PROCEEDINGS

EIGHTY-SECOND
ANNUAL MEETING

of the

UNITED STATES
ANIMAL HEALTH
ASSOCIATION

STATLER HILTON HOTEL
OCTOBER 29-31, NOVEMBER 1-3, 1978
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Saul Wilson, Washington, DC

CONSULTANTS:

D. R. Cassidy, Ames, Iowa
F. P. Gluckstein, Bethesda, MD
A. Gonzales-Origel, Mexico DF, Mexico
H. Q. Sibley, Austin, TX
A. E. Lewis, Ottawa, Canada
Larry Schaffer, O'Neill, NE
E. C. Sharman, Washington, DC

Committee on Import-Export—1979

Glenn B. Rea, Chairman, Salem, OR

Clint Booth, Kansas City, MO
Ron Caffey, Bowie, MD
R. L. Evinger, Salem, OR
John Gray, Austin, TX
Frank Harding, Geneva, IL
Royce Henderson, Dripping Springs, TX
D. E. Herrick, Bowie, MD
Bob Mathis, Phoenix, AZ
David J. Matthews, Washington, DC
E. G. Ongert, Crofton, MD
R. H. Rumler, Brattleboro, VT
E. C. Sharman, Hyattsville, MD
Donald H. Spangler, Lacey, WA
H. M. Steinmetz, Washington, DC
J. E. Thomas, Roseville, MN
J. S. Walker, Greenport, NY
B. D. Ward, White Bear Lake, MN
William Wilson, Pensacola, FL
Committee on Infectious Diseases of Horses—1979

C. L. Campbell, Chairman, Tallahassee, FL

W. L. Anderson, Addison, TX
George C. Cilley, Concord, NH
A. H. Dardiri, Southold, NY
Jesus C. Garcia, Maracay, Venezuela
Jack M. Gaskin, Gainesville, FL
Edward F. Hackett, Columbus, OH
John B. Healy, Sacramento, CA
E. H. Honnen, Englewood, CO
Floyd Jones, Austin, TX
M. J. Kemen, Ithaca, NY
W. O. Kester, Golden, CO
John A. Kimsey, Atlanta, GA
H. C. King, Laurel, MD
Wayne Kirkham, Lafayette, IN
Ralph Knowles, Silver Spring, MD
T. S. Maddox, Frankfort, KY
Michael J. Nolan, Washington, DC
Sidney R. Nusbaum, Trenton, NJ
D. D. Philson, Hyattsville, MD
Wilson Powell, Tallahassee, FL
V. M. Schroeder, Mexico City, Mexico
M. B. Teigland, Miami, FL
Thomas E. Walton, Denver, CO
Elna White, Weiman, TX

Sam Winkelmann, Austin, TX

Committee on Leptospirosis—1979

James W. Glosser, Chairman, Helena, MT
Stanley L. Diesch, Co-Chairman, St. Paul, MN

Miles H. Bairey, Nevada, IA
R. Wayne Behan, Whitehall, IL
Alex Canales, Miami, FL
J. J. Cecil, Charles City, IA
H. C. Ellinghausen, Ames, IA
Lyle E. Hanson, Urbana, IL
R. Harrington, Ames, IA
R. L. Morter, Lafayette, IN
H. Stewart Powell, Nashville, TN
L. A. Rosner, Jefferson City, MO
H. L. Rubin, Live Oak, FL
Paul R. Schnurrenberger, Auburn, AL
Herbert G. Stoenner, Hamilton, MT
James M. Williams, St. Joseph, MO

Committee on Livestock Identification—1979

J. Ralph Bishop, Chairman, Tipton, IN
Lee S. Garner, Co-Chairman, Albuquerque, NM

J. H. Baldwin, Greene, NY
Harry Christians, Twin Brooks, SD
Roger Connor, Columbus, OH
Tom Cook, Denver, CO
H. Foster Embry, Peoria, IL
Richard L. Evinger, Salem, OR
R. Keith Farrell, Pullman, WA
Robert Gadd, Highmore, SD
Thomas V. Haas, Newport, KY
Royce Henderson, Dripping Springs, TX
Coleman Hensley, Santa Cruz, CA
Bill Jones, Seattle, WA
G. M. Jones, Albuquerque, NM
Dee Likes, Topeka, KS
Leon Locke, Hungford, TX
Harold Minderman, Des Moines, IA
David A. Mitchell, Tenino, WA
Richard E. Nelson, Brattleboro, VT
Norman Powers, Lake Luzerne, NY
E. C. Roukema, Springfield, VA
Raymond Schnell, Dickinson, ND
Richard S. Sechrist, Columbus, OH
William B. Sheets, Cody, WY
G. R. Snyder, Reston, VA
E. F. Sterner, Denver, CO
J. R. Taylor, Amarillo, TX

Mark Trask, Elm Springs, SD
Committee on Mastitis—1979
Robert Bushnell, Chairman, Davis, CA

R. W. Bennett, Bowie, MD
Barbara Coles, Corvallis, OR
Charles N. Dobbins, Athens, GA
N. Bruce Haynes, Ithaca, NY
Donald E. Jasper, Davis, CA
Clarence Jordan, Morgan Center, VT
C. A. Kirkbride, Brookings, SD
C. E. Knolle, Sandia, TX
Willis E. Lyle, Madison, WI

John S. McDonald, Ames, IA
William W. Menz, Arlington Heights, IL
Kermit J. Peterson, Corvallis, OR
Donald S. Postle, Ithaca, NY
Arlan R. Smith, Madison, WI
Douglas N. Stern, Amherst, MA
Gene H. Swenson, Kalamazoo, MI
Rufus F. Weidner, Chicago, IL
Kenneth M. Weinland, Lafayette, IN

Committee on Morbidity and Mortality—1979
Harry Goldstein, Chairman, Columbus, OH
Saul Wilson, Co-Chairman, Hyattsville, MD

Milton Skov, Olympia, WA
H. E. Binks, College Park, MD
Arthur A. Case, Columbia, MO
J. G. Flint, St. Paul, MN
H. G. Geyer, Washington, DC
Duane Hughes, Pierre, SD

A. F. Kaufmann, Stone Mountain, GA
L. G. Morehouse, Columbia, MO
S. R. Nusbaum, Trenton, NJ
George Poppensiek, Ithaca, NY
John Ragan, Nashville, TN
G. H. Snoeyenbos, Amherst, MA

Committee on Nominations, Resolutions and Internal Affairs—1979
H. E. Goldstein, Chairman, Columbus, OH

C. L. Campbell, Tallahassee, FL
J. C. Shook, Mechanicsburg, PA

O. H. Timm, Dixon, CA
W. C. Tobin, Denver, CO

Committee on Parasitic Diseases and Parasiticides—1979
R. L. Pyles, Chairman, Albuquerque, NM
John F. Hudelson, Co-Chairman, Denver, CO

James Bailey, Brookings, SD
Luis A. Colon, Santurce, PR
I. C. Elliott, Commerce City, CO
John H. Gray, Austin, TX
F. G. Hamilton, Austin, TX
J. W. Holcombe, Mt. Pleasant, TX
J. L. Hourrigan, Hyattsville, MD
Richard McDonald, Amarillo, TX
W. P. Meleney, Kerrville, TX

Howard Meyers, Rockville, MD
C. H. Miranda, Rio Piedras, PR
Gerald D. Morrow, Kingsville, TX
K. G. Powers, Bethesda, MD
Glenn O. Schubert, Hyattsville, MD
D. B. Sisk, Lexington, KY
R. K. Strickland, Ames, IA
W. C. Tobin, Denver, CO
W. W. Utterback, Dixon, CA
D. E. Zinter, Beltsville, MD
Committee on Pharmacology and Toxicology—1979

Roland A. Gessert, Chairman, Arlington, VA
William A. Rader, Co-Chairman, Chevy Chase, MD

Dan J. Anderson, Fort Worth, TX
Douglas Armstrong, West Chester, PA
Donn Blevins, Lenexa, KS
Jerry Brunton, Washington, DC
William B. Buck, Urbana, IL
Terrence Curtin, Raleigh, NC
E. E. Denlinger, Harrisburg, PA
Ralph W. Fogleman, Ringoes, NJ
James E. Fox, Ashland, OH
Hardin E. Gouge, St. Joseph, MO
Joseph S. Hayden, St. Louis, MO
William A. Knapp, McLean, VA
J. D. Kornder, Atlanta, GA
M. R. Levy, Cherry Hill, NJ
G. Dean Lindsey, Carmel, IN
Sam F. Scheidy, Bryn Mawr, PA
Vincent Scialli, Triangle Park, NC
Gail B. Smith, Sommerville, NJ
Homer R. Smith, Cincinnati, OH
Norman R. Tufts, Boston, MA
C. D. Van Houweling, Washington, DC

