies will follow the dog path and move into Ontario from New York through the Niagara Falls area. At this point raccoon rabies in New York has reached to within 28 km of the Canadian border.

Dr. Keller reviewed the history of rabies in Canada. The distribution of strains of rabies has been monitored using PCR technology. Rabies appears to peak in 2-4 year cycles. Natural cycles are affected on one hand by reforestation projects, and decreased trapping and hunting, and on the other hand by wildlife vaccination. The oral bait vaccination program for fox rabies in southeastern Ontario has been effective. There is currently a program being established to create a second vaccinated fox barrier.
Canada is preparing for raccoon rabies. The area where raccoon rabies is expected to enter is massively populated. It is hoped that a vaccinated raccoon barrier can be established. A task force has been formed to address the raccoon rabies problem if it occurs. Issues being considered are resources, communications, collaboration, and vaccination. Collaboration is being done both internally and with New York State. Internally, local rabies control procedures are being reviewed so any weak spots can be identified and addressed before a problem occurs. The vaccinia vectored rabies vaccine is undergoing scrutiny in Canada. There have been no Canadian trials at this point.

Dr. Dennis Slate, USDA, APHIS, ADC, reviewed Animal Damage Control functions and programs. He then focused on rabies control programs in New Hampshire and Vermont. In Vermont, the primary carriers of rabies are foxes and bats. A 1-800-4-RABIES program was established to help educate the public about rabies. In the first year of the program about 1200 calls were handled. About 29% of the calls concerned raccoon rabies even though raccoon strain rabies has not yet affected Vermont. In New Hampshire, ADC primarily functions cooperatively with the state wildlife division. The primary program concerns are with white tail deer and bears. In October 1992 raccoon strain rabies did enter New Hampshire. This has consumed considerable program time and resources responding to public concerns over rabies.

Dr. Slate reported on some preliminary analysis dealing with costs associated with responding to the raccoon and fox strain rabies in New Hampshire and Vermont, respectively. There are costs to both the public and private sectors. In New Hampshire, state agency costs to address rabies for one year were approximately $347,000 and federal agency costs were approximately $15,000. In Vermont, costs were approximately $278,000 for state agencies and $18,000 for federal agencies. In addition there were costs for pre-exposure immunization for persons at risk, immunization of domestic animals, and post-exposure treatment costs. There were also costs incurred to hire nuisance wildlife trappers to remove wild animals in conflict with humans. As another example, Dr. Slate presented rabies control costs for one small town (pop. 8,400): There were personnel costs of $1,600, mileage costs of $750, pre-exposure immunization costs of $2,000, and animal disposal costs of $660 for a total of about $5,000. This amount could substantially impact the budget of small communities. The costs for controlling rabies can be substantial especially in areas affected by raccoon strain rabies. Further study will be needed to fully elucidate these costs.

Following the presentations, a business meeting was held. There were suggestions made for topics to cover at next year's meeting. Two resolutions were proposed and passed.

The meeting ended at approximately 5:10 pm.
RABIES

Dr. Calvin W.S. Lum's paper "Rabies Serosurvey of Quarantined Pets and Mongooses", was previously presented to U.S.A.H.A. for inclusion in the Proceedings.
HOW COMMON IS SALMONELLA ON DAIRIES?

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Acknowledgements: Serotyping of Salmonella was performed by the National Veterinary Services Laboratory, Ames, Iowa.
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Cows which maintain persistent IgG titers against Salmonella LPS are considered to be carriers.1-4 Vaccination titers can be differentiated from titers associated with persistent infection by performing 2 titers at 60 day intervals.1-3 Many S. dublin carrier cows which remained seropositive only shed Salmonella in feces 3 to 4% of the time,12 leading to the conclusion that culture may underestimate the prevalence of carriers and of infected dairies. A previous localized study of Salmonella prevalence on California dairies using environmental culture techniques found a 16% prevalence.5 We designed a study to examine the prevalence of Salmonella infected dairies based on both culture and serology.6 We assumed that a seropositive result on a dairy which did not vaccinate with Salmonella was due to recent exposure to Salmonella, and that persistently elevated titers on dairies which did vaccinate against Salmonella were due to carrier animals, since vaccination titers fall off rapidly.1-3

We studied 25,155 cows on 60 dairies. Milk samples from 439 (1.75%) of these were positive by ELISA for antibodies to antigen containing group B, C1 and D1 LPS. Of these, 251 were from dairies which did not vaccinate against Salmonella. Of the 439 seropositive cows, 395 cows were available for follow-up study. Of these 385 cows, 307 (70%) were positive on the first serum sample taken. Of these cows, 276 cows were available for follow-up serum titer following 60 days or more, and 237 cows (86%) were still positive (indicating carrier status).6...

Sixty-eight percent of all dairies had 1 or more persistently seropositive carrier cows, and 78% of dairies which vaccinated had persistently seropositive carrier cows. Using the criteria that any seropositive cow on a nonvaccinated dairy indicated exposure to Salmonella (24 dairies), and that persistently seropositive carrier cows on vaccinated dairies indicated exposure to Salmonella (21 dairies), 75% (45 of 60) of all dairies were found to have evidence of recent Salmonella exposure.

A total of 7 isolates of Salmonella were recovered from 7 of the 60 (11%) dairies. Five of the isolates came from the hospital pen for sick cows and 2 came from calf pens. Serotypes recovered included 3 S. typhimurium(B), 1 S. dublin(D), 1 nonmotile group D, 1 S. derby, and 1 S. oranienberg.

Based on the finding that S. dublin carrier cows only shed in feces
HOW COMMON IS SALMONELLA ON DAIRIES?

3% to 4% of the time on average,\textsuperscript{1,2} it is not surprising that culture is less sensitive for detecting infected cows than serology. From one of the author's (BPS) experience, disease outbreaks in calves and cows associated with Salmonella tend to be cyclical or epidemic, so the chances of finding culture positive calves or cows at one point in time are relatively low. Nonetheless, 5 of the Salmonella isolates came from the hospital pen for sick cows and 2 came from calf pens.

Seropositive cows can be due to Salmonella vaccination, as well as infection. To control for this on dairies which used Salmonella vaccine, we only considered that dairy to be positive if it had 1 or more persistently seropositive cows. It has been shown that vaccination titer following use of a killed bacterin declines rapidly after peaking 1 to 3 weeks following vaccination.\textsuperscript{1-3}

The number of dairies which vaccinated against Salmonella was surprisingly high (45%). These dairies all used either a commercially available killed bacterin containing \textit{S. dublin} and \textit{S. typhimurium} or an autogenous killed bacterin made up from a Salmonella isolate from the farm. Bacterins are typically administered to dry cows, with 2 doses given the first year and a single dose given in following years. Administration is timed to booster colostral titer by giving a dose 2 to 4 weeks before parturition.

It appears that dairies which vaccinate have more persistently seropositive carrier cows than dairies which did not vaccinate (78% vs 61%). This is most likely due to the fact that dairies which vaccinate against Salmonella do so because they have previously experienced salmonellosis and are therefore more likely to have 1 or more carrier cows. Only 21 of 60 dairies responded yes when asked if they had salmonellosis on the farm in the previous 2 years, and only 12 of the 21 (55%) currently vaccinated against Salmonella. It is also possible that the difference in percent of persistently seropositive cows is due to persistent high vaccination titers. We consider this unlikely based on previous work, but the Salmonella vaccination response of cows which have recently recovered from salmonellosis has not been adequately studied. It appears clear, however, that vaccination with a killed bacterin does not eliminate Salmonella from a dairy.

The serotypes isolated are representative of the serotypes of Salmonella reported to cause disease in cattle in California. \textit{S. dublin} and \textit{S. typhimurium} are frequent causes of disease in cattle and are the 2 serotypes most commonly reported to cause bovine salmonellosis in the United States. Nonmotile group D Salmonella now rank as the third most frequent U.S. cattle isolate, while \textit{S. derby} was 11th and \textit{S. oranienberg} was 18th in the U.S. in 1991–92.\textsuperscript{7} The 11% prevalence rate of culture positive previous localized culture survey of California dairies.\textsuperscript{5}

The finding that such a high percentage (75%) of dairies have evidence of recent or current Salmonella infection is not surprising in view dairies was not dramatically different from the 16% prevalence found in aof
SMITH, DILLING, THURMOND

typical management practices on many farms, such as buying heifer and/or cow replacements (open herd) without quarantine or testing, recycling wastewater from lagoons as flushwater, buying feed commodities which are not routinely tested for Salmonella, having poor control of rodents and/or wild birds, having less than ideal sanitation in calving and calf rearing areas (in some cases the calving area and hospital area share the same space), having inadequate quarantine of sick animals, allowing contaminated rendering trucks to drive into animal areas, using the same front end loader for dead animals and feed, and not detecting and culling Salmonella carriers. Successful control of *S. dublin* has been achieved using serology. In order to have improved animal health and better on farm food safety, good management practices for pathogen control on dairies need to be promoted and considered in the building of new facilities and improving existing ones.

REFERENCES


INTRODUCTION

The incidence of cases and outbreaks of SE in humans in the United States began to rise in the late 1970's. By 1984 SE was the second leading Salmonella serotype in the United States and in 1990 became the leading serotype, with *Salmonella typhimurium*, the long-time leader, dropping to second place. Similar increases were seen in Great Britain and many other European countries.

In 1988, St. Louis, et al. (1), reported that from 1976 to 1986, *Salmonella enteritidis* infections increased more than sixfold in the northeastern United States. From January 1985 to May 1987, sixty-five foodborne outbreaks of SE were reported in the Northeast that were associated with 2,119 cases and 11 deaths. Twenty-seven (77%) of the 35 outbreaks with identified food vehicles were caused by Grade A shell eggs or foods that contained such eggs. National data from 1973 to 1984 showed that SE outbreaks were more frequently associated with egg-containing foods (44%) than were outbreaks of other Salmonella serotypes (15%). In 1976 SE represented 5% of the total *Salmonella* isolates reported from humans in the United States. By 1988 this had increased to 16% of the total *Salmonella* burden in the country.

In an effort to reduce the number of cases and outbreaks of SE associated with eggs and prevent further spread, the USDA initiated an emergency program in February 1990, to trace back from egg-implicated SE outbreaks to the flocks of origin, test the flocks for SE and divert the eggs to pasteurization plants if the flocks were positive.

The traceback program was originally planned on the assumption that only a limited number of egg-layer flocks in the Northeast were infected with SE and that if these could be detected and eliminated as sources of contaminated eggs, the SE problem could be controlled. Unfortunately, SE
was later found to be much more widespread in flocks in the U.S., and consequently the traceback program did not meet with the success that had been anticipated.

From a high of 77 SE outbreaks in the U.S. in 1989, there was a drop to 67 in 1990. During 1991, the number of outbreaks remained at about the same level and the year ended again with 67 outbreaks. Earlier that year the SE Task Force, established by the USDA, APHIS, Veterinary Services in 1990, had conducted a spent hen survey for SE, which for the first time indicated the extent of infection among egg-layer flocks in the U.S. Based on the findings of the survey, it was estimated that up to 27% of the flocks in the U.S. could be affected with SE, with 45% in the Veterinary Services Northern Region, 17% in the Central and Western Regions, and 3% in the Southeastern Region.

It became increasingly apparent in the latter part of 1991 that additional measures would be needed if the SE rates were to be brought down more quickly. There was an increasing interest in starting some type of preventive action, rather than just waiting for outbreaks to occur. There was also a growing realization that not enough was known about SE in egg-layer flocks, in regard to its distribution and epidemiology, and particularly what measures would be effective to control and eliminate this human pathogen.

The initial stimulus for increased efforts came from the SE Working Group, a committee representing organizations in the egg industry and State and Federal agencies, that had been meeting regularly for the past year. It was decided that a special effort should be made to start a pilot study in Pennsylvania, an area which was particularly affected by SE. The primary purpose was to take whatever action seemed most appropriate to prevent SE outbreaks originating from eggs, and at the same time to learn as much as possible about SE in egg layer flocks, to reinforce the current control efforts.

In early 1992, a small subcommittee of the SE Working Group was formed to organize an SE Pilot Project in Pennsylvania. After numerous meetings and intense activity, the project was initiated in Lancaster, Pennsylvania in April 1992. The following is an interim report of the organization, activities and results of the Pilot Project during the first 18 months of its existence.

**ORGANIZATION**

The Pilot Project is a voluntary, cooperative effort, between the egg industry in Pennsylvania, the Pennsylvania Department of Agriculture (PDA), the Pennsylvania State University, the University of Pennsylvania and the USDA. An Oversight Committee was established to represent the different groups involved, and was instrumental in setting up the organizational features of the program, the conditions for participation, and the approval of
the operational protocols. The egg producers were to provide the flocks to be studied, some assistance in collecting specimens and would be required to carry out appropriate control procedures. The PDA and the two universities would provide laboratory services and technical guidance, and the USDA (APHIS–Veterinary Services) would serve as the coordinating agency, as well as provide additional laboratory services through the National Veterinary Services Laboratories.

The producers who entered the program agreed primarily to have their flocks tested for SE. If initially SE was found in the environment, they agreed to have eggs from the flock cultured for SE. If the eggs were found to be positive, they agreed to divert the eggs from that flock to pasteurization. The decision to use the results of egg culture in this way was based on seminal work which had been completed just previously by the SE Task Force in a number of flocks examined during traceback operations, and by work at Penn State University, when it was found that culture of eggs could be a practical and feasible monitoring technique.

The operational and laboratory protocols for the SE Pilot Project are given in Appendices 1 and 2.

LABORATORY SERVICES

Four laboratories agreed to provide services, the PDA Summerdale Laboratory, the Penn State Poultry Diagnostic Laboratory, the Microbiology Laboratory at the University of Pennsylvania New Bolton Center and the National Veterinary Service Laboratories at Ames, Iowa.

Standard methods for Salmonella culture were used at the outset of the project, with some differences among the different laboratories. After laboratory experimentation and methods comparison, an agreement was reached by the 4 laboratories for a standard protocol to be used for culture of eggs (see Appendix 2).

PROJECT OBJECTIVES

As a primary objective of the project was to learn as much as possible about SE, in order to facilitate its control in egg–layer flocks, a number of operational objectives were adopted at the outset, with some revisions and additions as the project progressed:

1. Determine whether culture of eggs can be used to measure the risk for humans of SE in eggs, and to decide when to divert SE–positive eggs to pasteurization.
2. Determine the most practical and cost–effective methods to culture or test eggs for SE.
3. Determine the relationship between houses that are environmentally positive for SE and the potential for flocks in these houses to produce SE–positive eggs.
4. Determine whether there is a relationship between molting and an
increased risk of SE-positive egg production.  
5. Determine whether there are any particular phases of the egg cycle when SE-positive eggs are more likely to be laid, and determine the cause for any periods of increased risk.  
6. Determine whether cleaning and disinfection (C & D) after an egg cycle will eliminate SE from the environment and/or lower significantly the risk of the replacement flocks becoming infected and producing SE-positive eggs.  
7. Determine the role of mice in a hen house in the epidemiology of SE.  
8. Determine how to best trap and estimate rodent populations in hen houses.  
9. Determine the best methods to control and eliminate mice and other rodents in hen houses.  
10. Determine the role of chicks and pullets in transmission of SE to a farm premises.  
11. Determine whether chicks infected with SE will, upon maturity, produce SE-positive eggs.  
12. Determine whether any specific management practices are risk factors for SE.  
13. Determine the effectiveness of SE vaccine when administered to pullets before they become egg layers.  
14. Determine whether SE-infection in an egg-layer flock affects morbidity, mortality or egg production.  

OPERATIONAL DATA  
Project operations started on April 15, 1992. Flocks were added gradually. As of July 30, 1993, a total of 97 flocks have been or are being monitored:  
1. No. houses - 70  
2. No. premises - 50  
3. No. complexes - 9  
   4 with 2 houses  
   2 with 3 houses  
   2 with 4 houses  
   1 with 7 houses  
4. No. single houses - 41  
5. No. egg layers - 5+ million  
6. Total environmental samples - 5,089  
7. Total mouse organ pools - 768  
8. Total eggs cultured - 606,783 (in pools of 10 or 20 eggs per pool)
MAJOR FINDINGS DURING FIRST YEAR OF OPERATION

1. Sixty-six percent of the houses had environments positive for SE. (This may represent a biased sample, since producers were more likely to include houses suspected of being positive in the Project).

2. Of the houses with positive environments – 45% had eggs positive for SE.

3. In houses with positive eggs, eggs were positive infrequently and intermittently except in a few houses where eggs were more consistently positive.

4. Routine culture of eggs from an SE-affected flock can be used to estimate the level of risk of SE exposure of the public from foods containing eggs from such a flock.

5. The overall percent of eggs contaminated with SE in affected flocks was 0.02% or 2 in 10,000. The average for all flocks in the project is estimated to be about 1 in 10,000.

6. Mice were present in most of the houses with positive environments and were also positive for SE in 79% of these houses. In houses that had negative environments, 86% had no or very few mice. A method for categorizing rodent densities in houses has been formulated.

7. Rodent control requires persistent, effective action.

8. The same SE phage types were found in the environment, mice and eggs in positive houses. Environments often contained multiple phage types.

9. Fifteen percent of the environments of pullet houses checked were found positive for SE. This number, however, is highly biased as early in the project, progeny pullet flocks from a single infected multiplier breeder source produced half of all the positive pullet flocks tested.

10. The value of cleaning and disinfection between flocks is still under evaluation. Use of formaldehyde fumigation appears to be very valuable.

11. SE vaccine may reduce the number of SE-contaminated eggs in an SE positive flock, although the number of flocks available for study has been limited.

12. Several Salmonella serotypes other than SE have been cultured from egg contents. This finding is being investigated further to determine if shell contamination may have been responsible.

13. SE in a flock does not affect appreciably the mortality, morbidity or egg production of the flock.

14. SE in a flock does not seem to be related to any identifiable sanitation or management practices currently in use in the egg industry.
15. Molting in experimental settings has been shown to make a flock more susceptible to SE but this has not yet been confirmed in the project for commercial flocks.

16. No flock after entry into the project and monitored if necessary by egg culture has been involved in a traceback from an SE outbreak since the start of the project.

SUMMARY

After one and half years of operation, the Pilot Project has met many of its objectives. Much more is now known about the risk factors for SE transmission. The fact that no flock participating fully in the Project monitoring systems has been involved in an outbreak is encouraging. A parallel SE prevention program with protocols derived from the Pilot Project is being started in Pennsylvania in October, 1993, with projected coverage of most of the 21 million egg layers in the state. This large-scale coverage promises to result in an early reduction in the number of SE cases and outbreaks in the Northeastern quadrant of the U.S., where a majority of the SE reported in humans has been recorded.

REFERENCES


KRADEL, MASON

Appendix 1
Pennsylvania SE Pilot Project
Protocol

1. Producer enters the program and agrees to its conditions.
2. A Poultry Health Specialist visits the premises and conducts an initial flock review, records the findings, and recommends procedures to the producer or operator. An initial test of the flock is scheduled, or completed, during this first visit.
3. In general, environmental and rodent samples are collected three times for one cycle flocks, five times for two cycle flocks. Timing of these tests is described below. A flock may enter the project at any of the stages described below. Environmental testing follows the USDA, SE Task Force protocol.

TESTING CYCLE

Pullets
10% of chick papers
DOA's and early death optional
12–18 week old pullets – Manure drag swabs and swabs of house environment.

Layers
Collect environmental samples (i.e., manure pit and egg transport machinery) and rodent samples, then submit to designated laboratory during the following stages of production:
a) 2 weeks post placement – manure drag swabs if environmental tests after C/D or chick/pullet tests were positive.
b) 28–32 weeks of age
c) 40–45 weeks of age
d) 4–6 weeks prior to depopulation
e) For a molted flock, test 5–7 weeks following return of feed, then repeat 15–20 weeks later and again 4–6 weeks prior to depopulation.

4. If any environmental sample collected at the above layer stages is positive for SE, 1,000 nest run eggs are collected from the positive flock every 2 weeks for 4 collections.
5. If any egg sample from a flock is cultured positive for SE, all eggs from that positive flock are diverted to a pasteurization plant, or for hard cooking.
6. Collection and submission of nest run samples continues at two-week intervals. If four (4) consecutive egg tests are negative, then further egg testing of the flock is optional until the next positive environment test.
7. If an egg sample is cultured positive for SE, then four (4) consecutive SE negative nest run egg samples (collected at two week intervals) are necessary before requirement for diversion of all eggs from the positive flock to pasteurization ceases to apply.

8. If any environmental or rodent samples are found to be SE positive, the producer (operator) agrees to clean and disinfect the house at the end of the cycle, before placing new pullets.

9. If rodents are present, the producer (operator) agrees to conduct a rodent control program.

10. Follow-up reviews of the flock by a Poultry Health Specialist are conducted with the same frequency as environmental/rodent sampling.

11. All data and samples collected from a flock are identified by a special code. Access to this code is limited to as few people as possible.
### SEQUENCE OF PROJECT ENVIRONMENTAL TESTING - 1ST YEAR OF FLOCK LIFE

**Layer House Testing**

<table>
<thead>
<tr>
<th></th>
<th>(C&amp;D-EV)</th>
<th>(E-EV)</th>
<th>(M-EV)</th>
<th>(L-EV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empty Layer House</td>
<td>EV TEST</td>
<td>EV TEST</td>
<td>EV TEST</td>
<td>EV TEST</td>
</tr>
<tr>
<td>Early Cycle EV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid Cycle EV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late Cycle EV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EV TEST</strong></td>
<td>(4-6 wks pre-cleanout or molt)</td>
<td>(do if S.E. found in previous testing; otherwise optional)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hatch WKS</th>
<th>20</th>
<th>28-32</th>
<th>40-45</th>
<th>56</th>
<th>70</th>
<th>80</th>
</tr>
</thead>
</table>

---

**Key for abbreviations used above:**

- **EV** = Environmental sample test
- **E-EV** = Environmental sample test done during Early Cycle stage of 1st year of egg production
- **M-EV** = Environmental sample test done during Mid Cycle stage of 1st year egg production
- **C&D-EV** = Environmental sample test of empty house after cleaning and disinfection

* At 20 weeks (2 weeks post-placement) conduct manure drag-swabs if environmental tests after C/D was positive or chick/pullet tests were positive.

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**IF ANY EV TEST IS S.E. + A MINIMUM OF 4 EGG TESTS (1,000 EGGS COLLECTED EVERY OTHER WEEK FOR 6 WEEKS) WILL BE CONDUCTED**
SEQUENCE OF PROJECT ENVIRONMENTAL TESTING CONTINUED - 2ND YEAR OF FLOCK LIFE (POST-MOLT)

LAYER HOUSE TESTING

(Post-Molt)

<table>
<thead>
<tr>
<th>MOLT</th>
<th>(ME-EV) Early Cycle EV TEST</th>
<th>(MM-EV) Molt Mid Cycle EV TEST</th>
<th>(ML-EV) Molt Late Cycle EV TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full</td>
<td>5-7 WKS. AFTER RETURN TO FULL FEED</td>
<td>20-25 WKS.</td>
<td>4-6 WKS. PRE-CLEANOUT</td>
</tr>
</tbody>
</table>

If any EV test is S.E. positive, a minimum of 4 egg tests (1,000 eggs collected every other week for 6 weeks) will be conducted.

Key for abbreviations used above:

EV = Environmental sample test
ME-EV = Environmental sample test done during Early Cycle stage of egg production of molted flock after molt
MM-EV = Environmental sample test done during Mid Cycle stage of egg production of molted flock after molt
ML-EV = Environmental sample test done during Late Cycle stage of egg production of molted flock after molt
KRADEL, MASON

Appendix 2

PROTOCOL FOR EVALUATION OF EGGS

1. Remove any visible adherent material from the shell surface and disinfect with a 3:1 solution of 70% alcohol (ethyl or isopropyl)/10% iodine (Lugol's) or a 5 second dip in boiling water; remove and allow to air dry. Eggs with cracked, chipped or broken shells should not be included in the study. (N.B. The decontamination procedure utilized is the option of the testing laboratory.)

2. Crack eggs aseptically into a sterile Whirl-pak(r) bag, pooling the entire contents of 20 into each bag.

3. Thoroughly mix contents with stomacher or by hand; make sure all yolks are completely blended with the albumen.

4. Incubate at room temperature (68–75°F) for 3 days minimum.


6. Subculture isolated colonies onto XLD, BG and/or a nonselective medium for serogrouping.

7. Select 3 Salmonella–like colonies for serogrouping with group specific antisera. Transfer a colony presumptive of each serogroup into triple sugar iron agar slant [TSI] and lysine iron agar slant [LIA] for preliminary biochemicals. Additional testing is the option of all testing laboratories and is not a requirement of this protocol.

8. Submit all presumptive Salmonella isolates to NVSL for serogrouping.
NEWER SALMONELLA CONTROL AND QUANTIFICATION
TECHNIQUES FOR FARMS AND FOOD PLANTS

E.T. Mallinson, L.E. Carr, S.W. Joseph and L.E. Stewart
University of Maryland
College Park, Maryland
October 28, 1993

Practices that keep low level, hard-to-prevent Salmonella contamination from amplifying to levels that significantly increase the extent of on-farm infection/contamination may be central to the reduction of Salmonella in the food supply. In other words, the same basic hygiene and sanitation considerations that have so well served the interest of human health and food processing for more than a century may be equally as important on the farm. These basic considerations are: a) implementation of strategies that remove feces or reduce the hazards such accumulations produce (e.g., lowering their water activity); and b) significantly improved fly and rodent control.

New Salmonella detection (Tate, 1990) (Miller, 1991) and quantification (Mallinson et al, 1993) techniques that significantly improved our epidemiological and quality control studies are briefly discussed.

Water Activity of Fecal Wastes: Studies of over forty broiler flocks have demonstrated that levels of litter surface water activity (Aw) or free molecular water (equilibrium relative humidity expressed as a decimal from 0 to 1.0) below 0.83 were significantly associated with flocks that were negative for Salmonella when sampled by drag swabs of the litter surface. Litter Aw levels of >0.90 were associated with Salmonella-positive flocks. Values of ≤ 0.83 and ≥ 0.90 were considered an intermediate zone. These farm values closely correspond with those long-associated with the multiplication of Salmonella, E. coli, and Staphylococci in processed foods (Christian and Scott, 1953).

All of 60 two-carass pools of standard USDA "shake and bake" rinses of freshly-processed carcasses from six broiler flocks with low litter Aw values were, by quantitative evaluations, Salmonella-negative. In contrast, twelve of 80 two-carass pools from eight flocks with elevated Aw levels were Salmonella-positive.

Several physical and/or chemical approaches are currently being evaluated for the economical reduction of conditions that contribute to elevated Aw values in poultry and possibly other livestock litter or manure.

Survival of Salmonella in Biofilms: Early studies of weathered transport coop fiberglass surfaces treated with Salmonella suspended in a sterile fecal slurry, and held at varying Aw levels in sealed Kapak (Scotchpak Brand®) plastic bags for four to five days at 20 to 22°C indicated at least a one log₁₀ increase in Salmonella counts when the Aw in the bags (test
chambers) were 1.00. Lower A/w in the test chambers were followed by at least two to four log\textsubscript{10} reductions in counts of recoverable salmonellae. The various A/w concentrations in the chambers were produced using standard perforated histology specimen cassettes containing gauze soaked in either distilled water (A/w = 1.00), or different saturated salt solutions (NaCl = 0.75, KCl = 0.84, or KNO\textsubscript{3} = 0.94).

**Salmonella Amplification by House Flies:** Recent investigations on an SE-positive layer farm utilizing D-group ELISA immunoblot antisera [Kirkegaard and Perry Laboratories (KPL) Gaithersburg, MD] revealed extraordinarily high counts of Group D Salmonella in and on house flies (*Musca domestica*). These levels, which were similar to those reported by Fobert (1970) and Ostrolenk and Welch (1942), ranged up to 300,000 Salmonella per gram of flies or 6,000 Salmonella cells per fly. This source of contamination may be similar to that posed by rats and mice (Henzler and Opitz, 1992). Again, basic sanitation (i.e., fly and rodent control) appear to be key health and food safety precautions essential not only at the public health and food processing levels, but also on the farm.

**Direct, Rapid Quantification of Salmonella from Carcasses and Environmental Specimens:** *Salmonella* quantification from naturally-contaminated specimens has been seriously deterred by the laborious, 4- to 5-day, time-consuming, semi-quantitative features of the traditional "five-tube" most probable number (MPN) technique, which actually uses 30 tubes and 15 to 30 plates of culture media per sample. Provided that nuisance, interfering coliforms are suppressed and sufficient carcass rinse volumes are filtered, a membrane filter XLT4 agar transfer (MFT) technique has been used as an alternative to the "five-tube" MPN technique. MFT has provided rapid (24 hour), convenient (one-plate) direct quantification of *Salmonella* from processed carcasses and environmental specimens (Mallinson, et al., 1993).

*Salmonella* ELISA immunoblot techniques (KPL) have been combined with either MFT or standard spread plate techniques to achieve overnight detection, quantification and D-group identification and detection of *Salmonella* from specimens with relatively high background coliform levels (Lamichhane, 1993).

**Improved Epidemiological Investigations:** Newer culture media (e.g., XLT4), reinforced by supplemental delayed secondary enrichment (DSE) practices, which reduce false positives and false negatives for *Salmonella*; and simple, rapid MFT and/or ELISA immunoblot quantification techniques are producing opportunities for epidemiological studies of much greater scope and statistical validity. Such studies are providing a better understanding of "practical" *Salmonella* control at the farm level. More
specifically, these improved insights are beginning to suggest that: a) proper manure management; and b) fly and rodent control are key sanitation/hygiene practices that suppress the amplification and spread of Salmonella on farms. Keeping the farm hygiene/sanitation "lid" on this ubiquitous microbe may be central to solving the ON FARM side of the Salmonella equation.

Acknowledgements: This report was possible only through the generous contributions provided by our industry cooperators; USDA (FSIS, ES, APHIS, and ARS) and by Kirkegaard and Perry Laboratories, Gaithersburg, MD and Future Medical Technologies, Inc., Riviera Beach, FL.

REPORT OF THE COMMITTEE ON SALMONELLA

Chairman: Dr. B. S. Pomeroy, St. Paul, MN

C. Baxter-Jones, WV; C.W. Beard, GA; F.D. Bisplinghoff, FL; E.S. Bryant, CT; H. Cervantes, AR; D. Corrier, TX; M.S. Cover, MD; N. Cox, GA; K. Custer, MN; S.W. Davis, AR; M.A. Dekich, MD; T.G. Dickson, GA; D.F. Dineen, ME; N.M. Dorko, Jr., CT; W.H. Dubbert, DC; R.J. Eckroade, PA; P.J. Fedorka-Cray, IA; K. Ferris, IA; R. Foster, MO; D.A. Franco, VA; W.M. Frerichs, IA; L.W. Fussell, AL; S.G. Gbadamosi, AL; G.Y. Ghazikhanian, CA; H.M. Ghorai, AR; R.D. Glock, CO; E. Gonder, NC; E.E. Grass, CA; D.M. Grotelueschen, NE; T.J. Hagerty, MN; D.A. Halvorson, MN; G.T. Holder, MD; J. House, CA; W. James, DC; D.C. Johnson, GA; G.E. Kolb, WI; D.C. Kradel, PA; T.T. Kramer, IA; M.C. Kumar, MN; B. Lautner, IA; J. Leonard, KS; H.M. Loper, AL; E.T. Mallinson, MD; M. Marcotte, CAN; J. Mason, MD; R.H. McCapes, CA; P.L. McDonough, NY; K. McEnroe, AR; E.L. Menning, DC; R.D. Michaels, IA; G.P. Miller, Sr., NC; G.A. Mitchell, MD; A. Mutalib, MS; K.V. Nagaraja, MN; M.E. Potter, GA; M.M. Pullen, MN; R.D. Ragland, VA; G.D. Ritter, MD; R.A. Robinson, MN; M. Rosenstein, AR; M. Saeed, IN; J.P. Sanders, Jr., FL; H.L. Shivaprasad, CA; R.D. Siemons, OH; B.P. Smith, CA; K. Takeshita, CT; L.A. Thomas, IA; S.C. Trock, NY; L. van der Heide, CT; K. VanSteenbergh, MO; S.A. Vezey, GA; M.W. Vorhies, KS; A.L. Waldroup, AR; D. Waltman, GA; G.L. Waters, IL; R.D. Welsh, OK; S. Williams, AR; W.O. Williams, Jr., AR; D.H. Willoughby, CA; S.T. Wilson, Jr., AL; R.L. Ziprin, TX

The committee met at 4:30 pm, Monday, October 25, 1993. Thirty-eight members and 26 guests were present. As short eulogy to our departed colleague, Dr. Glenn Snoeyenbos, was presented by Dr. Harold Chute and Dr. B. S. Pomeroy.

Five subcommittee reports were considered and 11 papers were presented.

A. SUBCOMMITTEE REPORTS

1. Diagnostics, Data Collection, and Epidemiology.
   Dr. Lee Ann Thomas, Chair, reported that the new fee structure for the typing of Salmonella serotypes has gone into effect and the number of isolates received has dropped significantly. The data generated by NVSL should not be used for any epidemiological purpose because of lack of completed information on the cases.

   Dr. Tom Holder, Chair, reported on the corrections made on the recent draft at the subcommittee meeting on Monday morning, October 25. The draft as amended was presented to the committee and it was moved, seconded, and carried that the draft became an official part of the Committee report.

   Dr. K. V. Nagaraja acting chair for Dr. David Halvorsan reported on
REPORT OF THE COMMITTEE

the corrections made on the recent draft at the subcommittee meeting on Monday morning, October 25, the draft as amended was presented to the committee and it was moved, seconded, and carried that the draft as amended become an official part of the Committee report.

4. Salmonella Risk Reduction in Cattle

   Dr. Bradford Smith, Chair, reported the subcommittee will initially develop guidelines for dairy cattle, then enlarge the scope to include beef cattle and veal calves. The members of the subcommittee have been assigned to develop guidelines under the following 12 different headings:
   1. Facilities design and management.
   2. Cleaning and disinfecting procedures.
   3. Manure composting and other methods to destroy pathogens.
   4. Control of rodents, wild birds, insects, and domestic animals.
   5. Assuring Salmonella – free feedstuffs and the role of feeding practices.
   6. Handling of sick and dead animals.
   7. Salmonella vaccines.
   8. Serology and detection of carrier cows.
   9. Culture methods and sampling procedures, antigen capture tests, and antibiotic susceptibility testing.
   10. Milking and milk hygiene.
   11. Dairy beef slaughter concerns.
   12. Epidemiology and molecular epidemiology.

5. Salmonella Risk Reduction in Swine

   Dr. Ted Kramer, Chair, reported the subcommittee is not in position to present a risk reduction program at this time. He discussed the importance of a) Environment, b) Carrier animal, c) Management, d) Diagnosis, and e) Prevention of Salmonella infections in swine. He also stated the overwhelming clinical Salmonellosis of swine has been due to S. choleraesuis for the last five years. S. typhimurium has consistently been the second most important swine salmonella. The subcommittee strongly urges more research on swine salmonellosis.

B. PAPERS


   Dr. L. A. Thomas reported the serotyping results for 36,073 Salmonella isolates from animal disease cases and epidemiologically related sources. Of these, 35,198 (98%) isolates were serotyped at NVSL. The most frequently identified serotypes were: S. enteritidis, S. typhimurium, S. heidelberg, S. hadar, and S. choleraesuis var. kunzendorf. A complete report will be published in the proceedings of this meeting.

Mr. Andrew R. Rhorer, USDA-APHIS-VS-NPIP made the following report:

**Pullorum–Typhoid Status**

In calendar year 1992, there were 30 isolations/outbreaks of Salmonella pullorum reported to the Poultry Improvement Staff. There have been no isolations of S. gallinarum since 1988. These isolations/outbreaks were reported by 10 states. Three states reported 65% of the isolations/outbreaks.

One state shipping many chicks by mail was responsible for 10 isolations. Investigations of these shipments, where transmission occurred at a high rate, were reported as pullorum disease if high mortality occurred or reactors were found even without isolations of the organism.

There were no additional isolations of S. pullorum from the operation of an integrated producer of broiler/roasters which occurred in 1991. The last isolation was reported in October of 1991.

During the 1993 calendar year from January to October 1st, there have been 10 isolations of S. pullorum and no isolations of S. gallinarum; of these isolations four were reported from one state. None of the isolations were obtained from commercial poultry flocks.

3. **Pathogenesis, Transmission, and Control of Salmonella in Swine.** Dr. Paula J. Fedorka-Cray, Dr. T. J. Stabel and Dr. S. C. Whipp, USDA-ARS-NADC, Ames, Iowa.

Dr. Cray presented the paper.

**OBJECTIVES:**

1. To identify virulence factors important in the pathogenesis of Salmonella choleraesuis and Salmonella typhimurium in swine.
2. To define the epidemiology and transmission of Salmonella.
3. To define the porcine immune response to acute and chronic infection focusing on mechanisms to reduce or eliminate the pathogenic organism.
4. To identify methods to control Salmonella in swine.

**STATUS:**

We hypothesized that the route of inoculation as well as the inoculum dose could affect the development of the carrier state. In an attempt to create a challenge model that may mimic the carrier animal we began to explore challenge routes and doses. Pigs were compared following challenge with Salmonella typhimurium by the respiratory route via intranasal instillation (IN) or the oral route via delivery by gelatin capsule (GC). Results indicate that a dose of 10^4 CFU per pig the IN route had prolonged shedding patterns, 2 weeks of shedding vs 1 week of shedding for GC pigs. At necropsy more tissues were positive for the IN pigs: The lung, bronchial lymph node, ileocolic junction, ileocolic lymph nodes, cecum, cecal contents,
and colon were positive for the IN pigs vs the ileocolic junction, ileocolic lymph node, and cecum for the GC pigs. An experiment using a 10^6 dose by GC inoculation was also conducted. Fecal shedding was observed through day 42 post-challenge. Six weeks post challenge one pig was positive for Salmonella. At twelve weeks post-challenge one pig was positive and Salmonella was recovered from the tonsil, cecal contents, cecum, ileum, and colon. Currently we are repeating the 10^6 GC challenge and adding a second group challenged by the IN route for comparison.

The effect of route and dose using Salmonella choleraesuis was conducted. Intranasal inoculation had more of an affect on tissue distribution and fecal shedding than GC inoculation.

To confirm the respiratory route as a legitimate route of infection we esophagotomized pigs and challenged them by IN with 10^9 CFU. Salmonella was recovered from the gut tissues within 3 hours post-challenge. This suggest fecal/oral transmission should not be considered the sole or primary route of transmission for Salmonella typhimurium as aerosol transmission can result in gut colonization.

Analysis of tonsil explants seeded with either Salmonella typhimurium or Salmonella choleraesuis by bacteriology, histology, and immunohistochemistry indicate that the Salmonella appear to invade and replicate within the tonsil. This suggest that the tonsil may play an important role in dissemination of Salmonella by lymphatogenous as well as hematogenous routes.

We have been able to successfully raise pigs free of Salmonella by using a combination of early weaning and multiple rearing sites. Pigs are weaned from conventionally farrowed pigs at 10 to 14 days of age and transferred to clean facilities. By using strict management practices we have been able to maintain pigs free of Salmonella for 16 weeks. Plans are being developed to extend the observation period and to bring in pigs from known carrier to determine if the pigs can remain Salmonella-free.

Currently, we are measuring non-specific mitogen induce and Salmonella antigen-specific lymphocyte stimulation of lymphocytes following infection of swine with Salmonella typhimurium and Salmonella choleraesuis. Measurable differences in the level and type of cell proliferation are observed between oral and respiratory routes of infection In vivo and in vitro responses are determined by a series of bioassays measuring IL-2, interferon gamma, and tumor necrosis factor-alpha. The effect of challenge dose on porcine cellular immunity is also being considered.

In other studies, we have observed that house mice are vectors in transmission of Salmonella on the farm. Bacteriologic surveys of swine and the environment are also being conduct on Iowa farms. Three serotypes have been isolated from one farm and include Salmonella choleraesuis, Salmonella derby, and Salmonella anatum.

4. Epidemiology of Swine Salmonellosis
SALMONELLA

Dr. Ted T. Kramer and Dr. Kent Schwartz, College of Veterinary Medicine, Iowa State University, Ames, Iowa.

Dr. Kramer presented the paper.

Septicemic swine paratyphoid is typically concentrated in the swine-growing Mid-Western States, and has been on the rise since 1988, and Salmonella choleraesuis is the 3rd to 5th most commonly isolated Salmonella from domestic livestock. Dr. Kent Schwartz and I have conducted a survey of 200 NAHMS participating swine producers. Of 71 respondents, 49 did not have Salmonella problems in the past year, and 22 did. Depending on the interpretations of this questionnaire, salmonellosis may have been a problem on 11% or on 31% of these farms. I believe that 20% is probably a reasonable guesstimate of the real prevalence of this problem. Swine Salmonellosis is consequently a more severe problem than either poultry or bovine salmonellosis, certainly so in the mid-western states. of the 22 afflicted farms, 11 indicated that Salmonella choleraesuis was identified as the cause of the problem. Morbidity was highest among cold nursery pigs, while mortality was highest in the hot nursery category.

However, that feeder/growers and finishers taken together had higher morbidity than nursery pigs; this is important because of the economic implication. Looking at the number of herds and the total number of pigs affected, the feeder/growers were the highest target, closely followed by the cold nursery pigs. Again, this is an economically unfavorable trend for a disease that though to be a post-waning disease until recently.

The key to any disease control eradication program is a suitable simple, rapid, and reliable diagnostic test. Consequently, we have developed an ELISA for Salmonella. Features of this ELISA are selection of a suitable antigen, the use of protein A/G as antiglobulin, detecting only IgG antibody, high sensitivity but only moderate specificity. The greatest difficulty is the lack of a "gold standard," or reliable microbiologic confirmation of ELISA positive animals. In a Salmonella free herd, all samples tested were below O.D. 0.2. In an infected herd eight ELISA positive pigs - 4 of which were bacteriologically confirmed - were still ELISA positive when retested 2.5 months later, but some turned negative 3.5 months after the initial test. When we compared seroconversion of 8 blood culture positive pigs with seroconversion of 8 blood culture negative pigs, the seroconversion of the blood culture positive group was considerably higher; however, again, blood and fecal cultures are not a reliable "gold standard."

I shall only highlight two of the conclusions shown here: there is no "gold standard" for our - or anybody else's - ELISA, and the specificity of this test is difficult to assess. However, the test can reliably be used to identify infected from uninfected herds. Both are important, identification of the uninfected herd is important for the same reason that each of us wants to know that we don't have cancer.

Overall, swine salmonellosis - is overwhelmingly present as
REPORT OF THE COMMITTEE

septicemic swine paratyphoid - it is an important and widespread swine disease in the Midwest, affecting anywhere between 10 and 30% of our national swine herd.

5. Progress in the International Standardization of ELISA for Salmonella Serology.

Mr. George Dilling, School of Veterinary Medicine, University of California – Davis, Davis, CA. Dr. Bradford Smith reported for Mr. Dilling.

Two working groups have been formed under the auspices of WHO, Veterinary Public Health. One group, working with poultry, is headed by Paul Barrow, U.K. and involves seven laboratories exchanging sera and results. The second group involves cattle and is coordinated by George Dilling, Davis, CA. Five laboratories exchange sera and results. The goal is to standardize antigen production, methodology, and interpretation of results by comparing high, medium, and low titered sera.

6. Isolation of Salmonella – A Nationwide Survey.

Dr. W. D. Waltman, II, Georgia Poultry Laboratory, Oakwood, GA, and Dr. Ed Mallinson, University of Maryland, College Park, MD. Dr. Waltman presented the paper.

A nationwide survey was conducted to determine the various isolation methods for Salmonella used in veterinary laboratories. Completed questionnaires were received from 74 of 165 laboratories from 35 states and Canada. The results indicated a large degree of variation exists in laboratory procedures. For example, 17 different selective enrichments or enrichment combinations and 14 different plating media are being used for isolating Salmonella from poultry. Similar variations exist in the incubation temperature and the time of incubating the selective enrichments. This variation was also found for small and large animal and environmental samples. The survey showed that 69% of the laboratories would be interested in attending some type of training program on Salmonella isolation methodology.

We recommend the development of a training program for the isolation of Salmonella and suggest that it be sponsored by USAHA, AAVLD, or USDA. This would help to ensure the methods used in various laboratories are more effective and uniform.

7. Overview of Canadian Salmonella Control Program.

Dr. John Keller, Animal Health Division, Agriculture Canada.

Dr. Keller reviewed the domestic aspect of Canada's National Voluntary Program for the control of Salmonella and other pathogens.


Dr. Charles Beard, Southeastern Poultry and Egg Association presented a brief report describing the Salmonella control program as presented at the recent WHO/NVI sponsored course in Malmo, Sweden. The programs involved all aspects of the poultry industry from quarantining the imported grandparent breeders, producing clean feed to following
biosecurity practices at the production level. The control program has resulted in Salmonella contamination rate of 0.2 – 0.7% in slaughtered broilers in 1990. The Swedish poultry industry is committed to a continuing effort of providing Salmonella-free broilers to the processing plant so that Salmonella-free products can be provided to the consumer. The lack of a decline in the number of human cases of Salmonellosis was reported to be due to individuals leaving the country and returning infected.


Dr. John Mason, Director, USDA-SE Control Program, Hyattsville, MD.

Dr. Mason reviewed the USDA-SE Control Program 1990–93. He reported there were 235 human outbreaks in this period. Egg reported outbreaks accounted for 75 cases, but among the 35 traceback flocks 20 flocks tested positive to SE. He will report a detailed paper of the SE Pilot Project in Pennsylvania. This paper will be published in the proceedings of this meeting.

10. On Farm Hygiene and Sanitation and Salmonella Control.

Dr. E. T. Mallinson, L. E. Carr, S. W. Joseph and L. E. Stewart, University of Maryland, College Park, MD.

Dr. Mallinson presented the paper and it will be published in the proceedings.

11. Update on the APPI's Salmonella Education and Reduction Program.

Dr. Franco, National Renderers Association, Washington, D.C.

Dr. Franco reviewed the current APPI program.

1. Education
   a. Produced a video in concert with Silliker Laboratories exemplifying both control points and critical control points to highlight sanitation/hygiene and HACCP concepts in Salmonella control.
   b. Produced a booklet for the industry that serves as an educational resource that reviews Salmonella epidemiology with inference to feed, livestock/poultry, and public health.
   c. Have produced slides to introduce the membership to Salmonella with emphasis on the total food chain and the role of animal protein producers in safe feed, healthy livestock, and healthy people.