Committee on Transmissible Diseases of Poultry—1979

Raymond A. Bankowski, Chairman, Davis, CA
Walter K. Butterfield, Co-Chairman, Plum Island, NY

Bobby Baros, Gonzales, TX
Everett S. Bryant, Storrs, CN
Francis G. Buzzell, Augusta, ME
Morris S. Cover, St. Louis, MO
G. A. Erickson, Athens, GA
L. C. Grumbles, College Station, FL
Robert L. Hogue, Lafayette, IN
D. D. King, Hyattsville, MD
Thomas L. Landers, Hot Springs, AR
Hiram N. Lasher, Millsboro, DE
E. T. Mallison, Mechanicsburg, PA
R. McCapes, Davis, CA
H. E. Nadler, Albany, NY
W. C. Patterson, Jr., Athens, GA
J. E. Pearson, Ames, IA
I. L. Peterson, Beltsville, MD
G. F. Pierson, Glenn Dale, MD
Ben S. Pomeroy, St. Paul, MN
James B. Robert, Muldrow, OK
T. B. Ryan, Cary, NC
Raymond Schar, Beltsville, MD
John A. Smiley, Augusta, ME
H. W. Towers, Dover, DE

Committee on Professional Oversight—1979

J. L. O’Harra, Chairman, Reno, NV
Douglas R. Stauffer, Co-Chairman, Pickerington, OH

Jack Armstrong, Reno, NV
J. D. Branscome, Grenada, MS
G. C. Halver, Helena, MT
John B. Herrick, Ames, IA
David Ingraham, Harrisburg, PA
J. C. Jefferies, Hyattsville, MD
C. J. Nelson, Columbia, MD
John R. Ragan, Nashville, TN
P. L. Smith, Sacramento, CA
J. B. Taylor, Montgomery, AL
J. B. Young, Austin, TX
Committee on Sheep and Goats—1979

F. James Schoenfeld, Chairman, Salt Lake City, UT

T. Lynnwood Barber, Denver, CO
H. A. Hancock, Laramie, WY
Joseph N. Huff, Denver, CO
Michael Jochim, Arvada, CO
A. L. Klingsporn, Hyattsville, MD
Mort Mertz, Eldorado, TX
H. E. Metcalf, Lakewood, CO

Howard W. Whitford, College Station, TX

Committee on State-Federal Relations—1979

B. W. Hawkins, Chairman, Ontario, OR

T. F. Zweigart, Raleigh, NC
L. W. Hinchman, Indianapolis, IN
R. J. Stadler, Hartford, CT

H. E. Goldstein, Columbus, OH

Committee on Transmissible Diseases of Swine—1979

Lowell W. Hinchman, Chairman, Indianapolis, IN
Robert F. Behlow, Co-Chairman, Raleigh, NC

Leroy G. Biehl, Urbanna, IL
Neal Black, St. Paul, MN
E. H. Bohl, Wooster, OH
C. E. Boyd, Columbia, SC
John Brown, Athens, GA
E. A. Butler, Council Bluffs, IA
Robert Lee Daniel, Austin, TX
James Downard, New Carrollton, MD
D. P. Gustafson, Lafayette, IN
E. O. Haelterman, Lafayette, IN
Robert E. Hall, Madison, WI

Sam Young, Ossian, IN

Committee on Tuberculosis and Johne’s Disease—1979

John M. Dick, Chairman, Harrisburg, PA
Paul Spencer, Co-Chairman, Springfield, IL

R. W. Bennett, Hyattsville, MD
Carl E. Boyd, Columbia, SC
A. M. Carey, Beltsville, MD
J. G. Flint, St. Paul, MN
G. H. Frye, Hyattsville, MD
David Hughes, Phoenix, AR
Victor LaBranche, Boston, MA
A. B. Larsen, Ames, IA
Wallace Leary, Springfield, VA

Norman Lichtman, Westville, NJ
A. R. McLaughlin, Madison, WI
H. E. Nadler, Albany, NY
M. S. Silberman, Reynolds, GA
P. L. Smith, Sacramento, CA
Paul L. Spencer, Springfield, IL
R. J. Stadler, Hartford, CN
Charles Thoen, Ames, IA
K. M. Weinland, Lafayette, IN

M. L. Weldy, Goshen, IN
Committee on Wild and Marine Life Diseases—1979
Frank A. Hayes, Chairman, Athens, GA

W. D. Bolton, Burlington, VT
E. A. Car sbrey, Ames, IA
Milton Friend, Madison, WI
John S. Gottschalk, Washington, DC
Lynn A. Griner, San Diego, CA
A. H. Hulsey, Little Rock, AK
S. H. Madin, Berkeley, CA

E. V. Morse, W. Lafayette, IN
B. S. Pomeroy, St. Paul, MN
William Rosser, Lubbock, TX
J. S. Smith, Silver Spring, MD
H. L. Thacker, W. Lafayette, IN
G. S. Trevino, College Station, TX
L. L. Williamson, Washington, DC

G. W. Winkler, Atlanta, GA

Committee on Zoological Animals—1979

R. M. S. Temple, Chairman, Bristolville, OH
Keith Sherman, Co-Chairman, Hyattsville, MD

John Banks, Lorena, TX
C. P. Chase, Miami, FL
Al Decoteau, Waltham, MA
D. Farst, Brownsville, TX
Milton Friend, Madison, WI
D. E. Herrick, Bowie, MD

E. Clay Hodgin, Cary, NC
C. J. Mikel, Oklahoma City, OK
George Pearson, Washington, DC
D. F. Schwindaman, Hyattsville, MD
R. M. Scott, Lansing, MI
R. J. Yedloutschnig, Southold, NY
### RECORD OF PREVIOUS MEETINGS