2. End Point Testing
   Continued the seasonal end point testing for Salmonella. In the last testing period, the greatest number of submissions (237 plants) ever sampled by our contract laboratories.

3. Research
   Have recently concluded a joint research endeavor in Kansas City with Silliker Labs to evaluate the efficacy of formic acid as an adjunct to Salmonella control and prevention.
REPORT OF THE COMMITTEE

Resolution:

The committee passed one resolution that USAHA request USDA-APHIS to direct a portion of the pre-harvest food safety budget to NVSL that is sufficient to at least cover the 1992 level of submission for salmonella serotyping for diagnostic purposes.

SUBCOMMITTEE ASSIGNMENTS - 1993

1. Diagnostics, Data Collection, and Epidemiology
   Lee Ann Thomas, Chair


   Tom Holder, Chair


   David A. Halvorson, Chair

SALMONELLA

   Bradford Smith, Chair

   Kevin Custer, Don A. Franco, S. G. Gbadamosi, Robert D. Glock, Patrick L.
   McDonough, Rita Michaels, R. A. Robinson, Larry D. Shipman, and Ronald
   D. Welsh

   Theodore Kramer, Chair

   Kevin Custer, Paula J. Fedorka-Cray, Don A. Franco, Robert D. Glock, Eric
   Gonder, Beth Lautner, Rita Michaels, R. A. Robinson, and Mahlon W.
   Vorhies

6. Salmonella Risk Reduction Guidelines (Revision)
   David Kradel, Chair

   Charles W. Beard, Kevin Custer, Thomas G. Dickson, David F. Dineen,
   Robert J. Eckroade, David A. Halvorson, Tom Holder, D. C. Johnson, Joan
   Mitchell, Ahmed Mualib, H. M. Opitz, Ben S. Pomeroy, Robert D. Ragland,
   Mahdi Saeed, John P. Sanders, Jr., Richard D. Slemons, Louis van der
   Heide, Douglas W. Waltman, II., Gary L. Waters, and David H. Willoughby
BEST MANAGEMENT PRACTICES
FOR SALMONELLA RISK REDUCTION IN BROILERS*

Dr. Tom Holder
Salisbury, Maryland

INTRODUCTION

The broiler industry has made considerable progress in the reduction of salmonellosis. Pullorum disease and fowl typhoid have been practically eliminated. The incidence of *Salmonella typhimurium* in broilers has been greatly reduced, however, other salmonellas may be isolated from broiler and breeder flocks. Salmonella infections may occasionally cause serious economic losses in young broilers and the salmonella contamination of poultry products pose a potential public health concern.

The cycle of infection of salmonellosis in broilers is a complex problem. The organism may become established in breeder flocks and be egg transmitted. The environment of the breeder buildings may become contaminated and be a source of the infection to young and growing broilers. Rodents, flies, insects, free flying birds, pets and other animals on the premise including people may be carriers of salmonellas and be a source of introduction. Feed and feed ingredients and the water supply, particularly surface water, may become contaminated with salmonellas and be a threat. Unfavorable damp environments allow salmonella bacteria to multiply to higher levels, creating an undesirable cycle of litter-to-bird and bird-to-litter transmission and persistence.

If salmonellosis in broilers is going to be further reduced, it will require a total approach to the problem. These guidelines will help the broiler industry to reinforce the use of Best Management Practices to reduce the economic burden, and public health and market concerns of salmonellosis.


BEST MANAGEMENT PRACTICES
FOR SALMONELLA RISK REDUCTION IN PULLETS AND BREEDERS

I. Purchase your breeder chicks from breeders participating in the U.S. Sanitation Monitored Program of the NPIP.

II. Significantly reduce your pullet – breeder facilities of all rodents, wild birds, insects and pets. Refer to section on Vector Control.

III. Clean, wash and disinfect your pullet – breeder houses and equipment after each flock. Refer to section on Decontamination of Facilities.
Monitor pullet - breeder house for successful decontamination. Monitor chicks upon arrival and pullets before movement to the breeder house. Refer to section on Bacteriological Monitoring.

Attend to feed quality control and proper feed storage. Use of well-formulated, properly pelletized/crumbled feeds has been recommended at times of extra susceptibility to salmonellosis (e.g., days 1 to 14 and during early maturity or transport stress). Refer to section on Feeds.

Dirty coops/cages frequently carry live salmonella. Therefore, use decontaminated sanitized coops/cages and truck to transport pullets to the breeder farm.

Adhere to strict, continuing vector control and biosecurity standards throughout pullet/breeder grow-out. Refer to sections on Vector Control and Biosecurity.

Vaccination has been used in conjunction with biosecurity to attempt to reduce the effects of disease when the risks of exposure appears high. Vaccination results vary with different diseases and methods of vaccination preparation. Salmonella vaccination research is underway at several locations.

The application of effective hatching egg and hatchery sanitation will reduce the risk of hatchery transmission of Salmonella.

Use of closed drinking systems, (nipples) is highly recommended.

Competitive Exclusion (CE). Under experimental conditions immediate post-hatch establishment of CE intestinal microflora may help reduce the risks of salmonella colonization in the gut of typically susceptible chicks. However, at the present time, there are no commercially
available CE cultures in the United States and the use of CE cultures in the US is limited to research projects.

SALMONELLA RISK REDUCTION
IN THE PRODUCTION OF BROILERS

VECTOR CONTROL BROILERS, PULLETS, BREEDERS

Vector control goes beyond preparation of depopulated houses prior to cleaning and disinfection. It also is an absolutely essential risk reduction practice for the entire life of your broilers.

Routine, licensed professional rodent and insect detection/extermination is suggested. Be sure that personnel practice strict biosecurity procedures for their clothing, equipment and vehicles and that the service provider has a good vector control record with poultry operations. A well illustrated, detailed publication, Integrated Pest Management for Poultry, (Arends and Stingham) is available free of charge. To order, refer to Appendix. Purina Mills has produced a film illustrating unique techniques for rodent monitoring and control.

I. Rodents

Rodents feces contain infectious doses of salmonella, particularly S. enteritidis, S. typhimurium and S. arizonae. Mouse pellets are commonly deposited in feed troughs and this is believed to amplify salmonella contamination in confined poultry. Beyond their salmonella amplification role, rodents appear to carry infection to other houses and farms.

Consequently, salmonella risk reduction should include (1) attempts to make all facilities rodent-proof, (2) proper selection of baits and bait placement, (3) prompt, secure disposal of any dead birds, or unused or spilled feed, and (4) regularly repeated professional rodent inspections, baiting and trapping. A detailed rodent control program follows.

II. Rodent Proofing

A. Eliminate potential rodent harborage inside and outside the poultry house (e.g. high grass, shrubs, garbage, broken equipment, construction debris, burrows under the foundation, and cardboard boxes).

B. It is suggested that some type of rodent barrier be installed around the perimeter of poultry houses.

C. Seal all entrance holes inside and outside the building. Repair siding and close siding sheet seams. Doors and door frames should fit snugly.

D. Seal holes and broken concrete. The use of "steel wool" to block a hole with a masonry final coat is a method to insure no re-entry or exit.
BEST MANAGEMENT PRACTICES

E. Feed bins and buildings should be secured at night. Dispose of dead birds daily.

III. Preparations for Baiting
A. After house depopulation, all feed should be immediately removed from feeders and building so that rodents will promptly go to the bait.
B. Remove all alternative food sources for rodents, (e.g., spilled feed and dead birds).
C. Inspect the outside of the building routinely for rodent holes and burrows.

IV. Bait Selection and Placement
A. Warfarin, diphenacainone, or pival are "multiple-dose" type anticoagulant rodenticides. They require continuous feeding over several days to have any lethal effect. They are best used as a routine every two-week baiting program.

   Newer anticoagulants contain brodifacoum and bromadiolone which may cause death 3-5 days after a single feeding. Such "single-dose" rodenticides can be used at any time and are especially appropriate immediately upon house depopulation. Tracking power is especially useful for areas difficult to bait, but frequently used as passway by rodents (e.g. joists and rafters). Alternating rodenticides every 2 months has been found helpful by some in preventing bait shyness and rodenticide resistance. A list of rodenticides for use in poultry buildings can be found in Table 1.

B. Purchasers of rodenticides often under estimate the long-term need. Secure an adequate inventory.

C. Save bait by baiting only active holes. Fill all rodent holes with dirt or paper and then bait only those that have been reopened.

D. Place bait according to directions supplied by the manufacturer of your rodenticide. Place small amounts of bait frequently (up to 2x/wk) rather than large amounts infrequently. Rodents prefer fresh bait.

E. Control of attic rodents is facilitated by construction of a hatch for attic access and at least once yearly baiting with high wax, single-dose bait in throw packs as often as needed. Bait the outside perimeter of the poultry house with high wax bait as needed.

F. Once control has been achieved, inspection and service of permanent bait sites is essential every two weeks. Record the location and numbers of trapped mice and maintain these records. Inspecting premises with a low intensity red flashlight is an effective method of measuring control.

G. Caution: All baits are poisonous to rodents, poultry, other animals and people. Place baits carefully to prevent contamination of feed or accidental access by poultry and humans. Baits should not be placed loosely on the ground in areas frequented by people who...
might carry it on shoe soles and contaminate sensitive areas.

Table 1. Rodenticides for Use in Poultry Buildings

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Single/Multiple Feeding</th>
<th>Secondary Poisoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromethalin</td>
<td>Single</td>
<td>No</td>
</tr>
<tr>
<td>Cholecalciferol (Vit. D.)</td>
<td>Multiple</td>
<td>No</td>
</tr>
<tr>
<td>Warfarin and Na–Salt</td>
<td>Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Brodifacoum</td>
<td>Single</td>
<td>Yes</td>
</tr>
<tr>
<td>Bromadiolone</td>
<td>Single</td>
<td>Yes</td>
</tr>
<tr>
<td>Pindone and Na–Salts</td>
<td>Single/Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Diphacinone and Na–Salts</td>
<td>Single/Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Chlorophacinone</td>
<td>Single/Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>PMP–Ca–Salt</td>
<td>Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Scilliroside</td>
<td>Single</td>
<td>No</td>
</tr>
<tr>
<td>Zinc phosphide</td>
<td>Single</td>
<td>No</td>
</tr>
</tbody>
</table>

EPA registered for use in agricultural buildings

V. Insects
A. Basic control strategy
   The control of flies and beetles, which also may be salmonella vectors, requires use of a variety of practices. This reduces the selection pressure encountered with any single method. For example:

1. Keep litter well ventilated and dry.
2. Prevent water leaks and remove any wet areas.
3. If possible, use biological control methods (fly parasites and predators).
4. Use different classes of insecticides. Alternate, for example, between organic phosphates (Malathion), carbamates (Sevin) and pyrethrins. Diatomaceous earth may be used in conjunction with the chemical insecticides.

B. Insecticide Application
   1. After the floor is dry following cleaning and disinfection, apply an approved insecticide to the floor, support poles and walls to control beetles and other insect pests.
   2. Synergized pyrethrins (Pyrethrin + piperonyl butoxide) are among the few insecticides that can be utilized in automatic spray systems inside poultry houses. Their advantages are: ability for quick "knockdown" of flying insects; short residual times; and low mammalian toxicity. The rate of application of such insecticides, particularly when applied by an automatic spray systems, should be no more frequent than twice a week.
BEST MANAGEMENT PRACTICES

3. Follow all manufacturer-recommend safety precautions when applying insecticides.

VI. Wild Birds and Pets

Avoid feed spills outside buildings and clean up immediately if they occur. Buildings should be constructed not only to exclude wild birds but to avoid birds perching under eaves or on blinds. Allow no stragglers to live over after depopulation. Prevent wild birds from nesting and reproducing in the chicken house. Pets should be banned from poultry houses.

DECONTAMINATION OF FACILITIES

To reduce the risks of a flock-to-flock build-up of salmonella and other infectious agents, a between-flock decontamination program is necessary.

If any of your facilities tested salmonella-positive, the facility needs to be decontaminated promptly after bird removal to prevent residual contamination from infecting your replacements.

Successful decontamination programs require thorough, systematic implementation, proper equipment and professional training.

Decontamination of pullet and breeder facilities presents the broiler industry with a serious challenge due to facility size and complexity. Additionally, the common use of wooden construction materials, which are porous, appear to provide bacteria protection from the killing effects of disinfectants.

Formaldehyde has been widely used in the past to help disinfect broiler buildings. Although particularly effective against salmonellas, its use appears in jeopardy because of human safety concerns, product availability, and regulatory policies. Application of alternative gases, fumigants, heat-enhanced disinfectants, high-pressure sprays or disinfectant foams and use of sealants to reduce wood porosity may need to be further assessed as possible aids in disinfecting porous surfaces.

Facility decontamination needs to include the following basic considerations and precautions. Step-by-step decontamination procedures and the names and examples of various commercial disinfectants follow.

Basic Considerations

I. Invest in thorough dry cleaning with removal of all caked, layered or loose debris. This simplifies future cleanup operations and reduces the expense of wet cleaning.

II. Disinfectants and fumigants are effective only on clean surfaces. Cleaning and disinfection programs, when not fully effective at first, have been reported to have increased efficacy when they were improved and redone or repeated from flock to flock. Field observations have indicated a significantly improved probability for
HOLDERS

maintaining salmonella-negative broilers when they were placed in facilities that had previously passed both visual inspections and post-disinfection laboratory tests.

III. Bacteria can multiply on damp surfaces; therefore, disinfection should be started soon after washing/rinsing, and preferably within 24 hours.

IV. Drying of the facility immediately after application of disinfectants is highly advisable. Dryness is an impediment to salmonella multiplication. Recent studies indicate that relative humidity levels of less than 80% significantly reduce salmonella populations.

V. Carefully follow all disinfectant safety, dilution and application directions provided by the manufacturer. Consult with the suppliers of both your equipment and disinfectants for the best and safest procedures for such items as feeders and waterers. The operator must wear protective clothing.

DECONTAMINATION STEP-BY-STEP

I. Bird Removal
   A. Remove all dead and live birds from the building; including all escaped birds.
   B. Immediately begin vector control procedures during bird removal. Refer to guidelines section on Vector Control.

II. Dry Cleaning
   A. Turn off power to electrical equipment prior to dry or wet cleaning. Non-removable motors, switches, etc., have been dry cleaned with compressed air or brushing. Extreme care should be taken about not getting any sprays inside electric motors. Duct tape can be used to cover the slots in motor housings prior to wet cleaning and disinfection. The tape must be removed after wet cleaning and disinfection is completed.
   B. Clean fans and other air inlets from the outside.
   C. On the inside, brush, sweep, vacuum and wipe dust and other dirt from ceilings, light fixtures, beams, ledges, walls, fans, air inlets and walkways. Move from top to bottom.
   D. Promptly open feeder lines and remove feed from trough, all line corners and all other points of feed accumulation.
   E. Hard surface (concrete) floors can be cleaned faster and more easily than clay or earthen floors. Completely remove all litter. Hand sweeping and shoveling will be necessary around the perimeter, doorways, walkways, support poles, and corner of most houses to do a satisfactory job. If possible, fill trailers with manure inside the houses and cover before moving it to a disposal or composting site. Manure should not be spread near poultry facilities.

III. Wet Cleaning
BEST MANAGEMENT PRACTICES

Wet cleaning includes soaking, washing and rinsing steps. Use of hot water is preferred. Detergents and other surfactants are often added to washing solution to loosen debris and films and allow better penetration of cleaning agents.

Salmonella can multiply to high numbers in the presence of debris and moisture. Therefore, the following steps should be executed without interim waiting periods.

A. Soften dirt in heavily soiled areas. A low pressure (200 to 300 psi) sprayer, delivering 10–30 gallons/minute has been considered adequate.

B. Washing. Professional contractors use a systematic spray technique. They start at the back and work toward the front of the building, spraying the ceiling first, then the walls, and finally the floor. Use sprayer attachments and nozzles that permit washing of hard-to-reach areas.

1. Wash ceilings and walls. Clean everything completely. Although use of pressure sprays ranging from 200–2000 psi have been reported, washing pressures of 750–2000 psi appear to be preferred. At high pressure, however, special care and safety garments are needed. Pressure sprayers can cut human skin like a knife. Care must be exercised to follow the manufacturer's instructions for the use of this equipment.

2. Pay special attention not only to the top, but also to the underneath sides of troughs and obvious and hidden surfaces of all chains and augers.

3. Wash storage rooms, hallways, break, wash and restrooms.

4. Manually clean any areas that have resisted prior cleaning.

C. Rinsing

1. A final rinse is suggested to obtain a truly clean building and to reduce residues of cleaning chemicals.

2. Immediately remove all puddles. They are bacterial breeding grounds.

D. Danger of Carbon Monoxide Poisoning from Gasoline Engines

The National Institute for Occupational Safety and Health (NIOSH) recently issued the following warning because of recent farm accidents:

1. Do not operate gasoline powered pressure washers indoors to clean buildings or other machinery with gasoline engines in any building because of the emission of carbon monoxide, a deadly gas.

IV. Repairs

All repairs to the house should be made at this point.

V. Inspection

Third-party visual inspection for completeness of the wet cleaning and repair operations is recommended. This may be done by an outside authority or by an in-house unbiased employee responsible for quality control.
VI. Disinfection

Disinfection should be started within 24 hours of rinsing. Because disinfectants are effective only on clean surfaces, do not begin disinfection until the house has passed its inspection for proper cleaning.

A. Only clean potable water should be used for disinfection. Water from streams and ponds may reduce the effectiveness of disinfectants.

B. Heat Enhancement. All disinfectants, whether sprays, foams, aerosols, or fumigants, work best at temperatures above 65°F. Temperatures for chlorine– and iodine–based disinfectants should not exceed 110°F.

C. Dangerous Mixtures. Each disinfectant is the result of careful formulation, and any addition of detergents, surfactants or insecticides to a disinfectant without the approval of its manufacturer could dangerously reduce the efficacy of one or more of the products in the mixture. For economy, efficacy and human and flock safety, manufacturer’s label instructions must be followed carefully.

D. Evaluation of Products. There has been an influx of claims for new salmonella disinfectants and control systems. Table 2 provides guidance on evaluating efficacy of various products.

E. One gallon of diluted disinfectants is ordinarily applied to approximately 100–150 square feet of surface area. The total amount of disinfectant solution needed is determined by the total surface area of the floor, ceiling and walls.

F. Follow application instructions of the manufacturer. Use of pressure sprays or thermal devices is advisable to help force disinfectants into wood pores, cracks and crevices that protect salmonellas. Spray pressures of 500–1000 psi have been suggested. Move from back to front and from top to bottom.

G. Dirt floors are virtually impossible to fully disinfect. Disinfectant has been applied to the floor at 1 gallon diluted disinfectant per 10 square feet. Investigators reported favorable results with chlorine and formaldehyde. Note formaldehyde warning below.

H. Decontaminate feed bins, boots, augers, hoppers and carts. Sanitize waterlines. Waterline and feed system directions have been published in Biosecurity for Poultry. Refer to Appendix for source. Be careful – metal and non-metallic components of watering systems can be damaged and lines plugged from improper use of sanitizing agents. Check with the manufacturer of farm water handling equipment before implementing any specific chlorine or other sanitation treatments of your wells and water lines. Water lines should be disinfected between flocks. Routine chlorination of poultry drinking water to a minimum 1 to 1.5 ppm free chlorine level has been reported to reduce the spread of salmonellas. A level of
1.5 to 2.5 ppm free chlorine is recommended in the last water trough.

I. In the past, direct application of formaldehyde solutions (formalin) has been used as a surface disinfectant for salmonella. Formaldehyde fumigation also has been used as a final crack and pore penetration step in salmonella disinfection, provided proper levels of relative humidity (at least 70%) and temperature (at least 70°F) were maintained. Such applications may soon be unlawful.

WARNING: Formaldehyde and formalin are dangerous chemicals. Consequently, contact state/federal (EPA, OSHA, FDA) authorities and licensed professionals before considering use! Gas masks, protective clothing and rescue plans are essential.

J. Promptly dry the building. Bullet space heaters have been used to speed drying in cold and damp climates.

K. Salmonella are invisible. Verify decontamination success by laboratory procedures. Refer to section on Bacteriological Monitoring. Laboratory tests of your facility should be negative before you place chicks.

VII. Preparations for Restarting*

A. Remove old water filters. Clean and disinfect casing and install new filters.

B. Remove coverings and tape used to protect electrical circuits and motors and make sure that all electrical equipment, time clocks, feed and water lines, brooder stoves, etc. operate properly.

C. All decontamination equipment such as rakes, shovels, scrapers, brushes, trucks, manure spreaders, bucket loaders and spray/disinfection devices also should be cleaned and disinfected after use and stored in a secure location.

VIII. Reuse of Litter

A. The reuse of litter from known positive houses will enhance the recycling of salmonellas and other pathogens.

* Adapted from Biosecurity for Poultry. 1987 (Brunet)
Table 2. Properties and Examples of Common Disinfectants$^{a,b}$

<table>
<thead>
<tr>
<th>Special Properties</th>
<th>Hypochlorites</th>
<th>Chloramines</th>
<th>Iodophors</th>
<th>Cresols</th>
<th>Phenols</th>
<th>Glutaraldehyde</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active against Gram negative bacteria</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(Salmonella, E. coli, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistance to organic debris</td>
<td>Poor</td>
<td>Poor to fair</td>
<td>Good</td>
<td></td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td>Effect of hard water</td>
<td>None$^c$</td>
<td>None$^c$</td>
<td>None</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Detrimental effect of heat</td>
<td>d</td>
<td>d</td>
<td>No</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Residual activity</td>
<td>e</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Most effective Ph range</td>
<td>Acid</td>
<td>Acid</td>
<td>Acid</td>
<td></td>
<td>pH5–8.5</td>
<td></td>
</tr>
<tr>
<td>Compatibility with anionic surfactants</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(soaps)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compatibility with non-ionic surfactants</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

Common Brands and Names

- Chloramine-T
- Betadine
- Crest-400
- Ucarsan
- Clorox
- Bio-Dyne
- Environ-D
- lon:ec
- LpH-AG
- Isodyne
- Lysol
- Losan
- Orthophenylphenol
- R.I.D.
- PD256
- Tamed Iodine
- Tek-Trol

$^a$Modified from Biosecurity for Poultry (Brunet) and Selection and Use of Disinfectants in Disease Prevention (Meyerholz and Gaskin).

$^b$Where product types or names appear, no discrimination is intended and no endorsement over other products not mentioned is implied by the U.S. Animal Health Association (USAHA). Mention of a trade name does not constitute a guarantee or warranty of the product by the USAHA.

$^c$Unless hard water is alkaline.

$^d$Use at less than 110°F, active principal driven off by heat.

$^e$Hypochlorites: No, chloramines: Yes

$^f$Products listed are intended as examples; many other products are not listed. New quaternary ammonium disinfectants exist.
I. Purpose

A visual inspection is not enough. Salmonella are invisible. Birds, pets, pests or surfaces that "look O.K." can, nonetheless, be contaminated. Consequently, properly executed bacteriological monitoring at a qualified laboratory is necessary to assess the effectiveness of your cleaning and disinfecting program.

II. A Matter of Choice

Like a compass, monitoring lets you know where you are on the sea of risk reduction. Lawyers have offered that knowledge of a problem may be preferable to being blind to it. Refer to Appendix for sources of further guidance under the Economic/Legal heading. Sampling and testing services are available from both private and public laboratories.