<table>
<thead>
<tr>
<th>Date</th>
<th>Place of Meeting</th>
<th>President</th>
<th>Secretary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 27-28, 1897†</td>
<td>Fort Worth, Tex</td>
<td>*Mr. C. P. Johnson, Springfield, Ill.</td>
<td>*Mr. D. O. Lively, Fort Worth, Tex.</td>
</tr>
<tr>
<td>Oct. 11-12, 1898</td>
<td>Omaha, Neb.</td>
<td>*Mr. C. P. Johnson, Springfield, Ill.</td>
<td>*Mr. Taylor Riddle, Kan</td>
</tr>
<tr>
<td>Oct. 8-9, 1901</td>
<td>Buffalo, N.Y.</td>
<td>*Dr. E. P. Niles, Va.</td>
<td>*Dr. F. T. Eisenman, Louisville, Ky.</td>
</tr>
<tr>
<td>Dec. 5-7, 1910</td>
<td>Chicago, Ill.</td>
<td>*Dr. C. E. Cotton, St. Paul, Minn</td>
<td>*Mr. J. J. Ferguson, Chicago, Ill.</td>
</tr>
<tr>
<td>Dec. 5-6, 1911</td>
<td>Chicago, Ill.</td>
<td>*Dr. John F. Devine, Goshen, N.Y.</td>
<td>*Mr. J. J. Ferguson, Chicago, Ill.</td>
</tr>
<tr>
<td>Dec. 2-4, 1918</td>
<td>Chicago, Ill.</td>
<td>*Dr. M. Jacob, Knoxville, Tenn.</td>
<td>*Dr. S. H. Ward, St. Paul, Minn.</td>
</tr>
<tr>
<td>Nov 29-30-Dec 1, 1920</td>
<td>Chicago, Ill</td>
<td>*Dr. S. F. Musselman, Frankfort, Ky.</td>
<td>*Dr. D. M. Campbell, Chicago, Ill.</td>
</tr>
<tr>
<td>Nov 28-30, 1921</td>
<td>Chicago, Ill.</td>
<td>*Dr. W. F. Crewe, Bismarck, N.D.</td>
<td>*Dr. Theo A. Burnett, Columbus, Ohio</td>
</tr>
<tr>
<td>Dec. 6-8, 1922</td>
<td>Chicago, Ill.</td>
<td>*Dr. T. E. Muncie, Harrisburg, Pa.</td>
<td>*Dr. Theo A. Burnett, Columbus, Ohio</td>
</tr>
<tr>
<td>Dec. 5-7, 1923</td>
<td>Chicago, Ill.</td>
<td>*Dr. W. J. Butler, Helena, Mont.</td>
<td>*Dr. O. E. Dyson, Kansas City, Mo.</td>
</tr>
</tbody>
</table>
30. Dec. 1-3, 1926 ............ Chicago, Ill. ............ *Dr. John R. Mohler, Wash., D.C.
31. Nov. 30-Dec. 1-2, 1927 .... Chicago, Ill. ............ *Dr. L. Van Es, Lincoln, Neb.
32. Dec. 5-7, 1928 ............ Chicago, Ill. ............ *Dr. C. A. Cary, Auburn, Ala.
33. Dec. 4-6, 1929 ............ Chicago, Ill. ............ *Dr. Chas. G. Lamb, Denver, Colo.
34. Dec. 3-5, 1930 ............ Chicago, Ill. ............ *Dr. A. E. Wight, Wash., D.C.
35. Dec. 2-4, 1931 ............ Chicago, Ill. ............ *Dr. J. W. Connaway, Columbus, Md.
36. Nov. 30-Dec. 1-2, 1932 .... Chicago, Ill. ............ *Dr. Peter Malcolm, Des Moines, Iowa
37. Dec. 6-8, 1933 ............ Chicago, Ill. ............ *Dr. E. T. Faulder, Albany, N.Y.
38. Dec. 5-7, 1934 ............ Chicago, Ill. ............ *Dr. T. E. Robinson, Providence, R.I.
40. Dec. 24, 1936 ............ Chicago, Ill. ............ *Dr. Walter Wisnicky, Madison, Wis.
41. Dec. 1-3, 1937 ............ Chicago, Ill. ............ *Dr. R. W. Smith, Concord, N.H.
42. Nov. 30-Dec. 1-2, 1938 .... Chicago, Ill. ............ *Dr. D. E. Westmoreland, Frankfort, Ky.
43. Dec. 6-8, 1939 ............ Chicago, Ill. ............ *Dr. J. L. Axby, Indianapolis, Ind.
44. Dec. 4-6, 1940 ............ Chicago, Ill. ............ *Dr. H. D. Port, Cheyenne, Wyo.
45. Dec. 3-5, 1941 ............ Chicago, Ill. ............ *Dr. E. A. Crossman, Boston, Mass.
46 Dec. 24, 1942 ............ Chicago, Ill. ............ *Dr. I. S. Madory, Auburn, Ala.
47. Dec. 1-3, 1943 ............ Chicago, Ill. ............ Dr. W. H. Hendricks, Salt Lake City, Utah
48. Dec. 6-8, 1944 ............ Chicago, Ill. ............ Dr. J. M. Sutton, Atlanta, Ga.
49 Dec. 5-7, 1945 ............ Chicago, Ill. ............ Dr. C. U. Duckworth, Sacramento, Calif.
50 Dec. 4-6, 1946 ............ Chicago, Ill. ............ *Dr. William Moore, Raleigh, N.C.
51 Dec. 3-5, 1947 ............ Chicago, Ill. ............ *Mr. Will J. Miller, Topeka, Kan.
52 Oct 13-15, 1948 ........... Denver, Colo ......... *Dr. Jean V. Knapp, Tallahassee, Fla
53 Oct. 12-14, 1949 .......... Columbus, Ohio ........ *Dr. T. O. Brandenburg, Bismarck, N.D.
57 Sept 23-25, 1953 .......... Atlantic City, N.J. ..... *Dr. T. Childs, Ottawa, Canada
58 Nov 10-12, 1954 .......... Omaha, Neb. ............ *Dr. T. C. Green, Charleston, W.Va.
60 Nov 28-30, 1956 .......... Chicago, Ill. ......... Dr. A. L. Brueckner, Baltimore, Md
61 Nov 13-15, 1937 .......... St. Louis, Mo. .......... Dr. G. H. Good, Cheyenne, Wyo
<table>
<thead>
<tr>
<th>Date</th>
<th>Place of Meeting</th>
<th>President</th>
<th>Secretary</th>
</tr>
</thead>
<tbody>
<tr>
<td>62. Nov 4-6, 1958</td>
<td>Miami Beach, Fla.</td>
<td>Dr. John G. Milligan, Montgomery, Ala.</td>
<td>Dr. R. A. Hendershott, Trenton, N.J.</td>
</tr>
<tr>
<td>63. Dec. 15-18, 1959</td>
<td>San Francisco, Calif.</td>
<td>Mr. F. G. Buzzell, Augusta, Me.</td>
<td>Dr. R. A. Hendershott, Trenton, N.J.</td>
</tr>
<tr>
<td>65. Oct. 3-Nov. 1-3, 1961</td>
<td>Minneapolis, Minn.</td>
<td>Dr. A. P. Schneider, Boise, Idaho.</td>
<td>Dr. R. A. Hendershott, Trenton, N.J.</td>
</tr>
<tr>
<td>67. Oct. 15-18, 1963</td>
<td>Albuquerque, N.M.</td>
<td>Dr. T. J. Grennan, Jr., Providence, R.I.</td>
<td>Dr. R. A. Hendershott, Trenton, N.J.</td>
</tr>
<tr>
<td>70. Oct. 10-14, 1966</td>
<td>Buffalo, N.Y.</td>
<td>Dr. C. L. Campbell, Tallahassee, Fla.</td>
<td>Dr. R. A. Hendershott, Trenton, N.J.</td>
</tr>
<tr>
<td>80. Nov. 7-12, 1976</td>
<td>Miami Beach, Fla.</td>
<td>H. E. Goldstein, Columbus, Oh.</td>
<td>Dr. W. L. Bendix, Richmond, Va.</td>
</tr>
</tbody>
</table>

**Resigned Dec. 12, 1977**

*Deceased  †Reprinted in 54th Annual Report  ‡Reprinted in the 66th Annual Report  †This was the last meeting of the Interstate Association of Livestock Sanitary Boards
Our Father in Heaven, Hallowed be thy name.

We have assembled ourselves here this night at the convening of the 21st Annual Conference of the American Association of Veterinary Laboratory Diagnosticians, and the 82nd Annual Meeting of the United States Animal Health Association.

We have met together to learn and to exchange knowledge concerning the Animal Kingdom and those conditions which afflict them. May we accept this responsibility that thou has given unto us, and may we remember thee in our responsibilities that thou will grant us the knowledge in taking care of these responsibilities.

We appreciate this choice land, choice above all others. May we so live our lives and remember thee in all that we do that this may continue to be a choice land of America.

We pray for those who preside over our meetings. Our President, Secretaries, our Committee Chairmen, that they may fulfill their responsibilities.

We pray for our families, those that are with us and those that are home. May they be protected and watched over, and may we at the close of these meetings return to them safely.

We pray for the leadership of this nation, those of our Great States, and for the countries of the world. May we all be united in our efforts to help each other.

We pray for those who are ill amongst us. May thy blessings and comfort be with them.

We are thankful for circumstances of this city and facilities of this hotel. May we enjoy them in the accomplishments of our meetings.

We are thankful for the privilege of meeting together this night and we offer this prayer unto thee in the name of Jesus Christ,

Amen.
MEMORIAL SERVICE

October 30, 1978

Mr. President, Members of These Associations, Ladies and Gentlemen.

At this time, as is our custom, we pause for a moment of silent prayer and reverence to pay tribute to those friends and colleagues who have now completed their mortal existence and have passed on to paradise.

1977-78 Deceased

Dr. J.F. Andrews — Atlanta, Georgia — December 31, 1977
Dr. V.C. Bunker — Escondido, California — December 13, 1977
Dr. A.H. Frank — Ames, Iowa — January 13, 1978
Dr. J.W. Jackson — Oakland, California — February 17, 1978
Dr. W.E. Brock — Stillwater, Oklahoma — March 6, 1978
Dr. J.H. Galloway — Arlington, Virginia — January 17, 1977
Dr. J.R. Hay — Western Springs, Illinois — June 16, 1978
REPORT OF THE SECRETARY

W.L. Bendix, D.V.M.
Richmond, Virginia

Once again it is the Secretary's pleasure to greet all of you in attendance at this, the 82nd Meeting of the United States Animal Health Association in Buffalo, New York.

We are a strong active Association with a dedicated and loyal membership. The secretary's office has received, and will present for approval this year, 29 applications for new individual members and 4 applications for new allied organization members. If all of the latter are approved, this will bring the allied organization membership to 24. We have also received an application for one new official membership from the Bureau of Animal Health of Australia, at Canberra.

It became necessary to move the office of the U.S.A.H.A. when our lease ran out this past spring. We are in new and, we think, better quarters—less traffic, plenty of parking and a bank on the ground floor of our new building. It is planned to move our accounts to this bank after this meeting. Our rent is somewhat higher, but all in all, worth the difference.