III. Sample Collection Sites and Procedures

Sampling often requires on-the-spot judgments. It is impossible to sample everything. Collection technique is more important than the number of samples collected. Limited sampling and improper laboratory technique can result in a false negative reading. **Choose a laboratory that follows recommended salmonella culture techniques.** A laboratory manual for the isolation and identification of avian pathogens, including salmonellas, has been published by the American Association of Avian Pathologists (Appendix).

Refer to more detailed procedures for collecting environmental samples and drag swabs as described in auxiliary provisions of the National Poultry Improvement Plan APHIS 91−55−017 1993, 9CFR, Part 147.12. Use gauze pads or sponges that are not impregnated with a bacteriocidal agent. The NPIP publication may be obtained from the State Veterinarian's office.

A. Sampling the Building and Its Equipment

1. Surfaces of ceilings, walls, floors, fan housings and blades, waterers and feed troughs may be sampled.

2. Collection procedures. Use of cotton−tipped swabs is limited to sampling only hard−to−reach locations. For most other areas, 3 X 3 or 4 X 4 inch multiple−ply lightly−moistened gauze pads are preferred. They accommodate the forceful wiping of large (sometimes 2 X 2 foot) areas of a variety of surfaces. Pad moistness with double−strength skim milk enhances adherence of particulate matter. Sample collectors should wear sterile disposable gloves. Gauze pad samples should be promptly refrigerated at 35 to 38°F and cultured within 7 days. After the sample is collected, re−wipe the area with a disposable towel or gauze sponge moistened with a disinfectant to remove media left on the surface. Discard the towel or sponge; do not culture the towel or gauze sponge.

B. Sampling Manure/Litter Surfaces with Drag Swabs
1. Drag swabs, which typically contact the surfaces of many hundreds of freshly-voided droppings, are useful because they usually produce results that reflect the salmonella intestinal carrier or organ infection status of chickens. Instead of dragging the swabs, they may be attached to a wand.

2. Collection procedures. Using 2 gauze pads (previously described) connected to a cord of proper length and strength, draw the pads over the litter. Refrigerate, do not freeze the gauze pads and culture within 7 days.

C. Sampling Litter and Dust Samples

1. An alternative to the drag swab method is the collection of dust and/or litter samples from the house.

2. Collection procedures.

   Samples may be collected in broth or dry containers. Fecal material, litter or dust should be collected in accordance with the procedures described in auxiliary provisions of National Poultry Improvement Plan APHIS 91–55–017 1993, 9CFR, Part 147.12.

D. Sampling of rodents appears to be a prime strategy. The use of live rodent traps may supply valuable information.

1. Estimation of the initial degree of infestation.

2. Mechanism by which effectiveness of baiting and habitat-elimination procedures can be assessed by the producer. A suggested procedure is the use of a T-pipe which allows visual inspection of bait consumption.

   Traps are placed along the perimeter "mouse raceways" – the floor/wall intersections, especially where evidence of mouse activity is seen. When placing traps, remember that rodents usually stay within 20 to 50 feet of the nest. Traps may be baited with poultry feed and moved to suspected areas of reinfestation in order to provide an "early alert" if a new invasion is beginning.

   Traps should be checked daily. Trapped mice are killed and refrigerated at 35 to 38°F and submitted to a laboratory for salmonella examination of the viscera.

   A trap, Tin Cats, has been effectively used in Pennsylvania. It is manufactured by Woodstream Corporation, Lititz, PA 17543 and costs about $6.

E. Sampling Hatchery Debris, Environment and Mortality
Table 3. Examples of Chicken Monitoring Times, Locations and Purposes.

<table>
<thead>
<tr>
<th>Time/Age</th>
<th>Location</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1 day&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>Chick transport papers, meconium, cull chicks and dead chicks</td>
<td>Detection of breeder or hatchery transmitted Salmonella</td>
</tr>
<tr>
<td>Any age&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Abnormal mortality</td>
<td>Determine cause of mortality</td>
</tr>
<tr>
<td>Depopulation of House</td>
<td>Droppings/dust or drag swabs of litter</td>
<td>Detection of salmonella contamination</td>
</tr>
<tr>
<td>2 – 3 days after decontamination (C&amp;D) of facility&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Building/equipment surfaces, fan blades, etc.</td>
<td>Evaluation of C&amp;D operation prior to housing new chicks</td>
</tr>
</tbody>
</table>

<sup>a</sup>A laboratory manual detailing sampling and culture procedures and a magazine update on culture media improvements have recently been published. For more information refer to Appendix.

<sup>b</sup>An additional test for Salmonella in one-day-old chicks is described in the mentioned laboratory manual (Chapter 1, page 5).

<sup>c</sup>At any age, bacteriological examination of culls, fresh deads, and trapped mice especially, are used to enhance detection efficiency.

<sup>d</sup>If cultures are positive for salmonella, consult professional (veterinarian) for guidelines in better C & D procedures.

FEED

Many salmonella subtypes have been found in feed and feed ingredients. Salmonella contamination after manufacturing also needs to be prevented. Care should be exercised in selecting feed suppliers and in shipping, storing feed.

I. Feed and Feed Ingredient Suppliers

A. Consider including a salmonella negative specification (specific number of samples negative by a specific test) to feed ingredient and feed purchase contracts. This is particularly important when dealing with new or unknown suppliers or until confidence with regard to lack of microbial contaminants is developed in a suppliers' product.

B. Obtain feed from mills that follow the guidelines. "Recommended Salmonella Control for Processors of Livestock and Poultry Feeds," Published by the American Feed Industry Association, 1501 Wilson Boulevard, Suite 1100, Arlington, VA 22209.

C. It is strongly recommended that producers use animal protein ingredients originating from rendering plants participating in the Animal Protein Producers Industry (APPI) Salmonella Reduction Education Program or the Fishmeal Inspection Program sponsored by the National Marine Fisheries Service (NMFS). Contact APPI or
NMFS for a listing of participants in the respective programs. Both programs are working toward reduction of salmonella contamination in animal proteins.

D. Dryness of feed ingredients and finished feed at all stages of manufacture and storage is a critically important risk reduction step.

II. Heat Treatment and Pelleting of Feed
A. It is recommended heat treated, pelleted feed be used to reduce the risk of introduction of salmonellas into poultry flocks by contaminated feed ingredients. All feed manufactured in pellet form must contain a minimum moisture content of 14.5 percent prior to pelleting and must be subject to temperature of 190°F or above during the manufacturing process followed by drying using clean air. Alternative pelleting processes are available but their effectiveness to destroy salmonella must be validated.

B. Chicks are very susceptible to salmonellosis from 1 to 14 days of age. It is highly critical that the initial feed be pelleted.

C. Succeeding feed should be pelleted. If mash feeds are used and animal protein is included, the animal protein should be purchased from a participant in either the APPI Salmonella Reduction Education Program or the NMFS Fishmeal Inspection Program.

III. Feed Protection and Quality Control
A. Prevent contamination of feed in storage with an aggressive rodent and wild bird control program.

B. Prevent feed from getting wet. Condensation control and maintenance of the moisture barriers in storage bins is essential.

C. Seek advice from your nutritionist and/or veterinarian before using anti-salmonella feed additives. They vary in effectiveness and mode of action and may be subject to regulatory control by FDA.

D. Establish your own bank of feed samples so that they are available for analysis in case of a trace back situation. Feed banks and testing promote quality control. Store samples in a clean, dry location at room temperature.

**BIOSECURITY—BROILERS**

Biosecurity practices for the prevention of most viral, mycoplasma, and various bacterial diseases are equally appropriate in an integrated salmonella risk reduction program.

Salmonella can gain a foothold when a virus or other infectious agent weakens your flock's natural defenses. Research has demonstrated that infectious bursal disease, coccidiosis, mycoplasmosis, mycotoxicosis, and even antibiotic medication may increase susceptibility to salmonellosis. Consequently, every step in biosecurity (human traffic control, cleaning and disinfection of all materials moving between flocks, proper building location and construction, and much more) adds up to an investment in survival.
BEST MANAGEMENT PRACTICES

Look not at biosecurity as an expense — look at it instead as an insurance premium helping to ensure a more predictable future.

Humans can also carry salmonella to your chickens. Consequently, the personal hygiene of all farm workers is an essential consideration. Provide enough clean, operable toilets, with hand washing and drying facilities, in locations and numbers to serve all employees.

Additional materials (videotapes, pamphlets, etc.) to inspire, train, and retrain everyone in your operation are available for use at all levels, from the owner to the hired hand. Refer to Appendix. Review them regularly. If you cannot adopt all recommended practices, adopt some of them. Then add more every year until you have built a solid defense.

BIOSECURITY/HYGIENE CHECK LISTS

I. Suggested Check Lists for Flock Caretakers and Farm Managers
   A. Flock Caretakers. This list could be posted in all houses. Consider printing large, obvious posters.
      1. Watch for, correct and immediately report any rodent, beetle, fly, wild bird or pet control problems. Consider rats, mice and flies as "Poultry Enemy Number One!"
      2. Daily patrol for prompt, secure removal of all dead and dying birds.
      3. Have disinfectant soap available for personnel handling chickens.
      4. Do not come into the poultry house after hunting.
      5. Wear clean clothing.
      6. People and equipment moving from flock to flock or house to house should be sanitized to reduce transmission of salmonella and other pathogens.
   B. Farm Managers
      1. Establish training programs and require attendance by all employees.
      2. Insist that biosecurity garments are worn by all visitors, farm executives and anyone else.
      3. Absolutely prohibit caretakers from maintaining any home flocks of poultry, birds or fowl of any kind. Avoid contact with livestock and other animals because they may be carriers of salmonellas.
   C. Production Hatcheries should follow NPIP Guidelines Part 145.31.
   D. See List of Biosecurity information listed in appendix.
# Appendix

## Educational Resources

<table>
<thead>
<tr>
<th>Title</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biosecurity</strong></td>
<td></td>
</tr>
</tbody>
</table>
BEST MANAGEMENT PRACTICES

Cleaning and Disinfection


American Association of Avian Pathologists
New Bolton Center
Kennett Square, PA 19348

Economics/Legal


C.J. Pakuris, Esq. Margolis, Edelstein, Scherlis, Sarowitz and Kramer
Curtis Center, 4th Floor
Independence Square West
Philadelphia, PA 19106–3304
(215–922–1100)

Laboratory Methods


American Association of Avian Pathologists University of Pennsylvania
New Bolton Center
Kennett Square, PA 19348–1692
$26 per copy (215–444–4282)


Feedstuffs
12400 Whitewater Drive, Suite 160
Minnetonka, MN 55343


American Association of Avian Pathologists
New Bolton Center
Kennett Square, PA 19348–1692
HOLDER

Renderers

List of APPI participants with city and state addresses.

Ms. Dara John
Administrative Secretary
APPI
R.R. 2 Box 214C
Huntsville, MO 65259
(616) 277–3469

List of NMFS Fishmeal Inspection Program participants

Sandra Sharp
Department of Commerce
National Marine Fisheries Service
P.O. Drawer 1207
3209 Fredrick Street
Pascagoula, MS 39568–1207
(601) 762–7402

Vectors


Department of Entomology
Agricultural Extension, Box 7613
North Carolina State University
Raleigh, NC 27592–7613
(919–515–2703) No charge

Rodent Control in Poultry Facilities

Larry Kendall
Retail Specialties Division
Purina Mills
P.O. Box 66812
St. Louis, MO 63166
INTRODUCTION

The turkey industry has made considerable progress in the reduction of salmonellosis. Pullorum disease and fowl typhoid have been practically eliminated. The incidence of Salmonella typhimurium in turkeys has been greatly reduced, however, other salmonellas are isolated frequently from market and breeding flocks. Salmonella infections may occasionally cause serious economic losses in young turkeys and the salmonella contamination of turkey products have a potential public health concern.

The cycle of infection of salmonellosis in turkeys is a complex problem. The organism may become established in breeder flocks and be egg transmitted. The environment of the turkey buildings may become contaminated and be a source of the infection to turkeys of any age. Rodents, flies, insects, free flying birds, pets and other animals on the premise including people may be carriers of salmonellas and be a source of introduction. Feed and feed ingredients and the water supply, particularly surface water, may become contaminated with salmonellas and be a threat. Unfavorable damp environments allow salmonella bacteria to multiply to higher levels, creating an undesirable cycle of litter-to-bird and bird-to-litter transmission and persistence.

If salmonellosis in turkeys is going to be further reduced, it will require a total approach to the problem. These guidelines will help the turkey industry to reinforce the use of Best Management Practices to reduce the economic burden and public health concern of salmonellosis.


POULT REPLACEMENT

I. Purchase your poults from hatcheries participating in the National Poultry Improvement Plan "U.S. Sanitation Monitored, Turkeys" program.

II. Significantly reduce your turkey facilities of all rodents, wild birds, insects and pets. Refer to section on Vector Control.

III. Clean, wash and disinfect your turkey houses and equipment. Refer to section on Decontamination of Facilities.

IV. Monitor for successful turkey house decontamination. Monitor poults on arrival. Refer to section on Bacteriological Monitoring.
SALMONELLA RISK REDUCTION IN TURKEYS*

V. Attend to feed quality control and proper feed storage. Refer to section on Feeds.

VI. Adhere to strict, continuing vector control and biosecurity standards throughout the grow-out period. Refer to sections on Vector Control and Biosecurity.

VII. Vaccines. Vaccination has been used in conjunction with biosecurity to attempt to reduce the effects of disease when the risks of exposure appear high. Vaccination results vary with different diseases and methods of vaccine preparation. Salmonella vaccination of turkey breeder flocks prior to egg production with oil based autogenous vaccines has been used to reduce vertical transmission.

VIII. Competitive Exclusion (CE). Under experimental conditions, immediate post-hatch establishment of CE intestinal microflora in combination with a sanitary environment may help reduce the risks of salmonella colonization in the gut of typically susceptible poults. However, right now, there are no commercially available CE cultures in the United States and the use of CE cultures in this country is limited to research projects.

VECTOR CONTROL

Vector control goes beyond preparation of depopulated houses prior to cleaning and disinfection. It also is an absolutely essential risk reduction practice for the entire life of your turkeys.

Routine, licensed professional rodent and insect detection/extermination is suggested. Be sure that personnel practice strict biosecurity procedures for their clothing, equipment and vehicles and that the service provider has a good vector control record with poultry operations. A well illustrated, detailed publication, Integrated Pest Management for Poultry, (Arends and Stingham) is available free of charge. To order, refer to Appendix. Purina Mills has produced a film illustrating unique techniques for rodent monitoring and control.

I. Rodents

Rodent feces have been found to contain infectious doses of salmonella, particularly S. enteritidis, S. typhimurium and S. arizonae. Mouse pellets are commonly deposited in feed troughs and this is believed to increase salmonella contamination in confined poultry. Beyond their salmonella amplification role, rodents appear to carry infection to other houses and farms.

Consequently, salmonella risk reduction should include (1) attempts to make all facilities rodent-proof, (2) proper selection of baits and bait placement, (3) prompt, secure disposal of any dead birds, or unused or
spilled feed, and (4) regularly repeated professional rodent inspections, baiting and trapping. A detailed rodent control program follows.

II. Rodent Proofing
A. Eliminate potential rodent harborage inside and outside the poultry house (e.g. high grass, shrubs, garbage, broken equipment, construction debris, burrows under the foundation, and cardboard boxes).
B. It is suggested that some type of rodent barrier be installed around the perimeter of turkey houses (e.g. crushed rock in a 2 foot wide border around house walls, or concrete or asphalt).
C. Seal all entrance holes inside and outside the building. Repair siding and close siding sheet seams. Doors and door frames should fit snugly.
D. Seal holes and broken concrete. The use of "steel wool" to block a hole with a masonry final coat is a method to insure no re-entry or exit.
E. Feed bins and buildings should be secured at night. Dispose of dead birds daily.

III. Preparations for Baiting
A. After house depopulation, all feed should be immediately removed from feeders and building so that rodents will promptly go to the bait.
B. Remove all alternative food sources for rodents, (e.g., spilled feed and dead birds).
C. Inspect the outside of the building routinely for rodent holes and burrows.

IV. Bait Selection and Placement
A. Warfarin, diphacinone, or pival are "multiple-dose" type anticoagulant rodenticides. They require continuous feeding over several days to have any lethal effect. They are best used as a routine every two-week baiting program.
   Newer anticoagulants contain brodifacoum and bromadiolone which may cause death 3–5 days after a single feeding. Such "single-dose" rodenticides can be used at any time and are especially appropriate immediately upon house depopulation. A list of rodenticides for use in poultry buildings can be found in Table 1.
B. Purchasers of rodenticides often under estimate the long-term need. Secure an adequate inventory.
C. Save bait by baiting only active holes. Fill all rodent holes with dirt or paper and then bait only those that have been reopened.
D. Place bait according to directions supplied by the manufacturer of your rodenticide.
E. Control of attic rodents is facilitated by construction of a hatch for attic access and at least once yearly baiting with high wax, single-dose bait, in throw packs as often as needed.
SALMONELLA RISK REDUCTION IN TURKEYS*

F. Once control has been achieved, inspection and service of permanent bait sites is essential every two weeks. Record the location and numbers of trapped mice and maintain these records.

G. Caution: All baits are poisonous to rodents, turkeys, other animals and people. Place baits carefully to prevent contamination of feed or accidental access by poultry and humans. Baits should not be placed loosely on the ground in areas frequented by people who might carry it on shoe soles and contaminate sensitive areas.

Table 1. Rodenticides for Use In Poultry Buildings

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Single/Multiple Feeding</th>
<th>Secondary Poisoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromethalin</td>
<td>Single</td>
<td>No</td>
</tr>
<tr>
<td>Cholecalciferol (Vit. D.)</td>
<td>Multiple</td>
<td>No</td>
</tr>
<tr>
<td>Warfarin and Na–Salt</td>
<td>Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Brodifacoum</td>
<td>Single</td>
<td>Yes</td>
</tr>
<tr>
<td>Bromadiolone</td>
<td>Single</td>
<td>Yes</td>
</tr>
<tr>
<td>Pindone and Na–Salts</td>
<td>Single/Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Diphacinone and Na–Salts</td>
<td>Single/Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Chlorophacinone</td>
<td>Single/Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>PMP–Ca–Salt</td>
<td>Multiple</td>
<td>Yes</td>
</tr>
<tr>
<td>Scilliroside</td>
<td>Single</td>
<td>No</td>
</tr>
<tr>
<td>Zinc phosphide</td>
<td>Single</td>
<td>No</td>
</tr>
</tbody>
</table>

EPA registered for use in agricultural buildings

V. Insects

A. Basic control strategy

The control of flies and beetles, which also may be salmonella vectors, requires use of a variety of practices. This reduces the selection pressure encountered with any single method. For example:

1. Keep litter well ventilated and dry.
2. Prevent water leaks and remove any wet areas.
3. If possible, use biological control methods (fly parasites and predators).
4. Use different classes of insecticides. Alternate, for example, between organic phosphates (Malathion), carbamates (Sevin) and pyrethrins.

B. Insecticide Application

1. After the floor is dry following cleaning and disinfection, apply an approved insecticide to the floor, support poles and walls to control beetles and other insect pests.
2. Synergized pyrethrins (pyrethrin + piperonyl butoxide) are among the few insecticides that can be utilized in automatic spray systems inside poultry houses. Their advantages are: ability for quick "knockdown" of flying insects; short residual times; and low mammalian toxicity. The rate of application of such insecticides, particularly when applied by an automatic spray system, should be no more frequent than twice a week.

3. Follow all manufacturer–recommended safety precautions when applying insecticides.

VI. Wild Birds and Pets

Avoid feed spills outside buildings and clean up immediately if they occur. Prevent birds from nesting and reproducing in the turkey building. Buildings should be constructed not only to exclude wild birds but to avoid birds perching under eaves or on blinds. Pets should be banned from turkey houses.

DECONTAMINATION OF FACILITIES

To reduce the risks of a flock–to–flock carry over of Salmonella and other infectious agents, a between–flock decontamination program is necessary.

If any of your facilities tested salmonella–positive, the facility needs to be decontaminated promptly after bird removal to prevent residual contamination from infecting your replacements.

Successful decontamination programs require thorough, systematic implementation, proper equipment and professional training.

Decontamination of brooder and grow out facilities presents the turkey industry with a serious challenge due to facility size and complexity. Additionally, the common use of wooden construction materials, which are porous, appear to provide bacteria protection from the killing effects of disinfectants.

Formaldehyde has been widely used in the past to help disinfect turkey buildings. Although particularly effective against salmonellas, its use appears in jeopardy because of human safety concerns, product availability, and regulatory policies. Application of alternative fumigants, gases, heat–enhanced disinfectants, high–pressure sprays or disinfectant foams and use of sealants to reduce wood porosity may need to be further assessed as possible aids in disinfecting porous surfaces.

Facility decontamination needs to include the following basic considerations and precautions. Step–by–step decontamination procedures and the names and examples of various commercial disinfectants follow.

BASIC CONSIDERATIONS

1. Invest in thorough dry cleaning with removal of all caked, layered or loose debris. This simplifies future cleanup operations and reduces the expense of wet cleaning.
Disinfectants and fumigants are effective only on clean surfaces. Cleaning and disinfection programs, when not fully effective at first, have been reported to have increased efficacy when they were improved and redone or repeated from flock to flock. Field observations have indicated a significantly improved probability for maintaining salmonella-negative replacements when they were placed in facilities that had previously passed both visual inspections and post-disinfection laboratory tests.

Bacteria can multiply on damp surfaces; therefore, disinfection should be started soon after washing/rinsing, and preferably within 24 hours.

Drying of the facility immediately after application of disinfectants is highly advisable. Dryness is an impediment to salmonella multiplication. Recent studies indicate that relative humidity levels of less than 80% significantly reduce salmonella populations.

Carefully follow all disinfectant safety, dilution and application directions provided by the manufacturer. Consult with the suppliers of both your equipment and disinfectants for the best and safest procedures for such items as feeders and waterers. The operator must use protective clothing.

DECONTAMINATION STEP–BY–STEP

I. Bird Removal
   A. Remove all dead and live birds from the building; this includes all escaped birds.
   B. Immediately begin vector control procedures during bird removal. Refer to guideline section on Vector Control.

II. Dry Cleaning
   A. Turn off power to electrical equipment prior to dry or wet cleaning. Non-removable motors, switches, etc., can be dry cleaned with compressed air or brushing. Extreme care should be taken about not getting any water inside electric motors. Duct tape can be used to cover the slots in motor housings prior to wet cleaning and disinfection. The tape must be removed after wet cleaning and disinfection is completed.
   B. Clean fans and other air inlets from the outside.
   C. On the inside, brush, sweep, vacuum and wipe dust and other dirt from ceilings, light fixtures, beams, ledges, walls, fans, air inlets and walkways. Move from top to bottom.
   D. Promptly open feeder lines and remove feed from trough, all line corners and all other points of feed accumulation.
   E. Hard surface (concrete) floors can be cleaned faster and more easily than clay or earthen floors. Completely remove all litter. Hand sweeping and shoveling will be necessary around the perimeter,
doorways, walkways, support poles, and corners of most houses to do a satisfactory job. If possible, fill trailers with manure inside the house and cover before moving it to a disposal or composting site. Manure should not be spread near poultry facilities.