To improve our public information services, our President last year appointed a Public Relations and Information Committee. Dr. Mulhern graciously loaned us one of U.S.D.A.'s information officers to assist and direct this new effort. Miss Ellis provided a long list of names of the nation's agricultural press and kits were prepared and distributed. These kits told who we are, what we are, what we do and how we do it. All those contacted were provided with programs and invited to our meeting in Minneapolis. The response was encouraging—many attended the meeting and our many committee sessions. After the meeting, the press members we had contacted and provided with this information were given full résumés of the meeting and requested to inform us if they wanted to continue to be furnished information on the U.S.A.H.A. and its activities and policies. 110 members of the Agricultural Press indicated a continuing interest and are so routinely advised of all of our doings.

As a follow up and to fully familiarize our staff with procedures, we again have secured the loan of Information Officer Miss Cathy Ellis for this meeting. We hope to continue to improve our relations with the Agricultural Press of the country and thus to gain widespread coverage of our work and policies. This is something in which each member has a stake and your full cooperation in this effort is solicited. Let us know when and how we can serve you, both locally and regionally. If you don't see anything about U.S.A.H.A. in your favorite member or members of the Agricultural Press—let us know and we will see that omission corrected. We should expand our coverage greatly as time passes.
The Secretary and office staff hope that each of you enjoys your visit to Buffalo and this meeting. If we can do anything to help, you have only to ask.

Respectfully submitted,

W.L. Bendix, D.V.M.
Secretary

82nd Annual Meeting
Buffalo, New York
Monday, October 30, 1978
UNITED STATES ANIMAL HEALTH ASSOCIATION
SUITE 205, 6924 LAKESIDE AVENUE
RICHMOND, VIRGINIA 23228

STATEMENT OF CASH RECEIPTS and DISBURSEMENTS
FOR PERIOD OCTOBER 1, 1977 through SEPTEMBER 30, 1978

CASH BALANCE — OCTOBER 1, 1977:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Cash on Hand — October 1, 1977</td>
<td>$ 539.86</td>
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<tr>
<td>Southern Bank and Trust Company</td>
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<tr>
<td>Checking Account</td>
<td>$304.54</td>
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<tr>
<td>Savings Account</td>
<td>$15,949.55</td>
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<tr>
<td>Total</td>
<td>$16,793.95</td>
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INCREASED BY CASH RECEIPTS:

<table>
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<th>Description</th>
<th>Amount</th>
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<tr>
<td>Individual Dues</td>
<td>$14,893.00</td>
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<td>Official Dues</td>
<td>$9,450.00</td>
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<tr>
<td>Proceedings</td>
<td>$5,370.16</td>
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<td>Reprints</td>
<td>$3,090.94</td>
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<td>Foreign Animal Books</td>
<td>$666.69</td>
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<tr>
<td>Registration Fees</td>
<td>$32,900.00</td>
</tr>
<tr>
<td>Tours</td>
<td>$2,209.00</td>
</tr>
<tr>
<td>Interest Income</td>
<td>$1,437.66</td>
</tr>
<tr>
<td>Total</td>
<td>70,017.45</td>
</tr>
</tbody>
</table>

TOTAL BEGINNING BALANCE and RECEIPTS $ 86,811.40
STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS
FOR PERIOD OCTOBER 1, 1977 through SEPTEMBER 30, 1978

DECREASED BY EXPENDITURES:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Meeting</td>
<td>$10,659.42</td>
</tr>
<tr>
<td>Printing</td>
<td>14,822.05</td>
</tr>
<tr>
<td>Furniture and Fixtures</td>
<td>3,634.80</td>
</tr>
<tr>
<td>Office Supplies</td>
<td>2,130.60</td>
</tr>
<tr>
<td>Salaries</td>
<td>14,175.26</td>
</tr>
<tr>
<td>Wages</td>
<td>1,957.02</td>
</tr>
<tr>
<td>Social Security Tax</td>
<td>1,032.89</td>
</tr>
<tr>
<td>Communication</td>
<td>4,820.60</td>
</tr>
<tr>
<td>Travel:</td>
<td></td>
</tr>
<tr>
<td>Dr. J.C. Shook</td>
<td>98.25</td>
</tr>
<tr>
<td>Dr. W.L. Bendix</td>
<td>188.38</td>
</tr>
<tr>
<td>Dr. T.F. Zweigart</td>
<td>235.48</td>
</tr>
<tr>
<td>Dr. Harry E. Goldstein</td>
<td>242.50</td>
</tr>
<tr>
<td>Dr. L.W. Hinchman</td>
<td>168.72</td>
</tr>
<tr>
<td>Ella R. Blanton</td>
<td>116.00</td>
</tr>
<tr>
<td>Rent—Office Space</td>
<td>2,198.95</td>
</tr>
<tr>
<td>American Association of Veterinary Livestock Diagnostics</td>
<td>6,250.00</td>
</tr>
<tr>
<td>Virginia Unemployment Insurance</td>
<td>57.95</td>
</tr>
<tr>
<td>Surety Bond—Treasurer</td>
<td>36.00</td>
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<tr>
<td>Other Meetings</td>
<td>1,245.43</td>
</tr>
<tr>
<td>Moving Office</td>
<td>160.00</td>
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<tr>
<td>Miscellaneous Expense</td>
<td>477.10</td>
</tr>
<tr>
<td>Bank Service Charge</td>
<td>88.40</td>
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</tbody>
</table>

$64,795.80

CASH BALANCE — September 30, 1978:

<table>
<thead>
<tr>
<th>Account</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash on Hand—September 30, 1978</td>
<td>$ 214.50</td>
</tr>
<tr>
<td>Southern Bank and Trust Company Richmond, Virginia</td>
<td>33.46</td>
</tr>
<tr>
<td>Checking Account</td>
<td>21,767.64</td>
</tr>
</tbody>
</table>

$22,015.60
UNITED STATES ANIMAL HEALTH ASSOCIATION
SUITE 205, 6924 LAKESIDE AVENUE
RICHMOND, VIRGINIA 23228

SUMMARY OF OPERATIONS
FOR PERIOD OCTOBER 1, 1977 through SEPTEMBER 30, 1978

REVENUE:

Total Cash Receipts $70,017.45
Less — Expenditures 64,795.80
Excess of Receipts over Expenditures $5,221.65

NET WORTH — SEPTEMBER 30, 1978:
Cash on Hand — September 30, 1978 $214.50
Balance:
Southern Bank and Trust Company
Richmond, Virginia
Checking Account 33.46
Savings Account 21,767.64
Accounts Receivable 2,232.86
Petty Cash Fund 25.00
Deposit — C. & P. Telephone Company
Richmond, Virginia 100.00
Inventory — Supplies and Proceedings 20,684.00
Furniture and Fixtures 5,302.40

NEW WORTH — SEPTEMBER 30, 1978 $50,359.86
**ANALYSIS OF CHANGE IN NET WORTH:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Worth — September 30, 1977</td>
<td>$40,327.71</td>
</tr>
<tr>
<td>Increased by:</td>
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<tr>
<td>Savings Account</td>
<td>$5,818.09</td>
</tr>
<tr>
<td>Inventory of Supplies and Proceedings</td>
<td>$3,622.00</td>
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<tr>
<td>Furniture and Fixtures</td>
<td>$3,247.58</td>
</tr>
<tr>
<td><strong>Total Increase</strong></td>
<td><strong>$53,015.38</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased by:</td>
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<tr>
<td>Cash on Hand</td>
<td>$325.36</td>
</tr>
<tr>
<td>Checking Account</td>
<td>$271.08</td>
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<tr>
<td>Accounts Receivable</td>
<td>$2,059.08</td>
</tr>
<tr>
<td><strong>Total Decrease</strong></td>
<td><strong>$2,655.52</strong></td>
</tr>
</tbody>
</table>

**NET WORTH — SEPTEMBER 30, 1978**  
$50,359.86

______________________________
Henry H. Budd, Accountant.
ANALYSIS OF MISCELLANEOUS EXPENSE:

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditing Books</td>
<td>$300.00</td>
</tr>
<tr>
<td>Dues — Dr. W.L. Bendix (A.V.M.A.)</td>
<td>75.00</td>
</tr>
<tr>
<td>State of Delaware — Charter</td>
<td>10.00</td>
</tr>
<tr>
<td>Taxes — County of Henrico Virginia</td>
<td>49.50</td>
</tr>
<tr>
<td>Flowers — Dr. Andrews, Past President</td>
<td>42.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$477.10</strong></td>
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</tbody>
</table>

ANALYSIS OF BANK SERVICE CHARGES:

<table>
<thead>
<tr>
<th>Service Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safe Deposit Box Rent</td>
<td>$8.50</td>
</tr>
<tr>
<td>Bank Service Charges</td>
<td>79.90</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$88.40</strong></td>
</tr>
</tbody>
</table>
"WELCOME TO NEW YORK"

to

United States Animal Health Association and
American Association of Veterinary Laboratory
Diagnosticians
Joint General Session
Monday, October 30, 1978

By

J. Roger Barber
New York State Commissioner
of Agriculture and Markets

It is indeed an honor and a pleasure to welcome such distinguished guests to New York State. We in New York are very pleased to host the 82nd annual meeting of the United States Animal Health Association as well as the 21st Conference of the American Association of Veterinary Laboratory Diagnosticians.