III. Wet Cleaning

Wet cleaning includes soaking, washing and rinsing steps. Use of hot water is preferred. Detergents and other surfactants are often added to washing solution to loosen debris and films and allow better penetration of cleaning agents. Mash feeds often leave accumulations of oily debris on inner surfaces of feed troughs. This can be removed by thorough high pressure spray and brush scrubbing. Trough chains and surfaces should be dried and protected with a light coat of mineral oil to prevent rusting.

Salmonella can multiply to high numbers in the presence of debris and moisture. Therefore, the following steps should be executed without interim waiting periods.

A. Soften dirt in heavily soiled areas. A low pressure (200 to 300 psi) sprayer, delivering 10–30 gallons/minute, is considered adequate.

B. Washing. Professional contractors use a systematic spray technique. They start at the back and work toward the front of the building, spraying the ceiling first, then the walls, and finally the floor. Use sprayer attachments and nozzles that permit washing of hard-to-reach areas.

1. Wash ceilings and walls. Clean everything completely. Although use of pressure sprays ranging from 200–2000 psi have been reported, washing pressures of 750–2000 psi appear to be preferred. At high pressure, however, special care and safety garments are needed. Pressure sprayers can cut human skin like a knife. Care must be exercised to follow the manufacturer’s instructions for the use of this equipment.

2. Pay special attention not only to the top, but also to the underneath sides of troughs and obvious and hidden surfaces of all chains and augers.

3. Wash storage rooms, hallways, break, wash and restrooms and cool-cel vents in environmentally controlled breeder buildings.

4. Manually clean any areas that have resisted prior cleaning.

C. Rinsing

1. A final rinse is suggested to obtain a truly clean building and to reduce residues of cleaning chemicals.

2. Immediately remove all puddles. They are bacterial breeding grounds.

D. Danger of Carbon Monoxide Poisoning from Gasoline Engines

The National Institute for Occupational Safety and Health (NIOSH) recently issued the following warning because of recent farm accidents:

1. Do not operate gasoline powered pressure washers indoors to clean buildings or other machinery with gasoline engines in any building because of the emission of carbon monoxide, a deadly gas.
SALMONELLA RISK REDUCTION IN TURKEYS*

IV. Repairs
All repairs to the house should be made at this point.

V. Inspection
Third-party visual inspection for completeness of the wet cleaning and repair operations is recommended. This may be done by an outside authority or by an in-house unbiased employee responsible for quality control.

VI. Disinfection
Disinfection should be started within 24 hours of rinsing. Because disinfectants are effective only on clean surfaces, do not begin disinfection until the house has passed its inspection for proper cleaning.

A. Source of water for disinfection. Only clean potable water should be used for disinfection. Water from streams and ponds may reduce the effectiveness of disinfectants.

B. Heat Enhancement. All disinfectants, whether sprays, foams, aerosols, or fumigants, work best at temperatures above 65°F. Temperatures for chlorine- and iodine-based disinfectants should not exceed 110°F.

C. Dangerous Mixtures. Each disinfectant is the result of careful formulation, and any addition of detergents, surfactants or insecticides to a disinfectant without the approval of its manufacturer could dangerously reduce the efficacy of one or more of the products in the mixture. For economy, efficacy and human and flock safety, manufacturer's label instructions must be followed carefully.

D. Evaluation of Products. There has been an influx of claims for new salmonella disinfectants and control systems. Table 2 provides guidance on evaluating efficacy of various products.

E. One gallon of diluted disinfectant is ordinarily applied to approximately 100–150 square feet of surface area. The total amount of disinfectant solution needed is determined by the total surface area of the floor, ceiling and walls.

F. Follow application instructions of the manufacturer. Use of pressure sprays or thermal fogging devices is advisable to help force disinfectants into wood pores, cracks and crevices that protect salmonellas. Spray pressures of 500–1000 psi have been suggested. Move from back to front and from top to bottom.

G. Dirt floors are virtually impossible to fully disinfect. In situations where dirt floors can not be concreted, disinfectant is applied to the floor at 1 gallon diluted disinfectant per 10 square feet. Favorable results have been reported with chlorine and formaldehyde. Note formaldehyde warning below (I).

H. Decontaminate feed bins, boots, augers, hoppers and carts. Sanitize waterlines. Waterline and feed system directions have been published in Biosecurity for Poultry. Refer to Appendix for source.
NAGARAJA, HALVORSON

Be careful - metal and non-metallic components of watering systems can be damaged and lines plugged from improper use of sanitizing agents. Check with the manufacturer of farm water handling equipment before implementing any specific chlorine or other sanitation treatments of your wells or water lines. Water lines should be cleaned and disinfected between flocks.

Routine chlorination of poultry drinking water to a minimum 1 to 1.5 ppm free chlorine level has been reported to reduce the spread of salmonellas. A level of 1.5 to 2.5 ppm free chlorine is recommended in the last water trough.

I. In the past, direct application of formaldehyde solutions (formalin) has been used as a surface disinfectant for salmonella. Formaldehyde fumigation also has been used as a final crack- and pore-penetrating step in salmonella disinfection, provided proper levels of relative humidity (at least 70%) and temperature (at least 70°F) were maintained. Such applications may soon be unlawful. WARNING: Formaldehyde and formalin are dangerous chemicals. Consequently, contact state/federal (EPA, OSHA, FDA) authorities and licensed professionals before considering use! Gas masks, protective clothing and rescue plans are essential.

J. Promptly dry the building. Bullet space heaters are one method to speed drying in cold or damp climates.

K. Salmonellas are invisible. Verify decontamination success by laboratory procedures. Refer to section on Bacteriological Monitoring. Laboratory tests of your facility should be negative before you place poults.

VII. Preparations for Restarting*
A. Remove old water filters. Clean and disinfect casing and install new filters.

B. Remove coverings and tape used to protect electrical circuits and motors and make sure that all electrical equipment, time clocks, feed and water lines, brooder stoves, etc. operate properly.

C. All decontamination equipment such as rakes, shovels, scrapers, brushes, trucks, manure spreaders, bucket loaders and spray/disinfection devices also should be cleaned and disinfected after use and stored in a secure location.

VIII. Reuse of Litter
The reuse of litter from known positive houses will enhance the recycling of salmonellas and other pathogens.

*Adapted from Biosecurity for Poultry. 1987. (Brunet).
Table 2. Properties and Examples of Common Disinfectants $^{a,b}$

<table>
<thead>
<tr>
<th>Special Properties</th>
<th>Hypochlorites</th>
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<tbody>
<tr>
<td>Active against Gram negative bacteria</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Resistance to organic debris</td>
<td>Poor</td>
<td>Poor to fair</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Effect of hard water</td>
<td>None$^c$</td>
<td>None$^c$</td>
<td>None</td>
<td>Yes</td>
</tr>
<tr>
<td>Detrimental effect of heat</td>
<td>$d$</td>
<td>$d$</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Residual activity</td>
<td>$e$</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Most effective pH range</td>
<td>Acid</td>
<td>Acid</td>
<td>Acide</td>
<td>pH 5–8.5</td>
</tr>
<tr>
<td>Compatibility with anionic surfactants</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Compatibility with non-ionic surfactants</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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</table>

Common Brands and Names$^f$

<table>
<thead>
<tr>
<th>Chloramine-T</th>
<th>Betadine</th>
<th>Cres–400</th>
<th>Ucarsan</th>
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<tr>
<td>Clorox</td>
<td>Bio–Dyne</td>
<td>Environ–D</td>
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<tr>
<td>Halazone</td>
<td>Iofec</td>
<td>LPH–AG</td>
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<tr>
<td></td>
<td>Isodyne</td>
<td>Lysol</td>
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<tr>
<td></td>
<td>Losan</td>
<td>Orthophenylphenols</td>
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<tr>
<td></td>
<td>R.I.D.</td>
<td>PD256</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tamed Iodine</td>
<td>Tek–Trol</td>
<td></td>
</tr>
</tbody>
</table>

$^a$Modified from Biosecurity for Poultry (Brunet) and Selection and Use of Disinfectants in Disease Prevention (Meyerholz and Gaskin).

$^b$Where product types or names appear, no discrimination is intended and no endorsement over other products not mentioned is implied by the U.S. Animal Health Association (USAHA). Mention of a trade name does not constitute a guarantee or warranty of the product by the USAHA.

$^c$Unless hard water is alkaline.

$^d$Use at less than 110°F, active principal driven off by heat.

$^e$Hypochlorites: No, chloramines: Yes

$^f$Products listed are intended as examples; many other products are not listed. New types of quaternary ammonium disinfectants have been developed.
I. Purpose
   A visual inspection is not enough. Salmonellas are invisible. Birds, pets, pests or surfaces that "look O.K." can, nonetheless, be contaminated. Consequently, properly executed bacteriologic monitoring at a qualified laboratory is necessary to assess the effectiveness of your cleaning and disinfecting program.

II. A Matter of Choice
   Like a compass, monitoring lets you know where you are on the sea of risk reduction. Lawyers have offered that knowledge of a problem may be preferable to being blind to it. Refer to Appendix for sources of further guidance under the Economics/Legal heading. Sampling and testing services are available from both private and public laboratories.

III. Sample Collection Sites and Procedures
   Sampling often requires on-the-spot judgments. It is impossible to sample everything. Collection technique is more important than the number of samples collected. Limited sampling and improper laboratory technique can result in a false negative reading. Choose a laboratory that follows recommended salmonella culture techniques. A laboratory manual for the isolation and identification of avian pathogens, including salmonellas, has been published by the American Association of Avian Pathologists (Appendix).

   Refer to more detailed procedures for collecting environmental samples and drag swabs as described in auxiliary provisions of the National Poultry Improvement Plan APHIS 91–55–017 1993, 9CFR, Part 147.12. Use gauze pads or sponges that are not impregnated with a bacteriocidal agent. The NPIP publication may be obtained from the State Veterinarian's office.

A. Sampling the Building and Its Equipment
   1. Surfaces of ceilings, walls, floors, fan housings and blades, waterers and feed troughs may be sampled.
   2. Collection procedures. Use of cotton-tipped swabs is limited to sampling only hard-to-reach locations. For most other areas, 3 X 3 or 4 X 4 inch multiple-ply lightly-moistened gauze pads are preferred. They accommodate the forceful wiping of large (sometimes 2 X 2 foot) areas of a variety of surfaces. Pad moistness with double-strength skim milk enhances adherence of particulate matter. Sample collectors should wear sterile disposable gloves. Samples should be promptly refrigerated at 35 to 38°F and cultured within 7 days. After the sample is collected, rewipe the area with a disposable towel or gauze sponge moistened with a
disinfectant to remove media left on the surface. Discard the towel or sponge; do not culture the towel or gauze sponge.

B. Sampling Manure/Litter Surfaces with Drag Swabs
1. Drag swabs, which typically contact the surfaces of many hundreds of freshly-voided droppings, are useful because they usually produce results that reflect the salmonella intestinal carrier or organ infection status of turkeys. Instead of dragging the swabs, they may be attached to a wand.
2. Collection procedures. Using 2 gauze pads (previously described) connected to a cord of proper length and strength, draw the pads over the litter. Refrigerate, do not freeze the gauze pads and culture within 7 days.

C. Sampling Litter and Dust Samples
1. An alternative to the drag swab method is the collection of dust and/or litter samples from the house.
2. Collection procedures.

D. Sampling of rodents appears to be a prime sampling strategy. The use of live rodent traps may supply valuable information:
1. Estimation of the initial degree of infestation
2. Mechanism by which effectiveness of baiting and habitat-elimination procedures can be assessed by the producer. A suggested procedure is the use of a T pipe which allows visual inspection of bait consumption.

Traps are placed along the perimeter "mouse raceways" - the floor/wall intersections, especially where evidence (fecal pellets, fresh holes/chew marks or fresh trails) of mouse activity is seen. When placing traps, remember the rodents usually stay within 20 to 50 feet of the nest.

Traps may be baited with poultry feed and moved to suspected areas of reinfestation in order to provide an "early alert" if a new invasion is beginning. Traps should be checked daily. Trapped mice are killed and refrigerated at 35° to 38°F and submitted to a laboratory for salmonella examination of the viscera. Consult the laboratory about submission of rodents.

A trap, Tin-Cats, has been effectively used in Pennsylvania. It is manufactured by Woodstream Corporation, Lititz, PA 17543 and costs about $6.

E. Sampling Hatchery Debris, Environment and Mortality
Table 3. Examples of Turkey Monitoring Times, Locations and Purposes.

<table>
<thead>
<tr>
<th>Time/Age</th>
<th>Location</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 1 day&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>Poulт transport papers, meconium, cull poults and dead poults</td>
<td>Detection of breeder or hatchery transmitted Salmonella</td>
</tr>
<tr>
<td>Any age&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Abnormal mortality</td>
<td>Determine cause of mortality</td>
</tr>
<tr>
<td>Depopulation of House</td>
<td>Droppings/dust or drag swabs of litter</td>
<td>Detection of salmonella contamination</td>
</tr>
<tr>
<td>2–3 days after decontamination(C&amp;D) of facility&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Building/equipment surfaces, fan blades, etc.</td>
<td>Evaluation of C&amp;D operation prior to housing new poults</td>
</tr>
</tbody>
</table>

<sup>a</sup>A laboratory manual detailing sampling and culture procedures and a magazine update on culture media improvements have recently been published. For more information refer to Appendix.

<sup>b</sup>An additional test for Salmonella in one-day-old hatchlings is described in the mentioned laboratory manual (Chapter 1, page 5).

<sup>c</sup>At any age, bacteriological examination of culls, fresh deads, and trapped mice and flies, are used to enhance detection efficiency.

<sup>d</sup>If cultures are positive for salmonella, consult professional (veterinarian) for guidance in better C & D procedures.

**FEED**

Many salmonella serotypes have been found in feed and feed ingredients. Salmonella contamination after manufacturing also needs to be prevented. Care should be exercised in selecting feed suppliers and in shipping, and storing feed.

I. **Feed and Feed Ingredient Suppliers**

A. Consider including a salmonella negative specification (specific number of samples negative by a specific test) to feed ingredient and feed purchase contracts. This is particularly important when dealing with new or unknown suppliers or until confidence with
regard to lack of microbial contaminants is developed in a suppliers' product.


C. It is strongly recommended that producers use animal protein ingredients originating from rendering plants participating in the Animal Protein Producers Industry (APPI) Salmonella Reduction Education Program or the Fishmeal Inspection Program sponsored by the National Marine Fisheries Service (NMFS). Contact APPI or NMFS for a listing of participants in the respective programs. Both programs are working toward reduction of salmonella contamination in animal proteins.

D. Dryness of feed ingredients and finished feed at all stages of manufacture and storage is a critically important risk reduction step.

II. Heat Treatment and Pelleting of Feed

A. It is recommended that heat treated, pelleted feed be used to reduce the risk of introduction of salmonellas into turkey flocks by contaminated feed ingredients. All feed manufactured in pellet form must contain a minimum moisture content of 14.5 percent prior to pelleting and must be subject to temperature of 190 degrees F or above during the manufacturing process followed by drying to 12% moisture using clean air. Alternative pelleting processes are available but their effectiveness to destroy salmonellas must be validated.

B. Poultis are very susceptible to salmonellosis from 1 to 14 days of age. It is highly critical that the initial feed be pelleted.

C. Succeeding feed should be pelleted. If mash feeds are used and animal protein is included, the animal protein should be purchased from a participant in either the APPI Salmonella Reduction Education Program or the NMFS Fishmeal Inspection Program.

III. Feed Protection and Quality Control

A. Prevent contamination of feed in storage with an aggressive rodent and wild bird control program.

B. Prevent feed from getting wet. Condensation control and maintenance of the moisture barriers in storage bins is essential.

C. Seek advice from your nutritionist and/or veterinarian before using anti–salmonella feed additives. They vary in effectiveness and mode of action and may be subject to regulatory control by FDA.

D. Establish your own bank of feed samples so that they are available for analysis in case of a trace back situation. Feed banks and testing also promote quality control. Store samples in a clean, dry
Biosecurity practices for the prevention of most viral, mycoplasma, and various bacterial diseases are equally appropriate in an integrated salmonella risk reduction program.

Salmonella can gain a foothold when a virus or other infectious agent weakens your flock's natural defenses. Research has demonstrated that coccidiosis, mycoplasmosis, hemorrhagic enteritis, mycotoxicosis, and even antibiotic medication may increase susceptibility to salmonellosis. Consequently, every step in biosecurity (human traffic control, cleaning and disinfection of all materials moving between flocks, proper building location and construction, and much more) adds up to an investment in survival. Look not at biosecurity as an expense — Look at it instead as an insurance premium helping to ensure a more predictable future.

Humans can also carry salmonella to your turkeys. Consequently, the personal hygiene of all farm workers is an essential consideration. Provide enough clean, operable toilets, with hand washing and drying facilities, in locations and numbers to serve all employees.

Additional materials (videotapes, pamphlets, etc.) to inspire, train, and retrain everyone in your operation are available for use at all levels, from the owner to the hired hand. Refer to Appendix. Review them regularly. If you cannot adopt all recommended practices, adopt some of them. Then add more every year until you have built a solid defense.

**BIOSECURITY/HYGIENE CHECK LISTS**

I. **Suggested Check Lists for Flock Caretakers and Farm Managers**
A. Flock Caretakers. This list could be posted in all houses.
   Consider printing large, obvious posters.
   1. Watch for, correct and immediately report any rodent, beetle, fly, wild bird or pet control problems. Consider rats, mice and flies as "Poultry Enemy Number One!"
   2. Daily patrol for prompt removal of all dead and dying birds.
   3. Have disinfectant soap available for personnel handling turkeys.
   4. Do not come into the poultry house after hunting unless you have showered and changed all clothes and footwear.
   5. Wear clean clothing.
   6. People and equipment moving from flock to flock or house to house should be sanitized to reduce transmission of salmonella and other pathogens. Service youngest flocks first, then progress to older flocks.
B. Farm Managers
   1. Establish training programs and require attendance by all employees.
   2. Insist that biosecurity garments are worn by all visitors, farm executives
3. Absolutely prohibit caretakers from maintaining any home flocks of poultry, birds or fowl of any kind. Avoid contact with livestock and other animals because they may be carriers of salmonellas.

C. See list of biosecurity information available in Appendix.
# APPENDIX
## EDUCATIONAL RESOURCES

<table>
<thead>
<tr>
<th>Title</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biosecurity</strong></td>
<td></td>
</tr>
</tbody>
</table>
SALMONELLA RISK REDUCTION IN TURKEYS*

Cleaning and Disinfection


American Association of Avian Pathologists
New Bolton Center
Kennett Square, PA 19348

Economics/Legal


C.J. Pakuris, Esq. Margolis, Edelstein, Scherlis, Sarowitz and Kramer
Curtis Center, 4th Floor
Independence Square West
Philadelphia, PA 19106–3304
(215–922–1100)

Laboratory Methods


American Association of Avian Pathologists University of Pennsylvania
New Bolton Center
Kennett Square, PA 19348–1692
$26 per copy (215–444–4282)


Feedstuffs
12400 Whitewater Drive,
Suite 160
Minnetonka, MN 55343


American Association of Avian Pathologists
New Bolton Center
Kennett Square, PA 19348–1692
NAGARAJA, HALVORSON

Renderers

List of APPI participants with city and state addresses.

Ms. Dara John
Administrative Secretary
APPI
R.R. 2 Box 214C
Huntsville, MO 65259
(616) 277-3469

List of NMFS Fishmeal Inspection Program participants

Sandra Sharp
Department of Commerce
National Marine Fisheries Service
P.O. Drawer 1207
3209 Fredrick Street
Pascagoula, MS 39568-1207
(601) 762-7402

Vectors


Department of Entomology
Agricultural Extension, Box 7613
North Carolina State University
Raleigh, NC 27592-7613
(919-515-2703) No charge

Rodent Control in Poultry Facilities

Larry Kendall
Retail Specialties Division
Purina Mills
P.O. Box 66812
St. Louis, MO 63166
SALMONELLA SEROTYPES FROM ANIMALS AND RELATED SOURCES REPORTED DURING JULY 1992 – JUNE 1993

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National Veterinary Services Laboratories
Veterinary Services
Animal and Plant Health Inspection Service
U.S. Department of Agriculture
Ames, Iowa

SUMMARY
Serotyping results for 36,073 Salmonella isolates from animal disease cases and epidemiologically related sources are reported for July 1, 1992, through June 30, 1993. Of these, 35,180 (98%) isolates were serotyped at the National Veterinary Services Laboratories (NVSL). The most frequently identified serotypes were Salmonella enteritidis, S. typhimurium, S. heidelberg, S. hadar, and S. cholerasuis var. kunzendorf.

INTRODUCTION
Data were accumulated by the NVSL, and with the exception of serotyping results, were provided by laboratories that requested serotyping services. The data were screened for errors, and their accuracy reflects the commitment of referring laboratories to generating a quality report. This report also contains information from several laboratories that serotype salmonellae. We are grateful to them for these results. The purpose of this report is to make available serotype distribution and frequency data. Isolates formerly identified as "Arizona", which are now reported on the basis of their corresponding salmonella antigens, are reported separately in Tables 4, 5, and 6.

RESULTS
A total of 36,073 Salmonella isolates from animals and related sources from 48 states, the District of Columbia, and Puerto Rico were serotyped. This is a 15% increase from last year's total of 31,284'. Of these, 292 serotypes were identified (Tables 3 and 6). The 10 most common serotypes (Table 12) accounted for 53% of the total isolates identified. The five most frequently identified isolates have remained the same for the past 3 years.

Approximately one-third of all isolates submitted for serotyping resulted from activities of the Pennsylvania Pilot Project and the Salmonella enteritidis (SE) control program. Sources of these isolates included: environmental swabs, rodents, and chicken and pullet tissues. Those isolates characterized as "NOT SALMONELLA ENTERITIDIS" (NOT SE) were tested for "O" and, occasionally, "H" antigens. Twenty-four percent of
all isolates submitted (8,400 isolates) were identified as NOT SE.

Salmonella enteritidis was the most frequently identified serotype again this year, increasing 95% from 3,675 last year to 7,148 this year (Table 12). This large increase is due primarily to increased surveillance activities for SE. Salmonella enteritidis isolates were recovered from 35 states, the District of Columbia, and Puerto Rico (Tables 1 and 2). The majority of SE isolates were from environmental sources (41%) and chickens (30%). Only 31 of the isolates were from chickens with clinical disease. Salmonella pullorum isolates decreased again this year. There were 179 isolates of S. pullorum in 19912, 112 in 19921, and 73 in 1993 (Table 3).

Isolates identified as S. dublin decreased from 574 in 19912 to 540 in 19921 and to 417 in 1993 (Table 3). Seventy-three percent of S. dublin isolates were received from western states. Salmonella dublin continues as the second most frequently identified serotype from cattle. Salmonella typhimurium isolates identified from turkeys increased from 97 in 19921 to 225 this year (Table 3). Approximately one-third of these isolates were identified as causing primary or secondary infection (Table 7). A gradual increase in the number of S. typhimurium isolates has occurred since 1990 (Table 12).

REFERENCES

| STR TYPE | An | AB | CI | DE | FL | GA | IL | IN | KY | LA | MI | NJ | NY | OH | PA | SC | TN | TX | VT | VA | WI |
|----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 2,15,34,56-BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2,12-BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2,12,1-BHOMEPH | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2,12,1-BHOMEPH | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2,12,1-BHOMEPH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BUSH | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**FERRIS, THOMAS**
| TAHON | BECO | CLEVELAND | COLUMBUS | CORAL GABLES | CUMBERLAND | DAYTON | DELAWARE | DETROIT | DURHAM | ELYRIA | EUGENE | EVANSTON | FAYETTEVILLE | FELTON | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVO

**TABLE 1. CONTINUED**

| TAHON | BECO | CLEVELAND | COLUMBUS | CORAL GABLES | CUMBERLAND | DAYTON | DELAWARE | DETROIT | DURHAM | ELYRIA | EUGENE | EVANSTON | FAYETTEVILLE | FELTON | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVILLE | FAYETTEVIL

527
| SEROTYPE       | AL | AR | CT | DE | FL | GA | IL | KY | LA | ME | MD | MA | MI | MS | NJ | KY | NC | OH | PA | SC | TN | VT | VA | WV | WI |
|---------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| THOMPSON      | 0  | 23 | 0  | 7  | 0  | 71 | 1  | 6  | 17 | 0  | 12 | 3  | 0  | 0  | 0  | 0  | 0  | 2  | 6  | 0  | 10 | 0  | 0  | 0  | 4  | 2  | 2  |
| TYPHI         | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| TYPHIMURINUM  | 18 | 41 | 14 | 148 | 282 | 135 | 17 | 138 | 77 | 19 | 211 | 11 | 0 | 3 | 7 | 60 | 184 | 71 | 131 | 230 | 4 | 104 | 14 | 95 |
| TYPHIMURINUM (C) | 20 | 12 | 0  | 10 | 16 | 77 | 5  | 16 | 25 | 4  | 223 | 0  | 5  | 0  | 8  | 17 | 26 | 7  | 87 | 0  | 0  | 1  | 1  | 2  | 31 |
| UGANDA        | 2  | 14 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 2  | 2  | 2  | 1  | 1  | 0  |
| VIRGINIA      | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| VIRGIUS       | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| VIRGINIA      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| WAYCROSS      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| WISE          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| WORTHINGTON   | 0  | 0  | 0  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| YOUNGKONE     | 0  | 0  | 0  | 2  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| TOTALS        | 194| 640| 56 | 310| 437| 2098| 350| 734| 481| 94 | 757| 1770| 77 | 15 | 35 | 33 | 723| 2673| 82114065| 35 | 60 | 9 | 276 | 455 | 534 |

(A) TABLE OMIITS THE FOLLOWING ISOLATES:
FROM DC - 2 ENTERITIDIS, 1 TYPHIMURINUM, 1 TYPHIMURINUM (COPENHAGEN)
FROM NH - 1 TYPHIMURINUM (COPENHAGEN)
FROM PR - 1 ENTERITIDIS, 1 INFANTIS, 1 JOHANNESBURG, 1 NEWPORT

(B) VAR. KUNZENDORF
(C) VAR. COPENHAGEN
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| SEROTYPE | AI | CA | CD | CT | ID | IA | KS | MN | MT | NE | NV | HM | OK | SD | TI | UT | WA |
|----------|---|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| MINNEAPOLIS | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NORTHERN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MONTPELIER | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MONTVALEND | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WARWICK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WIDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WICHITA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WINDWARD | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WINTER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WISCONSIN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WILSON | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WINTERHOLM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| YOUGUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ZAHNBAR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**TABLE 2. CONTINUED**

| SEROTYPE | AI | CA | CD | CT | ID | IA | KS | MN | MT | NE | NV | HM | OK | SD | TI | UT | WA |
|----------|---|----|----|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| MINNEAPOLIS | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NORTHERN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MONTPELIER | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MONTVALEND | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WARWICK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WIDE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WICHITA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WINDWARD | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WISCONSIN | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WILSON | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| WINTERHOLM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| YOUGUE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ZAHNBAR | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**TOTALS** 74 2674 119 6 78 591 331 722 641 48 572 6 16 214 183 217 896 61 265

(A) TABLEOMITS THE FOLLOWING ISOLATES:
FROM AUS - 1 HAYARD, 1 READING, 1 SAINT-PAUL
FROM OR - 2 4,12:1-MONOPHASIC, 2 DUBLIN, 1 TYPHIMURIUM
(B) VAR. KURSKYNGOR
(C) VAR. COPENHAGEN

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## TABLE 3. DISTRIBUTION OF SALMONELLA SEROTYPES FROM ANIMALS

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<tr>
<th>Serotype</th>
<th>Turkey</th>
<th>Chicken</th>
<th>Avian</th>
<th>Pig</th>
<th>Rodent</th>
<th>Duck</th>
<th>Cattle</th>
<th>Swine</th>
<th>Horse</th>
<th>Sheep</th>
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<th>Other</th>
<th>Feed</th>
<th>Ruminant</th>
<th>Lap</th>
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**Note:** The table lists the distribution of Salmonella serotypes from animals, categorized by serotype and source. The data include various animal species, as well as other categories such as feed, ruminant, and lap. The total number of occurrences is provided at the bottom.
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**TOTALS**

- **Bovine L跻夫**: 4082
- **Pigs**: 8195
- **Sheep**: 1462
- **Cattle**: 36
- **Horse**: 2091
- **Sheep**: 1780
- **Human**: 933
- **Dog**: 82
- **Cat**: 173
- **Rat**: 2421
- **Mouse**: 206
- **Tamarin**: 1028
- **Macaque**: 2012

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**SALMONELLA SEROTYPES FROM ANIMALS**

- **SALMONELLA SEROTYPES FROM ANIMALS**

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**SALMONELLA SEROTYPES FROM ANIMALS**
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## TABLE 5. DISTRIBUTION OF ARIZONA SEROTYPES BY STATE FROM 07/92 THROUGH 06/93 - WESTERN STATES

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## Table 7. Turkey--Most Frequently Identified Serotypes from 07/92 through 06/93

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<th>ENVIRONMENT</th>
<th>UNKNOWN</th>
<th>TOTAL</th>
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<td>546</td>
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<td>144</td>
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<td>64</td>
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## Table 8. Chicken--Most Frequently Identified Serotypes from 07/92 through 06/93

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## Table 9. Cattle--Most Frequently Identified Serotypes from 07/92 through 06/93

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537
TABLE 10.  SWINE--MOST FREQUENTLY IDENTIFIED SEROTYPES FROM 07/92 THROUGH 06/93

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TABLE 11.  HORSE--MOST FREQUENTLY IDENTIFIED SEROTYPES FROM 07/92 THROUGH 06/93

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## SALMONELLA SEROTYPES FROM ANIMALS

### Table 12.
Salmonella Serotypes Identified Most Frequently from July 1, 1992 through June 30, 1993 with Comparison Data for 5 Years (All Sources)

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* Number of times serotype was identified
** Rank beginning with the most common
*** Includes S. typhimurium and S. typhimurium var copenhagen
The prevalence of bovine tuberculosis in cattle and in the United States was estimated at 5 percent at the onset of the Bovine Tuberculosis Eradication Program in 1917. Tuberculosis was the most prevalent and enduring of the infectious diseases in humans and domestic livestock. In the ensuing years, the program caused the prevalence of the disease to drop sharply at first, then steadily until by the early 1970's the disease had reached the stage of virtual eradication, where it remains today. During the mid-1980's, it became apparent that, unless factors deterring program progress were eliminated, this state of virtual eradication could persist forever. Significant progress has been made on most of the deficient areas, but other problem areas have emerged. These are: (1) tuberculosis in large dairy herds, (2) tuberculosis in steers imported from Mexico, and (3) tuberculosis in captive Cervidae.

In 1987, the United States began cooperating with Mexico in the implementation of their tuberculosis control program. These efforts included providing training and technical support and equipping tuberculosis diagnostic laboratories. Since that time, the number of cattle being imported from Mexico into the United States has increased as has the number of lesion animals found at slaughter. This increase has caused growing concern by the United States livestock industries and State officials about potential spread of tuberculosis to native cattle because of exposure to Mexican steers while on grazing operations and in feedlots.

In 1992, an Industry-Agency Tuberculosis Task Force was appointed to evaluate the tuberculosis risk and to gain consensus as to new control procedures that should be implemented to prevent tuberculosis exposure. The Task Force held several meetings in the United States and visited Sonora, Mexico, to review the tuberculosis program enforced in that State. Recommendations from the Task Force were submitted to the Tuberculosis Committee of the United States Animal Health Association (USAHA), which then submitted recommendations to APHIS.

The USAHA recommended that the USDA and the industry adopt a comprehensive Mexican-U.S. Bovine Tuberculosis Eradication and Control Program. The Program would require increased restrictions on cattle from Mexico and the development of a strategic plan with Mexico, including the establishment of a joint Mexican-U.S. Tuberculosis Commission.

The responsibility of the Commission was to:

A. Establish criteria by which cattle from Mexican States could qualify for
export under current U.S. tuberculosis import requirements. Meeting these criteria would permit freer movement of cattle and would be an incentive for other Mexican States to adopt the Sonora plan as a model.

B. Oversee operation of the joint Mexican–U.S. Bovine Tuberculosis Eradication Program with the ultimate goal of achieving complete eradication of bovine tuberculosis from both Mexico and the United States. 

C. Establish minimum requirements for the exportation of Mexican cattle into the United States and to evaluate the development, implementation, and progress of all individual State programs.

A Committee, rather than a commission, was officially formed and held its first meeting on August 5, 1993. The Committee is composed of three livestock producers, two regulatory officials, and one research official from each country. The actions taken at the August 5 meeting were that:

1. Officers from USDA and the Secretaria de Agricultura y Recursos Hidraulico (SARH) will meet to compare the standards of both countries for bovine tuberculosis eradication. This analysis will allow SARH to make revisions in its regulations to include items which it deems appropriate for harmonizing its standards with those of USDA.

2. Officers from USDA and SARH will develop criteria that on adoption will permit the States of Mexico with well organized tuberculosis programs, such as Sonora, to be exempt from the new USDA import requirements. The standards of USDA for Modified Accredited States will be taken as reference.

3. Officials from the Agricultural Research Service (ARS) and the Instituto Nacional Investigaciones Forestales Agricolas y Pecuarias (INIFAP) will meet to compare the procedures for the preparation of tuberculin in the United States and Mexico. This analysis will determine changes that will be necessary to use the same tuberculin in both countries.

4. ARS and INIFAP representatives will exchange information regarding research work on bovine tuberculosis in both countries. Their findings will be presented at the meetings of the Committee.

5. USDA, APHIS, Veterinary Services (VS), will review current procedures using eartag numbers in the identification of cattle from Mexico imported into the United States.

6. USDA, APHIS, will include in a proposal to be published in the Federal Register that cattle from tuberculosis accredited–free herds in Mexico be accepted directly for importation into the United States. The herd accreditation will be made by SARH based on two consecutive negative tests of 100 percent of all animals in the herd with annual reaccreditation based on negative tests to 100 percent of the breeding stock. The State of Sonora and other States exempted from the new requirements from USDA will be able to continue exporting cattle to the United States from herds qualified as free through the testing of 20 percent of all animals over 24 months.

7. The tuberculin tests performed at the Mexican border under the proposed USDA regulations will be by Mexican accredited veterinarians supervised by
USDA veterinarians, and paid by the interested parties through a "users fee" system. One USDA veterinarian will be able to supervise two or more Mexican accredited veterinarians if facilities are available at the site to perform simultaneous tests. The Deputy Administrator of VS will review the proposal to determine if facilities other than the official quarantine stations at the Mexican border could be approved for conducting the import testing.

The committee met again on October 23 and 24 in conjunction with the USAHA. The agenda included topics concerning the future responsibilities of the committee and the standardization of the Mexico tuberculosis eradication program and the U.S. program. The analysis of the standards revealed only minor differences between the two documents. Mexico's standards do not require five annual retests of previously infected herds after the quarantine has been released and allows herds to be accredited after two negative tests at least 90 days apart; U.S. standards require at least a ten month interval.

The committee also reviewed the import requirements recommended by USAHA in 1992. It recommended that those requirements be amended to delete the special provisions allowed for the State of Sonora but to allow the importation of cattle from accredited free herds and from ranches or specially designated testing pens supervised by SARH and monitored by the committee. A resolution to this effect was prepared for consideration by USAHA.
The Bovine Tuberculosis Eradication Program continued to make strides toward the final eradication of bovine tuberculosis during the past fiscal year. The disease is projected to be eradicated by the end of the 1998 fiscal year. This objective is still a valid one barring any major setbacks.

Four issues that could affect this objective are: 1) tuberculosis in imported Mexican steers, 2) inadequate slaughter surveillance, 3) persistent tuberculosis infection in large dairies, and 4) tuberculosis in captive Cervidae herds. Each of these issues has the potential to setback the date bovine tuberculosis will be eradicated from the United States. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS), Veterinary Services (VS) is working with other State and Federal regulatory agencies, industry groups, and the Mexican Government to prevent such setbacks.

During 1993, the national status for bovine tuberculosis changed with the addition of Hawaii to the list of States that are Accredited-Free. There were 12 herds infected with bovine tuberculosis this fiscal year; 9 were carried over from the previous fiscal year and 3 were detected during fiscal year 1993. The newly detected herds consisted of 2 dairy herds in Texas and 1 game park in Oklahoma. The infection in the Oklahoma game park can be attributed to tuberculosis in the park’s Cervidae population.

Since 1988, VS has conducted over 1,300 investigations of tuberculosis infected feedlot cattle of Mexican origin. These investigations were conducted in 13 States. Since 8 of these States are classified as Accredited Free, the possibility of tuberculosis reinfection by Mexican-origin steers is a foremost program issue.

Epidemiologic investigations involving Mexican steers have shown that approximately 67 percent of the infected imports are of the Holstein
breed. This information has prompted the Mexican government to temporarily ban the exportation of all Holstein cattle to the United States until they can act to minimize the presence of tuberculosis in such exported animals.

In accordance with the resolutions of the United States Animal Health Association (USAHA) in 1992, APHIS is considering regulations to limit exposure of domestic cattle to infected Mexican imports, to recognize the Mexican blue metal eartag as the official permanent identification for imported Mexican cattle, and to impose movement requirements for Mexican steers that have entered the United States.

Mexico has officially implemented a Bovine Tuberculosis Eradication program. A joint United States–Mexico Tuberculosis Committee has been formed to support initiatives aimed at disease eradication in both countries. In support of Mexico’s tuberculosis efforts, APHIS has sponsored cooperative training programs in the areas of post-mortem inspection, laboratory procedures, and field testing. Slaughterhouse findings of tuberculosis in Mexican steers and related traceback information is shared with Mexican disease control officials. Additionally, APHIS has provided the Mexican Government with laboratory supplies and equipment for a regional tuberculosis laboratory.

The submission of thoracic granulomas from slaughter animals is the principle method of tuberculosis surveillance in the United States. Federal meat inspection personnel are the cornerstone of this surveillance. VS has determined that the optimal submission rate for adequate surveillance is one sample per 2,500 animals slaughtered or one sample per 2,000 adult animals slaughtered. During fiscal year 1992, the national average for slaughter submissions was approximately 35 percent of the optimal submission rate, the highest ever achieved.

This granuloma submission data reflects inherent problems in the existing surveillance program for tuberculosis. Since this submission rate has never exceeded 35 percent of the optimum rate, meat inspection personnel must be encouraged to submit more granulomas for surveillance purposes. The goal of one sample per 2,500 animals slaughtered is also too general to be an accurate measure of slaughter surveillance. These figures must also be reevaluated to establish equitable rates throughout every region of the United States, and for every type of slaughter operation.

The inclusion of individual animal identification with slaughter samples is essential for the traceback of tuberculosis infected animals to their herds of origin. Meat inspection personnel provided identification on 1,028 (25 percent) of the 4,040 samples submitted for tuberculosis surveillance in fiscal year 1993. Of the 327 tuberculosis investigations conducted on feedlot animals of Mexican origin, 100 (31 percent) had Mexican eartags submitted with the slaughter samples. Mexico’s improved animal identification and computerized record keeping systems now
permits the traceback of these animals to their Mexican herd of origin.

Proper identification substantially increase the likelihood of a successful tuberculosis investigation. The USDA, Food Safety and Inspection Service (FSIS) is working with VS to increase the submission of identification devices with surveillance samples collected by its inspectors.

Bovine tuberculosis continues to persist at a very low level in some large dairy operations in the El Paso milkshed. Total depopulation of such large herds is the most effective method for eliminating the disease, but is rarely an economically acceptable option for either the Government or the herd owner. In recognition of this, a tuberculosis eradication initiative has been implemented for large dairy operations of this area. This initiative includes a Regional Tuberculosis Epidemiologist stationed in El Paso, Texas to develop individual herd clean-up plans and employment of new testing methods and schedules meant to enhance the eradication of tuberculosis in these large dairies. Total herd depopulation is still considered to be the most effective method to eradicate tuberculosis from affected herds. The re-appearance of tuberculosis in herds previously released from quarantine by testing has long been recognized as a deterrent to eradication. The rate of reinfection in such herds is estimated at 33 percent and appears to increase as herd size increases.

Uniform Methods and Rules (UM&R) for Cervidae have been developed in response to resolutions of the USAHA tuberculosis committee. These rules provide for accredited cervid herds, official tuberculosis tests, and requirements for interstate movement. The UM&R represents a cooperative effort between USDA, State regulatory agencies, the cervid industry, and USAHA. The cervid industry has also proposed an industry supported fund to indemnify cervid owners with herds affected with tuberculosis. This would be a significant step toward reducing the financial burden of owners and accelerating the eradication of the disease in Cervidae.

There has been a rekindling of interest in tuberculosis research in recent years that will help the program to continue its progress. Colorado State University, Cornell University, Iowa State University, and Texas A&M University have ongoing research programs in bovine tuberculosis. APHIS continues to support these efforts by providing diagnostic specimens and reagents to these institutions. The Scientific Advisory Subcommittee of the Tuberculosis Committee (TBSAS) that was established by USAHA during fiscal year 1993 provides a means for unbiased evaluations of scientific issues relevant to the national tuberculosis program. This subcommittee has been charged with the analysis of data from a joint United States–Canada project to evaluate the Blood Tuberculosis Test (BTB). The TBSAS has also been charged with the evaluation of the gamma interferon assay. Their reports should be available during the fiscal year 1994.

Figure 1—Fiscal year 1993 began with 40 States plus the U. S.
Virgin Islands having Accredited–Free State status for tuberculosis. During the year, Hawaii achieved Accredited–Free status by meeting all standards of the UMR. Nine States plus Puerto Rico have Modified–Accredited status.

There were 12 tuberculosis infected herds on record in FY 1993. Nine of these were carried over from previous fiscal years and three were newly detected in FY 1992.

Figure 2—The three newly detected herds during FY 1993 included two dairy herds in the State of Texas and one cattle/bison herd which was part of an exotic animal game ranch in the State of Oklahoma. Infection in the Oklahoma herd was associated with tuberculosis in their Cervidae collection. One of the dairies was in the El Paso milkshed area of Texas, while the other was in an area of Texas not associated with previous infection.

Figure 3—This figure depicts the numbers of imported Mexican steers since 1982. In 1993, in excess of 1,200,000 feedlot type animals were imported from Mexico. This represents an increase of more than 354,000 animals from the 1992 level, and the highest level of importation on record.

Figure 4—This figure depicts slaughter investigations of feedlot origin since 1984. In 1993, there were 388 feedlot investigations, a decrease of 135 cases over 1992. The proportion of feedlot investigations that traced to Mexico has remained at a relatively constant 71 percent over a 10 year period. Even though the percentage has remained uniform, the 1993 data shows an overall decrease in the absolute number of cases traced to a Mexican origin.

Figure 5—This map represents the premises of origin of 1,385 investigations of tuberculous cattle of Mexican origin. These investigations were conducted in 13 States. Eight of these States are Accredited Free for bovine tuberculosis.

Figure 6—Three of the 12 herds on record in FY 1993 were depopulated. Two of the three were Texas dairy herds, which together had a combined total of about 1,300 animals. One herd in California and one herd in New Mexico tested out of quarantine during FY 1993.

Figure 7—During the period 1984–1993 there were 108 tuberculous herds detected of which 84 (78 percent) were depopulated. Sixteen of these herds during this period have been released from quarantine following testing and slaughter of reactors, or are still being tested. Eight herds remain under quarantine for tuberculosis.

Figure 8—During the period 1984–1993, 24 herds were released from quarantine or are still under test. During this same period 9 herds in which M. bovis was confirmed had a previous history of bovine tuberculosis (36 percent).

Figure 9—Suspicious tuberculous lesions or thoracic granulomas were submitted by Meat Inspection personnel from 4,040 slaughter cattle in
FY 1993. Of these, 448 (11 percent) were positive for tuberculosis on laboratory examination. Only 10 (2.2 percent) of the positive cases were adult cattle with the balance of 438 cases being immature feedlot animals.

Figure 10—This figure depicts the granuloma submission rates for the 1989–1992 time period by VS region. Slaughter statistics for 1993 were not available at the time of this report. A goal of one granulomatous lesion submitted per 2,500 cattle inspected at regular slaughter was adopted by VS in 1970 as optimal for efficient tuberculosis surveillance. During FY 1992, 48 establishments slaughtered 40,000 or more adult cattle. Of these, 27 (56 percent) submitted less than 25 percent of the optimal submission rate, 15 (31 percent) submitted between 25 percent and 75 percent of the optimal submission rate, and 6 (13 percent) submitted samples in excess of 75 percent of the optimal submission rate for adult cattle.

Figure 11—This map shows the distribution of 13 captive cervid herds on record during FY 1993, which have had bovine tuberculosis confirmed in one or more animals. Eleven of these herds were newly detected during FY 1993 and 2 were carried over from the previous fiscal year. These herds are located in 11 States, 7 of which are Accredited Free of bovine tuberculosis.

Figure 12—This figure shows the species distribution of infected Cervidae herds during FY 1993. This includes 6 deer herds (46 percent), 5 elk herds (38 percent) and 2 mixed deer and elk herds (15 percent). Seven of the 13 herds were classified as exotic exhibits.

Distinct progress has been made during this fiscal year toward the eradication of bovine tuberculosis. The issues highlighted in this report have the potential for causing serious harm to the program if they are not adequately addressed. The national challenge that we face is to overcome such obstacles and achieve the tuberculosis eradication goal. This will require that all factions of industry and the State and Federal Governments remain firmly committed to the eradication of tuberculosis from this country.
BOVINE TUBERCULOSIS ERADICATION PROGRAM

Bovine Tuberculosis State Status and Location of 12 Tuberculosis Infected Herds

Fiscal Year 1993

- Accredited free States (41) plus Virgin Islands
- Modified accredited States (9) plus Puerto Rico

Figure 1

Location of 3 Tuberculosis Infected Herds Found in FY 1993

- Oklahoma - Game Park†
- Texas - Dairy Herd
- Texas - Dairy Herd

† Associated with infected Cervidae

Figure 2

548
Imported Mexican Steers
Fiscal Year 1982-1993

Numbers of Animals Imported

Fiscal Year

Slaughter Investigations of Feedlot Origin
Fiscal Year 1984-1993

Number of Investigations

Fiscal Year
Premises Associated with Tuberculous* Cattle of Mexican Origin

Fiscal Year 1988-1993

1,385 Investigations Conducted in 13 States Since 1988.