It surprises a great deal of non-New Yorkers to learn that agriculture remains as the single largest industry in the Empire State. With over $1.7 billion of agricultural products sold in 1977, 70% of which were derived from the sale of livestock and their products, it is easy to see that New York State is far more than just New York City. New York State ranks second only to Wisconsin in the number of milk cows and ranks first in the nation in the number of veal calves. A total of 1.1 million calves were slaughtered for veal purposes in New York during 1977. Additionally, New York ranks first in the nation in the production of cabbage for kraut, first in cottage cheese, second in apples, beets for canning, cauliflower, Italian cheese, maple syrup and sweet corn for fresh market. New York State ranks third in the production of milk and ice cream, cheese (excluding cottage), snap beans for processing, tart cherries and grapes. Truly New York’s agriculture forms the backbone of this state’s economy.

This is the time of year when farmers begin to prepare for the oncoming cold weather, ice and snow. I don’t know of a more appropriate region within our state to mention snow. And mentioning it is all I intend to do.

The efforts and inputs that your respective associations have provided over the years have greatly benefitted our nation’s animal industry. Brucellosis remains as a high priority for us in New York State and I encourage your group to once again focus in on this troublesome disease.
As a farmer and as Commissioner, I want to express my appreciation to this group. We in New York, with over 70% of our farm income derived from livestock and their products, understand very clearly the importance of your work for this industry. In total, the Animal Industry of the United States needs your guidance and expertise to deal effectively with animal diseases.

I hope you will take an opportunity in your free time to visit Niagara Falls and the surrounding areas. I hope as well that you have a pleasant stay in New York State and that Mother Nature waits until you depart to blanket this area with the inevitable. Do have a good meeting and a safe return home to your respective states and countries. Thank you.

October 30, 1978
Commissioner Barber, President Zweigart, Ladies and Gentlemen. It is an honor and pleasure to accept your warm welcome to Buffalo and the State of New York for the 82nd Annual Meeting of the United States Animal Health Association and the 21st Annual Conference of the American Association of Veterinary Laboratory Diagnosticians.

Buffalo, King of the Seaway, the first major port of call on the Great Lakes, is a vigorous, powerful major industrial city on the Niagara River and Lake Erie. The economy has been built on basic industries such as steel, grain, automotive and electric power. Buffalo was already a great city at the turn of the century when many of the western cities were no more than prairie villages.

The Niagara River is actually an inland strait between Lake Erie and Lake Ontario, carrying the overflow of the four great inland seas—Superior, Michigan, Huron and Erie. This great river is only 36 miles in length, but in that distance it drops 326 feet. More than half of that drop is at Niagara Falls. It is one of the world's great waterfalls and the most visited natural wonder in America. Every year more than 5 million visitors come to watch 200 thousand gallons of water thunder over the Falls every second. The Niagara River also serves as a boundary between two great nations. On the west bank is the Ontario Province of Canada and on the east bank is the State of New York.

This area is now peaceful, but history tells us that this was not always so. The three flags flying over the parade ground at Old Fort Niagara remind us of the three countries who controlled the fort since 1679. It was first built by the French, later captured by the British, and has been in American hands since the Revolution, except for its capture by the British during the War of 1812. This entire region of Western New York and the area in Canada across the river were where many territorial disagreements occurred in the past.

New York has rightfully been called the Empire State, taking its name from the commanding position, vast wealth and enterprise of its people. The importance of this great state cannot be overemphasized and we are awed by its strength and power. From the beginning of colonization, through the Revolution, War of 1812, and the Civil War, a major objective was to seize New York State. This would not only cut the nation in half but, also, it would bring control of the nation's economy.

Immigrants from most of the world have entered the United States through some part of New York. Most of us have near or distant relatives who at one time lived in New York or passed through there to become new citizens.
Truly, this is an Empire. Few countries can boast of the geographical advantages enjoyed by this state. At the eastern end, New York Harbor is the world's largest and busiest port; on the western and northern borders there is access to the Great Lakes. In between are some of the most beautiful areas in the world. Here you can see the Mohawk Valley, the Thousand Islands, orchards, farmland, the Adirondacks and Catskills to mention just a few pleasant sights.

New York is a center of culture with great libraries, colleges, music, art museums and theater. The mountain resorts and Broadway have produced more entertainers than any other area in the world.

One could go on and on. New York is the financial center of the world. Nearly every major corporation has an office here; and if not, the conglomerate to which it belongs probably calls New York its home. With heavy, industry, light industry, banking, the stock market, and transportation, it is a vigorous, surging giant. It is surely one of the wonders of the world.

Even with so many outstanding accomplishments, New York manages to be one of the major agricultural states. And, as Commissioner Barber has told us, production of livestock is one of the basic industries forming support for the economy.

These organizations feel it is a great privilege to again visit Buffalo and the rest of New York. Meeting in various parts of the country helps us to appreciate the agriculture and beauty of this great land. This year we are in the Northeast, just a short distance from Canada. Next year we will convene at the extreme southwest corner of America in San Diego, a few miles from Old Mexico. California invites the USAHA and the AAVLD to bring your families along for a visit.

Dr. Nadler and Commissioner Barber, we thank you for your welcome to Buffalo and New York State.
A PRESENTATION TO DR. W.L. BENDIX

T.J. Grennan, D.V.M.
Providence, R.I.

I have known Dr. Bendix more than a quarter of a century, and am privileged to call him friend.

In the conduct of this organization there have been many occasions when a tempering force was called for; occasions when a compromise was called for; occasions when wisdom was called for. As the occasion arose, Dr. Bendix provided the tempering force; he provided and recommended the compromise; and he provided the wisdom.

It is now my further privilege to present to Dr. Bendix this memento expressing the feelings of the membership of the U.S.A.H.A. for his excellence in his eleven years tenure as Secretary, U.S.A.H.A.
A PRESENTATION TO DR. W.L. BENDIX

C.L. Campbell, D.V.M.
Tallahassee, FL.

It is a distinctive privilege for me to participate in this ceremony honoring a man who has done so much for this Association, not only during the eleven years as Secretary, but through some thirty years as a contributing member. However, my greatest pleasure in this presentation is the honor of being selected by virtue of my close friendship with Bill through the years. It is said that a man who can number among his acquaintances one loyal friend, is truly blessed. I feel that I have such a friend in Bill Bendix.

It was in this very hotel twelve years ago when this organization was undergoing some trying times that I, as its President then, asked Bill if he would assume the important role of Secretary. With little hesitation, he agreed and we have been in an ascending cycle since.

Dr. Bendix now feels that it is time that he be allowed the opportunity to rest on his laurels, as it were, and although his leadership will be sorely missed, certainly it is not an unreasonable request.

On behalf of the membership then, Bill, I would like to present to you this diamond-studded lapel pin in the form of the logo of the United States Animal Health Association. God speed.
ADDRESS OF THE PRESIDENT ELECT

T.F. Zweigart
Raleigh, N.C.

Members of the United States Animal Health Association and guests:

Not many people outside our membership and affiliated groups have ever heard of the U.S. Animal Health Association; but not knowing about it doesn't prevent it from influencing the daily lives of every one who consumes animal products, is protected from diseases shared with animals or is interested in the humane treatment of animals. The USAHA, through its committee recommendations and resolutions, has great influence on the animal health, food inspection and animal welfare programs carried out in this country. It is important for the general public to understand what we are trying to do because we need its support. We must sell the voting public on the concept that tax funds are better spent in disease prevention and eradication than in attempting to live with or suppress disease outbreaks as they occur. They should realize that the actual direct losses due to animal diseases are compounded by the disruption of marketing and the expenditure of public funds needed to suppress diseases.

The decision to secure better press coverage for the activities of the USAHA is a step in the right direction. I am hopeful that constructive publicity will engender better support for the objectives of the USAHA and make its work more effective.

The purpose of this Association is defined in its Constitution; I believe most of us agree on the broad objectives. However, I know there is some difference of opinion as to how these objectives should be accomplished. A variety of ideas is needed, but surely all who are concerned realize that our resources are finite, and that we cannot afford the luxury of duplicating or competing programs. With the preamble out of the way, I would like to mention some of the points which relate to making our work more effective.

The main concept of animal disease control in this country is based on cooperative State-Federal programs. This is good, but sometimes one partner becomes too dominant and the cooperator loses interest. In other instances, the cooperator wasn't interested to begin with. At times, programs have been launched to help the livestock industry without checking to see if the industry could afford that kind of help. Fortunately, now we are consulting more with industry before programs are developed.