*Infected and exposed

Proportion of Tuberculosis Infected Herds Depopulated

Fiscal Year 1993

3 herds depopulated
12 Tuberculosis infected herds
* - 1 of 2 herds released from quarantine
† - 1 herd released from quarantine

Figure 5

Figure 6
Tuberculous* Herds Newly Detected vs. Herds Depopulated

Fiscal Year 1984-1993

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<th>Total Herds</th>
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*Infected and exposed

Figure 7

Reappearance of Tuberculosis in Herds Previously Released from Quarantine

Fiscal Year 1984-1993

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Figure 8
BOVINE TUBERCULOSIS ERADICATION PROGRAM

Suspicious Lesions Submitted from Regular Slaughter
Fiscal Year 1984-1993

Figure 9

Granuloma Submission Rates by VS Region: 1989-1992

Figure 10
Location of 13 Tuberculous† Cervidae Herds During FY 1993

Distribution of Infected Cervidae Herds

Fiscal Year 1993

SPECIES
- Mixed Deer and Elk Herds 2(15%)
- Elk Herds 5(38%)

PREMISES
- Deer Herds 6(46%)
- Private Farm/Ranch 6(46%)
- Exotic Exhibit 7(54%)

† Infected and exposed

Figure 11

Figure 12
REPORT OF THE COMMITTEE ON TUBERCULOSIS

Chairman: Dr. Bob R. Hillman, Boise, ID
Vice Chairman: Dr. Dennis L. Thompson, Sacramento, CA

L.G. Adams, TX; R.D. Angus, IA; D.L. Baca, TX; L.R. Barnes, IN; R.D. Buckmaster, IA; T.F. Conner, IN; R.A. Cook, NY; D.S. Davis, TX; K. Dowling, SD; S.R. England, NM; M.A. Essey, MD; D.P. Ferlicka, MT; M.E. Fowler, CA; R. Frost, CA; G.H. Frye, MD; B. Gallagher, SD; T.J. Hagerty, MN; B. Healey, OK; D.E. Hensel, CO; E.R. Hinshaw, AZ; J.W. Hunt, MO; S.B. Hurley, WI; S. Hutchins, 3rd, VT; J.L. Jarnagin, IA; R.D. Jones, SD; C. L'Ecuyer, CAN; V.P. LaBranche, MA; P. Lies, ND; H. Lloyd, FL; C.W. McGinnis, NH; A.R. McLaughlin, WI; R.M. Meyer, CO; R.D. Michaels, IA; M.W. Miller, CO; S. Musick, MT; M.E. Oetting, MO; J.B. Payeur, IA; J.O. Pearce, Jr., FL; S. Petty, Jr., TX; J.T. Prichard, NM; J.E. Rich, WA; W.A. Rotenberger, ND; C. Seubert, WI; D. Sockett, WI; C.D. Stumpff, KS; J.W. Templeton, TX; R.L. Tharp, MO; C.O. Thoen, IA; D.K. Thorpe, SD; R.D. Walker, KS; D.L. Whipple, IA; D. Whittlesey, CO; S. Withiam, OK; S. Wolcott, CO; J.M. Woodall, OK; R.E. Yoxheimer, PA; G.L. Zebarth, MN

The committee convened at 1:30 p.m. on October 27 and adjourned at 5:00 p.m. It reconvened at 1:30 p.m. on October 28 and adjourned at 6:45 p.m. After opening remarks by the Chairman, Dr. Mitchell Essey presented the Status of the U.S. Tuberculosis Eradication Program. Forty-one states and the Virgin Islands have achieved Free status. Nine states and Puerto Rico are Modified Accredited. Twelve tuberculous cattle herds were confirmed in five states during the past fiscal year. Nine continued from the previous fiscal year. Three were newly confirmed in FY 1993. These three included a game park in Oklahoma and two dairies in Texas. One of those dairies is far from the El Paso milk shed. Three major problems pose the greatest threat to eradicating bovine tuberculosis from the U.S. They are: infection in large dairies near El Paso, infection in Cervidae, and infection in cattle from Mexico. Over 1.2 million cattle were imported from Mexico during the past fiscal year. This is a 30% increase over those imported in FY 1992 and the third year in the last four that over one million have been imported from Mexico. Submission of suspicious lesions from abattoirs totaled 4,040 with 448 declared as tuberculous.

Dr. John Keller followed with a Status Report of the Canadian Tuberculosis Program. He stated that virtually all infected herds in Canada are depopulated and that all provinces in Canada are classified as Free except Ontario and Quebec. Quebec is expected to be declared free in 1994. Surveillance of elk in Alberta continues.

Dr. Francisco Gurria explained the new national bovine tuberculosis and brucellosis eradication programs. He also described progress in Mexico and major plans for training and utilizing personnel. New organizational structures coupled with 92.5 million dollars of funding over 5 years should

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REPORT OF THE COMMITTEE

result in major improvements in controlling and eradicating bovine tuberculosis. The Mexican Federal government has also prohibited the exportation of Holstein cattle for 6 months. An evaluation of this ban will be completed during this period.

A report on an evaluation of the sensitivity of the IDEXX M. bovis Gamma Interferon Test was presented by Diana Whipple, U.S.D.A., ARS, NADC. The study was a collaborative project involving personnel from U.S.D.A., APHIS, FSIS, ARS, and the Texas Animal Health Commission. When the Gamma-Interferon assay was conducted as described by the manufacturer, sensitivity estimates ranged from 64.5% to 70.6% when compared to culture and histopathology results. Sensitivity of the caudal fold test ranged from 82.0% to 85.3% when compared to results of culture and histopathology. Sensitivity of the Gamma-Interferon assay increased as cutoff values for test interpretation were lowered. However, sufficient data was not available to enable evaluation of this test with cutoff values different than those specified by the manufacturer.

Dr. Billy Johnson summarized the history and accomplishments of the Joint U.S.-Mexico Bovine Tuberculosis Committee. This Committee resulted from recommendations by U.S.A.H.A. Several meetings have been completed. The Committee is responsible for developing criteria for Mexican states to qualify for entry into the U.S. It will also oversee continued operation of the joint program to eradicate tuberculosis in both countries, evaluate the progress of all individual State Programs and monitor the apparent effectiveness of testing. Efforts will be made to harmonize standards in the two countries, including tuberculin, research and requirements for modified accredited status.

Dr. Dennis Thompson presented the following report from the Scientific Advisory Subcommittee:

REPORT OF THE SCIENTIFIC ADVISORY SUBCOMMITTEE
OF THE COMMITTEE ON TUBERCULOSIS

Chairman: Dr. Dennis L. Thompson, Sacramento, CA

Dr. G. Adams, TX; Dr. M. Fowler, CA; Dr. R. Meyer, CO; Dr. J. Payeur, IA; Dr. C. Thoen, IA; Dr. D. Whipple, IA

1. The Scientific Advisory Subcommittee has prepared its responses to specific questions regarding the Blood Tuberculosis Test. The recommendations are based upon the review and consideration of many documents presented to the Subcommittee. A list of those documents is attached to this report.

1. Evaluate the BTB for use as proposed in the proposed UM&R for Cervidae, i.e. for use as an alternative to the comparative cervical
TUBERCULOSIS

test (CCT) and with equal status to the CCT, on animals that are single cervical test (SCT) positive.

answer: The Subcommittee recommends that the Blood Tuberculosis Test (BTB) not now be used as an equal or alternative to the Comparative Cervical Test (CCT) on animals that are positive to the Single Cervical Test in the United States. Further evaluations of the BTB using protocols more specifically designed to evaluate the BTB may be indicated.

2. Evaluate the BTB for use in M. bovis infected cervidae herds as an adjunct to the SCT, i.e. use the SCT and the BTB test concurrently. Animals positive to either test or both tests would be Reactors. Use of the test in this manner would identify some infected animals that are SCT negative.

answer: The Subcommittee recommends that the BTB be considered for use in parallel (a positive on either test is classified positive) with the Single Cervical Test in infected or exposed herds. We base this recommendation upon information in the Report from Agriculture Canada, and other sources which show that sensitivity is increased when the BTB is used in parallel with the Single Cervical Test.

3. If neither of these uses of the test are appropriate, are there other situations in which the BTB test should be included in the National Tuberculosis Program?

answer: The Tuberculosis Scientific Advisory Committee recommends that the BTB not be used as the primary ("stand alone test") test in infected herds or herds of unknown status.

4. The TBSAS recommends that aggressive efforts be made to determine whether an Elisa test, DNA probe, and other diagnostic tests can be used as inexpensive ancillary tests for detecting M. bovis infection in cervidae.

II. The Scientific Advisory Subcommittee has prepared its responses to specific questions regarding the IDEXX Mycobacterium bovis Gamma–Interferon Test.

1. Evaluate the Gamma Interferon test (GI) as a test equal to the Caudal Fold Skin Test. Should the GI test be used in routine testing of animals or herds in the United States that are not known to be infected, for sale, interstate or international movement of animals?

answer: The IDEXX Mycobacterium bovis Gamma–Interferon Test is not recommended as a substitute for the caudal ford test or use as a "stand-alone" test on cattle in the United States or cattle intended for importation into the United States. This recommendation is based upon data presented to the Subcommittee, which showed that almost 30% (29.6%) of culture positive animals were not correctly diagnosed.

2. Evaluate the GI test for use in infected herds as an ancillary test to
REPORT OF THE COMMITTEE

be used in parallel with the Caudal Fold test, when the Caudal Fold test is used as the primary diagnostic test.

answer: The IDEXX Mycobacterium bovis Gamma–Interferon Test may be used in parallel (a positive on either test is classified positive) when the caudal fold test is used as the primary diagnostic test in infected herds. A study involving one herd with a high prevalence provided information regarding the ability of the IDEXX Mycobacterium bovis Gamma–Interferon Test to diagnose infected cattle that were not diagnosed by the caudal fold test. Further studies in other herds with varying prevalence rates are needed to determine its application for diagnoses of infected animals.

3. Evaluate the GI test for use as a test equal to the Caudal Fold test in populations from other countries that have a high prevalence of tuberculosis. Please consider the "human" factor. Although this goes beyond evaluation of a test strictly on its scientific merits, I believe we must look at the subjectivity/objectivity of skin testing versus laboratory procedures for a blood test. I realize this is not easy to measure, but lack of "sensitivity" in the fingers of the veterinary practitioner when reading a skin test can easily reduce the sensitivity of the skin test to that of the blood test.

answer: The Subcommittee recommends further evaluation of gamma–interferon tests, and recommends that those evaluations include use on animals subjected to stress such as steers presented for importation from Mexico. Proposed projects may be submitted to the TBSAS for comment.

III.

1. Would the TBSAS be able, with the information currently in hand to recommend changes in the interpretation of the CCT from that described in the current Guidelines for the Control of Tuberculosis in Cervidae? If so, what are the recommendations of the TBSAS?

answer: The TBSAS recommends the proposed Uniform Methods and Rules for cervids (UM&R) include the following changes for interpreting the Comparative Cervical Test in cervids;

Animals having a response to bovine PPD of 1.0 through 2.0 mm. and equal to or greater than the avian response should be classified as suspects.

Animals having a response to bovine PPD which is greater than 2.0 mm. and at least 0.5 mm. greater than the avian PPD response should be classified as reactors.

Animals having a bovine response greater than 2.0 mm. but equal to the avian response shall be classified as suspects.

The Subcommittee also recommends that the following be added to the proposed UM&R:

The Comparative Cervical Test should not be used in infected herds until two consecutive whole herd tests result in all animals being negative to
TUBERCULOSIS

the primary diagnostic test or responders yield no evidence of infection upon necropsy and laboratory examination.

2. The Subcommittee also requests that the interpretation of the Comparative Cervical Test (CCT) in cervids be reevaluated one year from now and that data reflecting the measurements found in all CCT's performed on cervids in the United States be compiled and presented to assist with that evaluation. The compilation should clearly separate data from elk and deer.

Dr. Terry Beals, State Veterinarian of Texas, reported on a forum involving the four states bordering Mexico. Common concerns about tuberculous cattle from Mexico were discussed. A meeting was held which resulted in a petition for rule-making being sent to Secretary of Agriculture, Mike Espy. The petition was signed by representatives of California, New Mexico, and Texas. The petition requests new regulations for testing cattle from Mexico, new regulations for test standards on imported cattle from Mexico, expansion of the membership of the Joint U.S.–Mexico Tuberculosis Committee, a comprehensive tracking system, and several measures to help assure that cattle from Mexico are free of tuberculosis and monitored after entry into the U.S. Dr. Beals also recommended that the Joint U.S./Mexico TB Committee be upgraded to a Bi-National Commission.

Dr. Leroy Coffman outlined proposed changes to regulations on cattle imported into Oregon from other states. The proposed measures are substantially different from current requirements in Oregon. Concerns about cattle from Mexico and other sources of infection stimulated these changes.

Dr. Mo Salman reported on the performance of an ELISA test in several species and herds. He pointed out particular advantages and disadvantages involved with this test. That ELISA test probably has good potential as a valuable ancillary test for diagnosing infected animals that may be missed by other tests. Potential uses include surveillance at slaughter establishments. Research on the test continues.

Dr. Dan Baca provided an update of eradication efforts in Texas. Six infected herds were recognized at the beginning of FY 1993. A herd near El Paso was depopulated and served as the source of samples for the joint research project described by Diana Whipple. One newly infected herd was confirmed with a high rate of infection, several hundred miles from El Paso.

Another more recently diagnosed herd is also far from El Paso and is being considered for depopulation. Dr. Baca also discussed a new herd plan for infected herds. This plan has three stages which include the removal of all cattle that are positive to either an approved tuberculin test or the IDEXX M. bovis Gamma–Interferon Test. Both tests will be administered to each animal. This plan is intended to aggressively remove infected animals while reducing costs to herd owners.

Dr. Mitchell Essey outlined the history of infected Cervidae in the
REPORT OF THE COMMITTEE

U.S. during the last eight years. He summarized transmission patterns, and the importance of officially including Cervidae in the national program. He also stated his opinion that problems confronting us can be overcome by working together and staying mindful that we all have eradication as a common goal.

Mr. Bob Frost of the International Llama Association reviewed efforts toward improving diagnostic capabilities in Camelids. Currently the axillary site is recommended for tuberculin tests, but this continues to be monitored and evaluated. A cooperative agreement between U.S.D.A. and Argentina has been signed to evaluate different tuberculin testing procedures. Several institutions will participate in this evaluation. Mr. Frost emphasized differences between llamas and other species. He pointed out the need for research specifically focused at llamas.

Dr. Paul Livingstone, from the Ministry of Agriculture in New Zealand, gave a report about bovine tuberculosis in his country. He described infection in opossums, cats, deer, feral swine, and ferrets. Over ten million dollars are being spent on research each year to address TB in feral animals. Development of several tests and methods is in progress. A polymerase chain reaction procedure is close to being ready for application on routine investigations. Dr. Livingstone suggested that assessments to reveal the presence of bovine tuberculosis in the wild should include small animals. Such animals are the most persistent threats to eradication in New Zealand.

The Committee considered a number of recommendations and resolutions. These included the recommendations from the Scientific Advisory Subcommittee and recommendations and resolutions from various members. Recommendations approved by the Committee include the following:

1. Recommend that the Blood Tuberculosis Test (BTB) be utilized as proposed by USDA/APHIS/VS, in the October 15, 1993, Tuberculosis Eradication in Cervidae, Addendum to: Bovine Tuberculosis Eradication Uniform Methods and Rules, Draft Proposal (Draft Cervidae UM&R). This recommendation was approved by the Committee even though it is contrary to the recommendation of the Scientific Advisory Committee.

2. Recommend that the Draft Cervidae UM&R be amended to approve the BTB for use in infected herds, in parallel (a positive on either test is classified positive) with the Single Cervical Test (SCT).

3. Recommend that the Draft Cervidae UM&R be amended to include the following changes for interpreting the Comparative Cervical Test (CC): Animals having a response to bovine PPD of 1.0 through 2.0 mm. and equal to or greater than the avian response should be classified as suspects; Animals having a response to bovine PPD which is greater than 2.0 mm. and at least 0.5 mm. greater than the avian response should be classified as reactors; Animals having a bovine response greater than 2.0 mm. but equal
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to the avian response should be classified as suspects.

4. Recommend that the interpretation of the CCT in Cervids be reevaluated one year from this meeting and that data reflecting the measurements found in all CCT's performed on cervids in the United States be compiled by USDA/APHIS/VS and presented to assist with that evaluation. The data should be collected by species, date, sex and age on the changes in skin thickness in the mid-cervical region over the 72 hours tuberculosis skin testing interval. The resulting data should be reported to the Scientific Advisory Subcommittee. The Subcommittee will review the data and make recommendations to the Committee, further refining the interpretation of the CCT in cervidae.

5. Recommend that changes be made to the Draft Cervidae UM&R, Part II.J.2.c. to provide for retest of suspects by the BTB as defined in the Protocol for use of the BTB; Part II.J.2.d. to clarify the disposition of tuberculin responders; and Part III.B.1. by removing the age of animals on which identification and records are to be kept under the Monitored Herd Plan. The Committee further recommended that the Draft Cervidae UM&R incorporating the changes contained in this report be implemented by USDA/APHIS/VS as rapidly as possible.

6. Recommend that the IDEXX Mycobacterium bovis Gamma Interferon Test (GI Test) not be used as a substitute for the Caudal Fold Test (CF) or as a "stand alone" test on cattle in the United States or cattle intended for importation into the U.S. There was much deliberation on this recommendation and a substitute resolution to recognize the GI Test as an official test was defeated by a narrow vote.

7. Recommend that the Bovine Uniform Methods and Rules for Tuberculosis be amended to declare that the GI Test, with cut-off values of 1.8 through 1.3, is an official test when used in parallel with the CF test (a positive response on either test is classified as positive) when the CF test is used as the primary diagnostic test in infected herds.

8. Recommend that the GI Test not be used on cattle imported from Mexico. The Committee agreed with the Scientific Advisory Subcommittee that there is insufficient data on the use of the test in stressed animals to approve its use in imported animals.

The Committee approved resolutions on the following topics and issues:

1. Importation of cattle from Mexico and assistance, monitoring and review of the Mexican Bovine Tuberculosis Program.

2. Recognition of the Gamma Interferon as an Ancillary test and authority of Tuberculosis Epidemiologists.


4. Indemnity for "Diagnostic Suspects".

5. Continuation of the Tuberculosis Working Group and direction for its function.
6. Cervidae voluntary indemnification insurance program.
7. Risk of spread of tuberculosis from non-human primates.
REPORT OF THE AD HOC COMMITTEE  
ON CONSTITUTION AND BYLAWS  
NOVEMBER 1, 1992 – LOUISVILLE, KENTUCKY

Adopted as amended by the Executive Committee – October 1993  
A. Constitution and Bylaws amendments to lie on the table for final action at the 1994 meeting.  
B. Policy recommendations effective upon passage.

The committee feels that the existing Constitution and Bylaws of USAHA is essentially sound. Our recommendations are an attempt to clarify its provisions and to add procedural policy guidelines.

The following changes in the existing constitution and bylaws are recommended to the Board. Comments are included where appropriate in an effort to clarify and/or give the basis for changes.

Line 3 – Delete "a non-profit association" as unnecessary.  
Lines 5-17 – Delete in entirety. Add new Article II – Purpose as follows:

ARTICLE II – PURPOSE

The mission of USAHA is to be a forum for communication and coordination among State and Federal governments, universities, industry, and other groups on issues of animal health and disease control, animal welfare, food safety and public health. It serves as a clearing house for new information and methods which may be incorporated into laws, regulations, policy, and programs. It acts to develop solutions to animal health-related issues based on science, new information and methods, public policy risk/benefit analysis, and the ability to develop a consensus for changing laws, regulations, policies, and programs.

Line 24 – Delete "and Los Angeles County, California.... of such....units" and add "agencies". This would clarify the potential for official membership for APHIS subdivisions such as REAC as well as other related agencies such as FSIS, FDA, ARS, and the Agricultural Extension Service.

Line 44 – Add "in USAHA". This clarifies that the membership referred to is in the Association and not necessarily on the Executive Committee.

Line 48 – Delete "or any other assessments". This avoids the appearance that life members will not be required to pay meeting registration fees.

Lines 101-102 – Delete "Los Angeles, California....units" and add "agencies" where "units" is deleted.

Line 108 – Add footnote regarding Executive Committee credentials from bottom of page.

Constitution Article IX, Lines 277–291 – Delete in entirety. Replace with Article IX as follows:
ARTICLE IX – COMMITTEE ON NOMINATIONS AND RESOLUTIONS

There shall be appointed annually a Committee on Nominations and Resolutions which shall be comprised of the Association's living immediate past presidents from each of the five districts, and the current president of the Northeast, North Central, Southern and Western Animal Health Associations. The immediate past president of the United States Animal Health Association shall serve as chairman of the committee. The purpose of the committee shall be to receive, consider and present to the general assembly nominations for officers and elected regional delegates, as well as resolutions, following such procedures as are established in Articles X and XI.

ARTICLE X – ELECTION OF OFFICERS AND ELECTED REGIONAL DELEGATES

The Committee on Nominations and Resolutions shall annually report to the Association membership at the first morning general session. Its recommendations for the offices of President, President-Elect, First Vice-President, Second Vice-President, Third Vice-President and Treasurer, as well as Elected Regional Delegates shall constitute its report. Except for the office of Treasurer, nominations shall not originate within this committee but shall be submitted by the appropriate region after caucus of its official and affiliate representatives who are members of USAHA. From such caucus, there must originate every fifth year a nominee for the office of Third Vice-President from the district of that of the retiring President of the Association. Annually, by caucus, two nominees for Elected Regional Delegate will likewise be selected and offered in nomination by each of the four regional associations.

The recommendations of the Committee shall be posted on the registration bulletin board immediately following their presentations at the first morning general session. Any member of the Association, at the second general session, may propose amendments to the slate presented by the Committee. Such amendments shall be made at a time certain specified in the program for "Report of Action of the Committee on Nominations and Resolutions" during that session; provided that if a paper is being presented at that specified time, its presentation will be completed, immediately after which the report will be read. Provided further, if the program is ahead of schedule for that session, a recess will be taken until the time certain established in the program for the "Report of the Action of the Committee on Nominations and Resolutions". The Report of the Committee on Nominations and Resolutions, and proposed amendments to the report, shall be presented to the Executive Committee for consideration. The acceptance of the report or amendments shall constitute election.
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ARTICLE XI - RESOLUTIONS

As the concluding committee report at the final session of the meeting, the Committee on Nominations and Resolutions shall present for consideration by the membership those resolutions which it has properly received and reviewed for ambiguity and redundancy. Such resolutions must have been submitted in proper format to the Committee by officially designated committees of the Association, including the Executive Committee, or by its Board of Directors. Resolutions, properly submitted, will not be altered as to intent by the committee. Majority approval of resolutions or amendments made thereto by the general membership present and voting, will constitute acceptance.

The amendment of Article IX and the addition of Articles X and XI clarifies the formation and function of the Committee on Nominations and resolutions. It further clarifies the handling of USAHA resolutions and the process for the election of officers.

Lines 307–309 – Delete. This is covered in new Article VI of the Bylaws.

Lines 313–314 – Delete "forty-five" dollars "($45)" and add "sixty" dollars "($60)" to reflect 1991 amendment.

Line 340 – Delete "in the month of October" and add "between September 15 and November 15". This provides increased opportunity to obtain adequate sites and facilities for the annual meeting at favorable rates.

Lines 356–357 – Delete "forty-five" dollars "($45)" and add "sixty" dollars "($60)".