During recent years there has been more awareness of the fact that an animal disease problem in one state is the legitimate concern of people in other states, and that problems in other countries can become our problems. Brucellosis, tuberculosis, cattle scabies, anaplasmosis, Venezuelan equine encephalomyelitis, and screw worm infestation are
examples familiar to us all. Because of this interrelationship, one state cannot be allowed to imperil others. The late Dr. Frank Wheeler stated that the USDA has two roles in the cooperative State-Federal programs—to assist states in the implementation of programs of national interest, and to represent the interests of the other 49 states. I believe this still applies.

Those persons who are interested in preserving the environment should understand that a little contamination may be a better long term choice than a lot of hunger. We are in a good position to get across to certain sincere, well-meaning people that nineteenth century agricultural methods cannot be used if we are to feed and clothe our twentieth century population—especially in the style to which it has become accustomed.

Even with our best efforts, it is just a matter of time until another exotic disease gains access to this country. Human nature being what it is, it is difficult to get support to combat a danger that hasn’t arrived yet. Despite the fact that prevention is always better than eradication, we have difficulty in keeping up our defenses. Educating the public and their representatives to the advantages of preparedness should be a worthwhile endeavor.

Governmental solutions are becoming harder to sell to the public—especially to the increasing number of citizens who have finally figured out who really pay the costs. Many are awakening to the fact that Big Brother does not know best and cannot handle their affairs any better than they can themselves. Taxpayers are beginning to wonder if they need or can afford all of the protection some people in government would like to give them. All of this poses problems for us in securing funding and needed regulations for animal health and related programs. We have spent some money unwisely and continue to do so. Reform is needed. However, we must avoid having the pendulum swing too far in the other direction and crippling programs which do contribute to the gross national product and increase the standard of living of our people. Making our programs more effective seems to be the best way to do this.

We need to get more animal disease control for the public money we spend in the name of animal health. A while back, a Raleigh, N.C. newspaper printed an article concerning the budget of a Federal-City Rat Control Program. The amount budgeted for the nine-month program was $47,000. The salaries of two administrators and a secretary amounted to $22,906. Office equipment for the project cost $3,270. A radio system to direct field operations cost another $725. The total budgeted for administrative costs was $26,901. The rat catcher and his assistant who actually performed the work rode in a $6,000 van and were paid a total of $10,200. It is hoped that all of our administrative costs are better controlled than in this example, but some people do wonder if the Chief to Indian ratio is out of balance in some of our programs.
We must support the appropriation of the state and federal funds needed to carry out needed programs, but at the same time, we should encourage the most efficient use of these funds. One outstanding example of waste of money and effort involves the allowing of states to become reinfected with animal disease agents after having been cleared. We should urge better enforcement of existing state and federal regulations applying to the movement of infected and exposed animals and the promulgation of new regulations when actually needed.

Budget specialization has its place, but at times too much of it is counter-productive. With our limited resources, we cannot afford a separate program for each disease. Instances where regulatory veterinarians have been on farms for one purpose and could not perform duties connected with other diseases are not frequent, but have been recorded.

Restrictions can't be separated from regulatory programs. In order to help some, we can't avoid some harm to others. However, we owe it to the industry we serve and to the taxpaying public to support the elimination of unnecessary red tape and restrictions. The tremendous expense involved with test and slaughter eradication of animal diseases probably will result in more use of vaccines and chemotherapeutic agents in future programs. This being the case, we need to be more understanding and supportive of those companies which produce those products. No one can reasonably quarrel with valid efficacy and safety requirements, but this association should lend its support to the elimination of any unnecessary requirements or bureaucratic red tape. Failing this, the products we need may never be developed.

Except for changes to meet changing conditions, I see no need for major alterations in our Association. I propose that we intensify our efforts where more emphasis is needed but maintain the same course overall. The Committees of the USAHA are its backbone, and the committee chairmen are especially important. Resolutions are useful, but too much of a good thing can be bad. A good resolution directed to the right person or agency at the right time can be very effective. However, in many cases a resolution serves only to make the resoluters feel better. Superfluous resolutions tend to reduce the impact of the needed ones. Committees should be very selective about passing resolutions.

Through unforeseen circumstances, I have been Acting President of this Association during the past year. Fortunately, there has been very good support from the membership and the staff. I have yet to ask for help that hasn't been given. Secretary Bill Bendix and Ella Blanton have been especially helpful. I am glad I have the good fortune to serve while the present staff is intact.

Not long ago, a friend and I were considering who we thought had been the best governor of our state in recent years. Interestingly enough, both of us chose the same one. Our reasoning was that he had done the least.
All he did was run the State Government. He didn't even propose to change the State's Constitution or reorganize the State Government to his advantage. We hardly knew he was there, but things ran smoothly. There are times when it is better to finish what has been started, and I believe this is one of those times.
Each year, for the past four, I have had the pleasure of presenting the Animal and Plant Health Inspection Service's Administrator's Award. This award is given to a person who has not only established a meritorious record in the control and eradication of livestock and poultry diseases in his home State but has contributed significantly to the national prevention, control and eradication programs.

Few people in your respective States appreciate the time and effort that State control officials spend away from their States to effect the progress of national programs. I just marvel at and appreciate the dedication of many of the State officials who have done this over the years. Without their help and hard work, many of the accomplishments that were successful in past years would not have been possible and, so, that is the purpose of this recognition.

Past recipients have been Dr. John Milligan of Alabama, Grant Kaley of New York, Bill Bendix of Virginia, and "Mitch" or Dr. Mitchell of South Dakota, and tonight we honor Mr. Francis Buzzell of Maine.

Mr. Buzzell, or rather Dr. Buzzell, received an honorary doctorate from the American Veterinary Medical Association in recognition of his enviable record in the State of Maine. They say, "As Maine goes, so goes the Nation." Maine, through Mr. Buzzell's leadership, eradicated tuberculosis and brucellosis many years ago. In addition, the State has been a leader in poultry disease control and eradication.

Mr. Buzzell was Director of Animal Health in Maine for over 30 years and has been a member of the United States Animal Health Association for that length of time. I have seen him attending meetings all over this country for the past 25 years. In his gentle manner, he, on more than one occasion, would say that he had heard all the negative statements back in Maine, but if they would quit talking and get moving they could do the job just as Maine has done. Remember, those people in Maine are known for not wasting words. Besides, Robbie Smith could talk enough for both Francis and himself.

This is an era where we recognize those minorities who have made it and Francis certainly represents a minority in the United States Animal Health Association. In fact, throughout the history of this organization, there have been relatively few officers who were not veterinarians. Since he has held numerous offices, including the presidency, this indicates the esteem the people in USAHA have for him.
This award is presented to State officials who have retired so that in giving such recognition it is not misinterpreted that we are expecting something in return. They have already given to their country and State more than what is expected. Therefore, we in the Animal and Plant Health Inspection Service and the United States Department of Agriculture salute, you, Francis Buzzell, for a job well done. Through your efforts, and those of others like you, the livestock and poultry industries have grown and prospered free of many diseases that other countries have to endure. As a result, the people of this country have a more abundant food supply and that is what it is all about.

Now, I would like to read the citation:

In recognition of your many years of meritorious service to the State of Maine and your support of major national animal disease eradication programs which have contributed significantly to the health of the livestock of this country.
REPORT OF THE COMMITTEE ON NOMINATIONS AND RESOLUTIONS

The Committee on Nominations and Resolutions presents the following slate of candidates for election at this meeting:

President ........................................ T.F. Zweigart
                                             Raleigh, N.C.

President Elect ................................... B.W. Hawkins
                                             Ontario, Oregon

1st Vice President ............................... L.W. Hinchman
                                             Indianapolis, Indiana

2nd Vice President ............................... Robert Stadler
                                             Hartford, Connecticut

3rd Vice President ............................... Glen Rea
                                             Salem, Oregon

Treasurer .......................................... John Shook
                                             Mechanicsburg, Pennsylvania

Region Representatives:

Northeast ........................................... Francis Buzzell
                                             E.S. Bryant

North Central .................................... J.R. Bishop
                                             Bill Gallagher

South ............................................... J.O. Pearce
                                             Joe Finley

West ................................................ Bob Laramore
                                             Olin Timm
RESOLUTION

WHEREAS: The U.S. turkey industry is dependent on uninterrupted shipment of breeder flock replacement hatching eggs from few and geographically concentrated primary breeding sources and the inclusion of such sources in a USDA VVND quarantine would interrupt egg shipment.

WHEREAS: Available laboratory tests, epidemiological procedures and prevention methods can accurately determine the VVND status of a given population of turkeys and the "California Proposal for Turkey Breeder Surveillance for Exclusion of Exotic Newcastle Disease - Redraft 6/28/78" is a program utilizing these technologies.

WHEREAS: The California program as amended 6/28/78 has been endorsed by the USAHA Committee on Transmissible Diseases & Poultry, The Pacific Egg & Poultry Association, the National Turkey Federation, and the USDA-APHIS work group formed to review the program.

THEREFORE BE IT RESOLVED: The USAHA recommends to USDA and State Animal Health Regulatory Agencies the adoption of a program of standard rules and regulations for certification of primary turkey breeding flocks as negative for VVND as outlined in the document "California Proposal for Turkey Breeder Surveillance for Exclusion of Exotic Newcastle Disease - Redraft 6/28/78" and which will provide for the exclusion of such flocks, when feasible, from VVND quarantine areas and allow for the continued shipment of breeder flock replacement hatching eggs.

RESOLUTION

WHEREAS, on May 30, 1978, the presence of African Swine Fever (ASF) was confirmed in Brazil from which this disease may spread throughout South America, thus posing an ominous threat to the entire swine industry of that continent; and
WHEREAS, on July 6, 1978, ASF was confirmed in the Dominican Republic with spread of infection anticipated for a significant segment of islands in the Caribbean thus accentuating possibilities for introduction into Central America, Mexico, the United States, and Canada; and

WHEREAS, ASF virus has capabilities for devastating the swine industry of the Western Hemisphere thus exerting a profound impact upon the economy of many nations; and

WHEREAS, the wildlife fauna of the Western Hemisphere has not been exposed previously to ASF virus and the potentials of various wildlife species becoming victims to or serving as reservoirs for this foreign animal disease have not been defined;

THEREFORE BE IT RESOLVED, that the U.S. Animal Health Association (USAHA) go on record in expressing grave concern for introduction and spread of ASF in the Western Hemisphere; and

BE IT FURTHER RESOLVED, that USAHA not only express support of ongoing ASF research programs but also urge expansion of such investigative efforts into biologic parameters as may be necessary to identify the means and vectors by which African Swine Fever could spread in the Western Hemisphere.

Respectfully submitted,
Frank A. Hayes, Chairman

Resolution No. 3 USAHA Meeting
Held At: Buffalo, New York Dates: October 30, 1978

Source: Committee on Wild and Marine Life Diseases
Subject Matter: Educational Materials

RESOLUTION

NOW, THEREFORE, BE IT RESOLVED, that the United States Animal Health Association supports IAFWA's position in this regard and also offers the services of a review committee to work with any agency or corporation to assist in developing the authenticity of educational materials to be distributed within public schools.

Resolution No. 4 USAHA Meeting

Source: Zoological Animal Committee
Subject Matter: Foreign Animal Disease Training for Zoo Veterinarians

RESOLUTION

BE IT RESOLVED that the Committee on Zoological Animals, USAHA, recommends that the United States Department of Agriculture make
arrangements to provide a course of training in foreign animal
diseases for zoo veterinarians at the Plum Island Animal Disease
Laboratory and that such training course be held as soon as possible.

Resolution No. 5
USAHA Meeting
Held At: Buffalo, NY
Source: Zoological Animal Committee
Subject Matter: Proper Manning of USDA Bird Quarantine Facilities

RESOLUTION

BE IT RESOLVED that the Committee on Zoological Animals, USAHA recommends that
USDA, APHIS, Veterinary Services make certain that properly trained
personnel be available to adequately man the bird quarantine facilities
to prevent the introduction of VVND and other communicable diseases of
poultry.

Resolution No. 6
USAHA Meeting
Held At: Buffalo, New York
Source: Zoological Animal Committee
Subject Matter: Inspection of USDA Approved Zoos

RESOLUTION

Be it resolved that the Committee on Zoological animals, USAHA, recommends that
USDA, APHIS, Veterinary Services, provide sufficient funding and adequately trained personnel
be made available to inspect all USDA approved zoos at
least two times a year to assure the necessary level of
security is maintained to prevent the escape of any
exotic disease agent.

Resolution No. 7
U.S. Animal Health Assoc Meeting
Held At: Buffalo, N.Y.
Source: Infectious Diseases of Horses
Subject Matter: Equine infectious disease activities

WHEREAS, This organization has been informed that the United States
Department of Agriculture does not intend to place proper program priorities
on equine infectious diseases and it is highly probable that certain federal
activities such as those to control Contagious Equine Metritis, Equine
Infectious Anemia, Equine Piroplasmosis, and for the production of antigen
for Equine piroplasmosis testing of animals moving into clean areas from
regions where the disease is endemic, and for the exporting of animals to other countries may be scrapped entirely; and

WHEREAS, there are 8 million equidae in the United States of great monetary value which contribute to the well being of this nation through work, companionship, recreation, parimutual taxation, and sales, and upon which more than $7 billion is spent annually for care and feeding; and

WHEREAS, the equine industry has historically depended on regulatory agencies to protect and aid them in disease control, and foreign interests who purchase over $32 million worth of horses annually from this nation likewise depend on their being free of contagious and infectious diseases;

Now, therefore, be it

RESOLVED, That the U. S. Department of Agriculture and the Congress be asked and urged to give proper credence to this important industry and to provide the necessary federal support to remove this threat of disease, both domestic and foreign, facing our equine population.

Resolution No. 8
U.S. Animal Health Assn. Meeting
Held At: Buffalo, New York
Dates: October 30, 1978
Source: Submitted by the Committee on Sheep & Goats
Subject Matter:

RESOLUTION

THEREFORE: The Committee recommends that the funds for Epidemiological study of Blue Tongue incidences in California be maintained at its present level.

THEREFORE: The Committee requests that man hours for Blue Tongue Vaccine at the Arthropod Borne Disease Laboratory at Denver, be increased.

Resolution No. 9
U.S. Animal Health Assn. Meeting
Held At: Buffalo, New York
Dates: October 30, 1978
Source: Submitted by the Committee on Sheep & Goats
Subject Matter: Resolution on Mycoplasma

RESOLUTION

THEREFORE: Be it resolved that the U.S. Animal Health Association request that the U.S. Department of Agriculture make available safety-tested diagnostic reagents for identification of mycoplasma isolated from affected goats, sheep and other species of animals in the United States.
Resolution No. 10  
U.S. Animal Health Association Meeting  
Held at: Buffalo, New York  
Dates: October 30, 1978  
Source: Submitted by the Committee on Sheep and Goats  
Subject Matter: Resolution on Foot Rot  

RESOLUTION  
Foot Rot is a serious disease problem of the Sheep industry. Therefore, be it resolved this Committee requests that U.S.D.A. give priority to this problem with funds for Foot-Rot research.

Resolution No. 11  
U.S. Animal Health Association Meeting  
Held at: Buffalo, New York  
Dates: October 31, 1978  
Source: Committee on Public Health & Environmental Quality  
Subject Matter: Laws enabling quarantining of diseased animals or animals containing biological or chemical residues.  

RESOLUTION  
1. That laws be enacted in each state enabling the animal disease control authority to promulgate regulations for the quarantine of animals and animal products, as deemed necessary for the protection of human and animal health, that are found to have or contain infectious disease, biological, and/or chemical residues injurious to human or animal health.  
2. That such laws and regulations shall also require veterinarians and any laboratory involved in biological or chemical testing of animal tissues and fluids to report the finding of any animal or animal products containing infectious agents, biological residues, or chemical residues injurious to human and/or animal health to the State animal disease control authority.

Resolution No. 12  
82nd Annual USAHA Meeting  
Held at: Buffalo, New York  
Dates: October 29, 30, 31, 1978  
Source: Brucellosis Committee  
Subject Matter: Discrepancies in MCI Program  

RESOLUTION  
NOW THEREFORE BE IT RESOLVED that this Resolution be directed to the Technical Commission, The Brucellosis Committee of USAHA, and directly to APHIS, and Meat Inspection Division of USDA for correction.
Resolution No. 13
Held At: Buffalo, New York
Source: Brucellosis Committee
Subject Matter: Commission Report

RESOLUTION

THEREFORE BE IT RESOLVED that the United States Animal Health Association strongly recommends that priority be given to completion of these studies, and their evaluation jointly with the states, to insure earliest possible implementation of adequate data collection and data management systems, with compatibility of state and federal processing systems.

Resolution No. 14
Held At: Buffalo, New York
Source: Brucellosis Committee
Subject Matter: Brucella abortus Strain 19 Vaccine

RESOLUTION

THEREFORE BE IT RESOLVED that the USAHA request the USDA to impose a restriction on the sale and distribution of Brucella Abortus Strain 19 vaccine by the manufacturer only to federal and state animal health regulatory agencies, and to accredited veterinarians as approved by the state or federal animal health officials to receive the vaccine.