Lines 359–361 – Delete in entirety.

Delete footnote following line 370.

Add Article VI as follows:

ARTICLE VI – ALTERATION OF BYLAWS

For the purpose of changing the order of business or to facilitate important business, Articles I and III of the Bylaws, or any portion thereof, may be suspended during any single meeting by unanimous consent of the Executive Committee.

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After a review of its charge, the committee offers recommendations for Association policy on procedures in two areas.

ESTABLISHMENT AND OPERATION OF STANDING COMMITTEES

1. All members of standing committees must be paid up members of USAHA.
2. The Chairman and all members of USAHA Committees shall be appointed by the President. It is expected that member appointments will be made in consultation with Committee Chairman.

3. Efforts should be made to keep committee size between 15 and 50 members, and to maintain a geographical balance, as well as an appropriate balance of State, Federal, industry and technical members.

4. Committee Chairmen shall be appointed for a term of not more than five years, and may not be reappointed Chairman for at least one year.

5. All recommendations and resolutions shall be approved by a majority of the committee members present before the adjournment of a committee meeting.

6. All USAHA members present at committee meetings may enter into discussions. Only committee members may introduce resolutions or vote on items of business.

7. Committees shall submit reports only to the Executive Committee and Resolutions only to the Committee on Nominations and Resolutions. Committee resolutions and reports have no standing until approved by the Executive Committee.

8. Committee chairman may appoint sub-committees as necessary. Subcommittee members must be members of the parent committee. Subcommittees shall report only to the parent committee.

PARTICIPATION IN USAHA OF FEDERAL AGENCIES AND FEDERAL EMPLOYEES

Federal agencies and personnel have long been an integral and valuable part of USAHA. Agencies have taken part in the organization through official membership and representation on the Executive Committee. This provides the opportunity for presenting agency positions and concerns to the association.

Of undoubtedly greater value has been the individual membership and participation of numerous animal health, food safety, and research professionals from a variety of federal agencies. All disease program-related committees have long had key federal agency members who were critical to the committees' success.

A major function of USAHA is to develop and recommend policies and procedures of national disease control and eradication programs. This means that many committee findings and resolutions constitute recommendations to the appropriate federal agency which is responsible for the area of concern. Some of these recommendations are contrary to agency policy or position. For this reason, federal employees should actively share their expertise and opinions as committee members, but should not serve as chairmen where they would be making recommendations to their employer.
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A number of committees have used federal employees as assistant chairmen to good advantage. Also, committees which do not deal with federal agency policy may be chaired by federally-employed USAHA members where appropriate.

The committee strongly recommends that we maintain USAHA as a professional and technical advisory organization. We recognize that many of the Association's activities have political implications, but feel that lobbying and other political activity should be left to official, affiliate, and individual members.

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DRAFT CONSTITUTION--12/9/93
Proposed Constitution and Bylaws as amended by the Executive Committee at the 1993 Annual Meeting, to lie on the table for final action by the Executive Committee at the 1994 Meeting.

CONSTITUTION AND BYLAWS
OF THE
UNITED STATES ANIMAL HEALTH ASSOCIATION

ARTICLE I - NAME
The name of this Association shall be "The United States Animal Health Association."-a non-profit association.

ARTICLE II - PURPOSE
The purpose of this Association shall be the study of animal health science, milk and meat hygiene, and the dissemination of information relating thereto; the unification so far as possible of laws, regulations, policies and methods pertaining to milk and meat hygiene, and to the prevention, control, and eradication of transmissible animal diseases; to maintain coordination among the various animal health regulatory organizations, and to serve as the animal health science clearing house between this Association and the following: The livestock owner, the animal health scientist, the milk and meat hygienist, the veterinary practitioner, the transportation and stockyard companies, the milk and meat producing and distributing companies, and various other interested agencies. The word "animal" as herein used shall be understood to include poultry.

The mission of USAHA is to be a forum for communication and coordination among State and Federal governments, universities, industry, and other groups on issues of animal health and disease control, animal welfare, food safety and public health. It serves as a clearing house for new information and methods which may be incorporated into laws, regulations,
policy, and programs. It acts to develop solutions to animal health-related issues based on science, new information and methods, public policy risk/benefit analysis, and the ability to develop a consensus for changing laws, regulations, policies, and programs.

ARTICLE III – MEMBERSHIP

There shall be five kinds of members: Official, allied organization, individual, elected regional delegates, and nonvoting juniors.

OFFICIAL MEMBERSHIP

The animal health departments of each state, also the United States, and the Canadian, and Mexican governments, Puerto Rico, the Virgin Islands, and Los Angeles County, California, and of such other governmental agencies units as the Executive Committee may by a two-thirds vote approve, shall be eligible to official membership in this Association and be represented on the Executive Committee by the animal health executive official.

ALLIED ORGANIZATION MEMBERSHIP

Any nonprofit organization approved by the Executive Committee that is national in scope and actively and directly concerned with the interests and objectives of this Association as outlined in Article II—Purpose, may be elected to allied organization membership and be represented on the Executive Committee by a duly authorized member of the organization. Such organizations applying for membership shall have and shall continue to maintain no less than 50 (fifty) individual members of the U. S. Animal Health Association to qualify.

INDIVIDUAL MEMBERSHIP

Any person engaged in animal health work for Federal, provincial, state, county, or municipal governments, and any other person interested in animal health science or milk and meat hygiene, may be elected to individual membership.

Any individual member who has maintained membership in this Association for 35 years, or if such member is at the point of retirement, for 25 years, may be elected to life membership in USAHA by the Executive Committee. Such life membership shall carry with it all the rights and privileges of regular individual membership, including receipt of the Annual Proceedings of this Association. Such life membership shall be exempt from the payment of dues, or any other assessments. Fully retired life members, not otherwise gainfully employed in the field of animal science or health, shall also be exempt from the payment of annual meeting registration fees. All past presidents shall automatically become life members.
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Members of the Executive Committee will be eligible for such life membership; but for such member, the requirements for maintaining individual membership will be waived. But the period of time for such membership will be as herein provided.

The Executive Committee may, at its discretion, confer honorary individual memberships. Such memberships shall be exempt from the payment of dues and other assessments and may be withdrawn at the discretion of the Executive Committee.

ELECTED REGIONAL DELEGATE MEMBERSHIP

Such elected regional delegates as provided for in Article V—Executive Committee shall by virtue of such election automatically become members of this organization for such term or terms as may be decided by the Executive Committee and shall pay such dues as the Executive Committee may decide.

NONVOTING JUNIOR MEMBERSHIP

Students in agriculture, medicine, veterinary medicine, vocational agriculture, or any 4-H Club member, as well as future farmers under 21 years of age are eligible to election as nonvoting junior members.

ARTICLE IV—MEETINGS

The meetings of this Association shall be annual and special.

ARTICLE V—OFFICERS

The officers of this Association shall be: President, President-Elect, First Vice-President, Second Vice-President, Third Vice-President, Secretary, Treasurer, Board of Directors, and an Executive Committee.

BOARD OF DIRECTORS

The Board of Directors shall consist of the officers, including the immediate Past President with the exception of the Executive Committee. It shall handle the financial, administrative, and internal affairs of the Association during such time as the Association and/or the Executive Committee is not in session. It shall handle all other duties and responsibilities as may be assigned to it by the Executive Committee or as may be provided in the Constitution. The Board of Directors shall meet immediately after the adjournment of each annual meeting of this Association and at the same place. The purpose of such meeting is to review plans for the administrative functions of the Secretary for the coming year, to give administrative guidance to the Secretary, and to approve the operations of the office of the Secretary including, upon consultation with him, the employment of an Executive Director and such other employees as may be
required which are not otherwise in conflict with the Constitution and Bylaws. The Board of Directors may meet at such other times and places as it, by a majority vote, deems necessary. The Secretary shall keep minutes of all meetings of the Board of Directors, and after approval of such minutes by the President, they shall be presented to the Executive Committee at the next annual meeting of this Association.

EXECUTIVE COMMITTEE

The Executive Committee shall be composed of the executive officer representing the animal health departments of the various states, the principal animal health officer of the United States Department of Agriculture, the Veterinary Director General of Canada, the executive animal health officer of Mexico, Puerto Rico, the Virgin Islands, Los Angeles County, California; and of such other governmental units as may be approved for official membership by the Executive Committee, the elective officers of this Association, not more than eight (8) delegates at large representing the livestock industry, including poultry, and allied organization members. All past presidents in attendance not included in any other section shall be ex-officio members. For the purpose of having proper credentials, the name of the Executive Committee representative or substitute, if applicable, shall be provided to the Association Secretary by the executive officer of those entities named herein.


Each district, as provided above, shall on a rotating basis, annually submit to the Nominating Committee, nominees for vacancies that shall occur in the following offices: President; President–Elect; First Vice–President; Second Vice–President; Third Vice–President. The order of rotation shall be as follows: Northeastern; Western; Southern; Region–at–Large; North Central. In the event that an elected officer is unable to complete an elected term, the District that originally submitted the nominee shall have the opportunity to resubmit a nominee to fill the vacancy; or, the provisions of
Article VII—Duties of Officers shall apply.

The elected officers shall have the authority to place before the Executive Committee applications for allied organization membership. Not more than five (5) such applications shall be presented to the Executive Committee for consideration at any annual meeting of the United States Animal Health Association.

The Executive Committee shall constitute the administrative body of this Association and shall determine its activities and policies.

All recommendations and reports of officers and committees shall be referred for consideration to the Executive Committee.

The President-Elect shall be ex-officio chairman of the Executive Committee.

The Executive Committee shall elect yearly a Secretary for the Association. The Secretary shall receive such salary and allowance as may be fixed by the Executive Committee.

The Executive Committee shall cause to be audited annually, or oftener if deemed necessary, the receipts and disbursements of the Secretary and of the Treasurer, and shall have authority to hear and determine all complaints filed before it in writing relative to the conduct of any member; and shall accept or reject applications for individual and for allied organization membership properly placed before it. Three negative votes shall disqualify for either such membership.

That, with the exception of a change in the name of this Association, upon the dissolution of this corporation or the termination of activities thereof, all remaining assets thereof shall be contributed for utilization in the advancement of research of diseases of animals, and no part of the net assets shall inure to any person or group of persons for private gain.

ARTICLE VI—PROGRAM COMMITTEE

The President, the Chairman of the Executive Committee, the Secretary, the Treasurer, and the Chairmen of the respective committees shall constitute the Program Committee. It shall be the duty of the members of the Program Committee to make the necessary arrangements and provide the program for the annual and special meetings.

ARTICLE VII—DUTIES OF OFFICERS

1. President: It shall be the duty of the President to preside at all meetings of this Association and of the Board of Directors; to appoint all committees excepting the Executive and officer faction of the Program Committee; to call special meetings of the Association whenever he considers the holding of such meetings necessary for the good of the livestock industry or upon written request of five members of the Executive Committee. The President shall be an ex-officio member of all committees.
REPORT OF THE AD HOC COMMITTEE

The President shall officially represent this Association in such places and at such meetings as he, with the concurrence of a majority of the Board of Directors, deems desirable or necessary in the best interests of this Association. He may at his discretion designate a member of the Executive Committee to substitute for him. A report of such attendance shall be made annually to the membership, and all actual expenses incidental thereto shall be paid by this Association.

2. President-Elect: The President-Elect shall be chairman of the Executive Committee. In the absence of the President, he shall preside at the meetings of the Association. In the event of the absence, disability, or resignation of the President, he shall perform all duties of the President. He shall be an ex-officio member of the Executive and Program Committees and of the Board of Directors.

3. First Vice-President: The First Vice-President shall assume the duties of the President in the event of the absence, disability, or resignation of the President and President-Elect. He shall assume the chairmanship of the Executive Committee in the event of the absence, disability, or resignation of President-Elect. He shall be an ex-officio member of the Executive Committee and the Board of Directors.

4. Second Vice-President: The Second Vice-President shall assume the duties of the President in the event of the absence, disability, or resignation of the President, President-Elect, and First Vice-President. He shall assume the chairmanship of the Executive Committee in the event of the absence, disability, or resignation of the President-Elect and First Vice-President. He shall be an ex-officio member of the Executive Committee and of the Board of Directors.

5. Third Vice-President: The Third Vice-President shall assume the duties of the President in the event of the absence, disability, or resignation of the President, President-Elect, First Vice-President, and Second Vice-President. He shall assume the chairmanship of the Executive Committee in the event of the absence, disability, or resignation of the President-Elect, First Vice-President, Second Vice-President. He shall be an ex-officio member of the Executive Committee and of the Board of Directors.

6. Secretary: The Secretary shall keep an accurate record of the proceedings of the Association. Whenever authorized so to do by the Executive Committee, he shall publish said proceedings and distribute them to the members of the Association. The Secretary shall also keep an accurate record of the proceedings of the Executive Committee. He shall forward to each Executive Committee member a copy of each regulation approved by the Association.

He shall keep an accurate account of all Association moneys received and disbursed. All moneys due this Association received by the Secretary shall be promptly turned over to the Treasurer, accompanied by transmittal information identifying the amount, the source, and such other
CONSTITUTION AND BYLAWS

information as the Treasurer and the Board of Directors may require. He shall draw on the Treasurer, on proper warrants, over his signature and that of the Executive Director, such sums as may be necessary to discharge the financial obligations of this Association, provided however that for the payment of incidental expenses of his office, the Secretary may draw on the Treasurer from time to time sums not to exceed one hundred dollars ($100) at any one time on his own authority over the sole signature on warrants signed by the Executive Director. The President shall be furnished at the end of each month, for his validation, a list of financial obligations satisfied during the preceding period. He shall also present to the chairman of the Executive Committee a list giving the name, occupation, and address of each applicant for individual membership for the approval of the Executive Committee. He shall present to the Chairman of the Executive Committee for election by that body the names of individual members eligible and applying for life membership. He shall prepare forms for applicants for allied organization membership and shall notify each of the elected officers upon receipt of such completed application. He shall perform such other duties as may be authorized and prescribed by the Executive Committee. He shall be ex-officio secretary of the Executive Committee, ex-officio secretary of the Board of Directors, and an ex-officio member and secretary of the Program Committee. He shall be bonded for not less than ten thousand dollars ($10,000).

7. Treasurer: The Treasurer shall keep an accurate account of all Association moneys received and disbursed. He shall receive from the Secretary all monies of the Association paid directly to the Secretary along with proper identification of such moneys. By and with the approval of the Board of Directors, he shall deposit the funds of this Association in such types of accounts as may be approved by the Board of Directors, and he shall invest the funds of the Association or liquidate Association investments in such manner as may be approved by the Executive Committee upon recommendation of the Board of Directors. He shall honor warrants for the proper expenditure of Association funds furnished him by the Secretary over his signature and that of the Executive Director. He shall honor warrants from the Secretary on the Secretary's own authority for incidental expenses of the Secretary's office in sums not to exceed one hundred dollars ($100) for any given expenditure over the sole signature on warrants signed by the Executive Director. He shall be given guidance and general administrative supervision by the Board of Directors, and he shall furnish the Executive Committee with a financial statement of the Association's funds annually. He shall be bonded for not less than ten thousand dollars ($10,000), and he shall receive such salary as the Executive Committee may from time to time determine.
REPORT OF THE AD HOC COMMITTEE

ARTICLE VIII—AMENDMENTS

The Constitution and Bylaws of this Association may be amended by a two-thirds vote of the members of the Association present and voting at an annual meeting, provided that the specific amendment to be acted upon shall have been presented in writing at a previous annual meeting, printed in the annual proceedings, and further provided that the amendment has received the approval of a majority of the Executive Committee members present and voting.

In the event of an extreme financial emergency to the association as determined by the Board of Directors, the dues structure of the organization may be amended immediately, solely by action of the Executive Committee at the next annual meeting, as set forth in Article V—Dues of the Bylaws.

ARTICLE IX—ELECTION OF OFFICERS AND ELECTED REGIONAL DELEGATES

The Nominating Committee shall annually report to the membership of this Association at the first morning general session. Their recommendations for the offices of President, President-Elect, First Vice-President, Second Vice-President, Third Vice-President, and Treasurer, and Elected Regional Delegates shall constitute their report. Nominations shall not originate within this committee but shall be submitted by the appropriate district. Said recommendations shall be posted on the registration bulletin board immediately following their presentation. Any member may propose amendments to the slate presented by the Nominating Committee prior to, or at the second morning general session. The report of the Nominating Committee, and proposed amendments of the report shall be presented to the Executive Committee for consideration. The acceptance of the report or amendment shall constitute election.

**The phrase "at the second morning general session" shall be deemed to mean at a time certain specified in the program, "Report of the Action of the Nominating Committee", during that session; provided that if a paper is being presented at that specified time, its presentation will be completed immediately after which the Nominating Committee Report will be read. Provided further, if the program is ahead of schedule for that session, a recess will be taken until the time certain established in the program for the "Report of the Action of the Nominating Committee".

ARTICLE IX—COMMITTEE ON NOMINATIONS AND RESOLUTIONS

There shall be appointed annually a Committee on Nominations and Resolutions which shall be comprised of the Association's living immediate past presidents from each of the five districts, and the current president of the Northeast, North Central, Southern and Western Animal Health Associations. The immediate past president of the United States Animal...
Health Association shall serve as chairman of the committee. The purpose of the committee shall be to receive, consider and present to the general assembly nominations for officers and elected regional delegates, as well as resolutions, following such procedures as are established in Articles X and XI.

ARTICLE X - ELECTION OF OFFICERS AND ELECTED REGIONAL DELEGATES

The Committee on Nominations and Resolutions shall annually report to the Association membership at the first morning general session. Its recommendations for the offices of President, President-Elect, First Vice-President, Second Vice-President, Third Vice-President and Treasurer, as well as Elected Regional Delegates shall constitute its report. Except for the office of Treasurer, nominations shall not originate within this committee but shall be submitted by the appropriate region after caucus of its official and affiliate representatives who are members of USAHA. From such caucus, there must originate every fifth year a nominee for the office of Third Vice-President from the district of that of the retiring President of the Association. Annually, by caucus, two nominees for Elected Regional Delegate will likewise be selected and offered in nomination by each of the four regional associations.

The recommendations of the Committee shall be posted on the registration bulletin board immediately following their presentations at the first morning general session. Any member of the Association, at the second general session, may propose amendments to the slate presented by the Committee. Such amendments shall be made at a time certain specified in the program for "Report of Action of the Committee on Nominations and Resolutions" during that session; provided that if a paper is being presented at that specified time, its presentation will be completed, immediately after which the report will be read. Provided further, if the program is ahead of schedule for that session, a recess will be taken until the time certain established in the program for the "Report of the Action of the Committee on Nominations and Resolutions". The Report of the Committee on Nominations and Resolutions, and proposed amendments to the report, shall be presented to the Executive Committee for consideration. The acceptance of the report or amendments shall constitute election.

ARTICLE XI - RESOLUTIONS

As the concluding committee report at the final session of the meeting, the Committee on Nominations and Resolutions shall present for consideration by the membership those resolutions which it has properly received and reviewed for ambiguity and redundancy. Such resolutions must have been submitted in proper format to the Committee by officially designated committees of the Association, including the Executive.
REPORT OF THE AD HOC COMMITTEE

Committee, or by its Board of Directors. Resolutions, properly submitted, will not be altered as to intent by the committee. Majority approval of resolutions or amendments made thereto by the general membership present and voting, will constitute acceptance.

BYLAWS

ARTICLE I-ORDER OF BUSINESS

Registration.
Call to Order.
Report of Secretary.
Report of Treasurer.
President-Elect's Address.
Reading of Papers.
Committee Reports.
Discussion.
Unfinished Business.
New Business.
Nominations and Election of Officers and eight members to Executive Committee.
Adjournment.

A suspension of the Bylaws may be made by a two-thirds majority for the purpose of changing the order of business or to facilitate important business.

ARTICLE II-APPLICATIONS FOR MEMBERSHIP

Applications for individual membership shall be made in writing to the Secretary. The application shall give the name, occupation, and address of the applicant and shall be accompanied by a fee of forty-five dollars ($45) sixty dollars ($60), which amount shall include the membership dues for one year. Applications shall be presented in proper form to the Secretary, who shall in turn submit them to the Executive Committee.

Applications for allied organization membership shall be made in writing to the Secretary on an appropriate form prepared by him. In turn, notice of receipt of such application shall be provided each of the elected officers.

An individual or allied organization member may be expelled for cause by the Executive Committee. A majority vote by the members of the Executive Committee present and voting shall be required in order to expel any such member.
ARTICLE III—MEETINGS

The annual meetings shall be held in a location selected at a previous annual meeting by a majority of the members of the Executive Committee. The annual meetings shall be held in a location selected at a meeting of the geographical districts as outlined in Article V, Executive Committee, on a rotating basis as follows: North Central, Northeast, Western, Southern, and in concurrence with the executive officer of the animal health department of the state in which the meeting is proposed.

Each meeting site in the selected location shall be determined by the secretary with the approval of the Board of Directors, and in consultation with the executive officer representing the animal health department of the state in which the meeting is to be held. The Executive Committee shall be advised of said selecting at least five (5) years in advance of any annual meeting.

The annual meetings shall begin in the month of October between September 15 and November 15.

The Board of Directors is authorized to select an alternate location and a site in the event that the previous selections, because of any unforeseen circumstance, become unavailable and/or unacceptable.

The place for holding special meetings shall be determined by the President with due regard to the wishes of the members of the Executive Committee, the subject matter to be considered, accessibility, and the information to be obtained. The notice of time and place of holding a special meeting shall be mailed to the members at least thirty days prior to the date fixed for the special meeting.

ARTICLE IV—QUORUM

Twenty-five members of the Association shall constitute a quorum. Thirty members of the Executive Committee shall constitute a quorum, providing that at least two-thirds of this number are the majority of those in attendance is comprised of the executive officers representing the animal health departments of their respective states.

ARTICLE V—DUES

The dues for individual membership in this Association shall be forty-five sixty dollars ($45) ($60) per annum, payable in advance (on or before January 1st of each year) to the Secretary of the Association.

The dues for nonvoting junior members shall be three dollars ($3) per annum, payable (on or before January 1st of each year) to the Secretary of this Association.

The dues for official and allied organization memberships shall be three hundred dollars ($300) each per annum, payable in advance (on or before January 1st each year) to the Secretary of this Association.
REPORT OF THE AD HOC COMMITTEE

In the event of an extreme financial emergency to the association as determined by the Board of Directors, the dues structure of the organization may be amended immediately, solely by action of the Executive Committee, provided that such contemplated increases in dues have been furnished in writing to each member of the Executive Committee at least ninety (90) days before such action is taken.

NOTE: — The interpretation of the constitution as reflected in the explanatory footnotes was concurred in by the Executive Committee on October 26, 1984 at the 88th Annual Meeting in Fort Worth, Texas.

ARTICLE VI — ALTERATION OF BYLAWS

For the purpose of changing the order of business or to facilitate important business, Articles I and III of the Bylaws, or any portion thereof, may be suspended during any single meeting by unanimous consent of the Executive Committee.
98th ANNUAL MEETING
October 29 – November 4, 1994
AMWAY GRAND PLAZA HOTEL
Grand Rapids, Michigan

99th ANNUAL MEETING
October 28 – November 3, 1995
JOHN ASCUAGA’S NUGGET HOTEL
Reno, Nevada

100th ANNUAL MEETING
October 12–18 1996
EXCELSIOR HOTEL
Little Rock, Arkansas