Resolution No. 15
Held at: Buffalo, New York
Source: Brucellosis Committee
Subject Matter: Brucellosis Program

RESOLUTION

THEREFORE BE IT RESOLVED that the Brucellosis Committee of USAHA request that USDA, Animal and Plant Health Inspection Service, Veterinary Services, develop adequate standards for the manufacture of durable ear tags that can be easily read, and that contractors be required to conform to the established specifications when supplying ear tags on government contracts.
Resolution No. 16

Held At: Buffalo, New York

Source: Parasitic Diseases and Parasiticides Committee

Subject Matter: Cattle Fever Tick Eradication Program and Introduction of Cattle Fever Ticks from Mexico

RESOLUTION

Be it resolved that the Secretary, U. S. Department of Agriculture, cause to be deleted those portions of Section 92.35 (a) (2) in such a manner that such Mexican cattle no longer be permitted entry into the State of Texas.

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Resolution No. 17

Held At: Buffalo, NY

Source: Parasitic Diseases and Parasiticides Committee

Subject Matter: Scabies Eradication

RESOLUTION

THEREFORE, BE IT RESOLVED that the USAHA endorses acceleration of the present Scabies Program with the adoption of the following eleven-point proposal, with special emphasis on §7. That is, that all cattle that are required to be dipped for interstate movement be dipped in a state-federal approved dipping vat, either at origin or destination.

BE IT FURTHER RESOLVED that the USAHA recommends that the following eleven points be incorporated in any program before an expanded national Scabies Program be adopted.

1) Establish several centrally located laboratories to conduct vat analyses for prompt return of test results.

2) Establish several centrally located laboratories for prompt confirmation of scabies.

3) Increased federal-state funding for research on the biology of the scabies mite.

4) Increased federal-state funding for more and better-trained personnel.

5) Increased federal funding for industry educational programs.

6) Increased federal-state funding of portable dipping vats for industry use.

7) All official dipping for interstate movement shall be done at federal-state approved dipping facilities.

8) Increased surveillance of the spraying of trucks hauling infested and/or exposed cattle.
9) Request the National Academy of Sciences-National Research Council to review present scabies research programs and make recommendations for needed research.

10) Establish a National Scabies Technical Commission to evaluate the present scabies eradication program and to suggest needed improvements.

11) Increase federal-state funding for more and improved surveillance and inspection.

BE IT FURTHER RESOLVED that the Secretary of Agriculture be requested to maintain scabies eradication funds at not less than the level for fiscal year 1979.

Resolution No. 18 U.S. Animal Health Assoc. Meeting
Source: Oversight Committee
Subject Matter: Identification of Brucellosis Suspects & Reactors

RESOLUTION
THEREFORE: BE IT RESOLVED, that the U.S. Animal Health Association recommend to the U.S.D.A. APHIS Veterinary Services that official recognition be given to the use of plastic ear bangle tags for this purpose.

Resolution No. 19 U.S. Animal Health Assoc. Meeting
Held At: Buffalo, New York Dates: October 29 - November '78
Source: Oversight Committee
Subject Matter: Uniform Health Certificates

RESOLUTION
THEREFORE: BE IT RESOLVED THAT: The U.S. Animal Health Association meeting in Buffalo October 29 through November 3 review this problem and devise a health certificate that can be uniformly used by each state and to use their influence to persuade each state to adopt this revised health form for all cattle moving in interstate commerce.
Resolution No. 20  
U.S. Animal Health Assc. Meeting  
Held At: Buffalo, New York  
Dates: November 1, 1978  
Source: Oversight Committee  
Subject Matter: Accreditation of Veterinarians

RESOLUTION

This Committee requests the AVMA Council on Public Health & Regulatory, Veterinary Medicine to make a feasibility study and make recommendations in regard to amending these regulations to incorporate means for requiring close adherance to standards and the feasibility of requiring continuing education in regulatory Veterinary Medicine.

Resolution No. 21  
USAHA Meeting  
Held At: Buffalo, N. Y.  
Dates: Nov. 1, 1978  
Source: Import-Export Committee  
Subject Matter: Withdrawal - proposed import regulations for horses

RESOLUTION

BE IT HEREBY RESOLVED: That the proposed rulemaking to permit the importation of horses into any port designated by the Treasury Department as an international port or airport be withdrawn and horse importations be restricted to ports of entry designated for animal importation in Part 92 of the Department's regulations.

Resolution No. 22  
USAHA Meeting  
Held At: Buffalo, New York  
Dates: November 1, 1978  
Source: Import-Export Committee  
Subject Matter: U. S. - Mexico Border - Illegal Livestock Movements

RESOLUTION

THEREFORE, BE IT RESOLVED that effective surveillance to deter illegal movements be established in this international corridor similar to the United States - Mexico border surveillance presently in effect between Amistad Lake Dam and Boca Chica on the Gulf of Mexico.

BE IT FURTHER RESOLVED that the entire Texas-Mexico border surveillance be placed under one organizational unit, with the degree of surveillance along the entire border being consistent with the number of livestock on either side of the border.
Resolution No. 23

USAHA Meeting

Held At: Buffalo, NY

Dates: ____________________________

Source: Transmissible Diseases of Swine Committee

Subject Matter: Recognition of Need for A.S.F. Diagnostic Training

RESOLUTION

NOW THEREFORE BE IT RESOLVED that the Secretary of Agriculture, USDA, make available funds to Emergency Programs so that they might provide additional training for A.S.F. diagnosis to diagnostic pathologists, microbiologists and state regulatory officials.

Motion by Dr. N. Black, 2nd by Dr. M. Lang—unanimous approval.

Resolution No. 24

USAHA Meeting

Held At: Buffalo, New York

Dates: November 1, 1979

Source: Import-Export Committee

Subject Matter: Canadian Import Requirements - Bluetongue

RESOLUTION

Be it hereby RESOLVED: That the United States Department of Agriculture, through its contacts with the Canadian Health of Animals Branch; negotiate a more practical testing requirement for cattle, sheep and goats entering Canada including:

1. Recognition of both the AGP and the MDCF test for meeting the test requirements, and

2. Requirement of a single test with either the AGP or MDCF test on cattle, sheep or goats entering Canada during the non-vector months in the State of origin, or

3. Requirement of a single AGP test at any time on cattle, sheep or goats entering Canada.

4. Requirement of a single test for cattle, sheep or goats entering Canada when the animals originate in a bona fide breeding herd or flock in which all the cattle, sheep, and goats on the premise of origin have been tested negative for bluetongue not more than 60 days before the date of export or if during the winter months animals may be exported if the herd or flock of origin is tested negative at least 30 days after the first recorded frost. Provisions for testing an adequate sample of the herd or flock on the premises or origin should be made for large herds or flocks.
NOW THEREFORE be it resolved that the U.S. Animal Health Association urge the U.S. Department of Agriculture to assemble a mobile laboratory unit equipped with laboratory apparatuses, glassware, biological and non-biological reagents and such other equipment as is deemed necessary by the U.S.D.A. for the diagnosis of A.S.F. and, further, that such a mobile unit be so designed as to permit immediate surface and air transportation wherever needed in the U.S. or abroad.

BE IT FURTHER RESOLVED that the U.S.D.A. identify an appropriate source of funding for the assemblage, transportation and operation of the diagnostic mobile unit hereinbefore described.

NOW, THEREFORE, BE IT RESOLVED that the Secretary of Agriculture be requested to arrange for the Emergency Programs Staff and the Plum Island Animal Disease Center to provide the needed reagents of nonviable nature, equipment, and training for approved selected animal disease diagnostic laboratory personnel as needed to be able to make diagnoses of sufficient specificity to justify initiation of immediate control measures.

THEREFORE, BE IT RESOLVED that the USAHA urge the USDA, APHIS responsible officials to: 1) reestablish practitioner participation fees; 2) approve animal health technicians whose competency is determined and approved by an appropriate state regulatory official employed by an accredited veterinarian.
Resolution No. 28  USAHA Meeting
Source: Identification Committee- Ralph Bishop

Subject Matter:

RESOLUTION

WHEREAS, the Identification Committee of USAHA has supported the development of Electronic Identification in all of its aspects and has provided a forum to record its development, along with the development of other forms of identification, and

WHEREAS, USAHA was not successful in the effort to have an Advisory Committee appointed by the Secretary of Agriculture for the purpose of giving centralized direction to final stages of development and implementation in order that all equipment and devices would be compatible and meet minimum standards within the definition of a National System permitting expedient and uniform application at all levels and locations thus affording maximum cost effectiveness and effectively function in disease control and eradication, a National Livestock Electronic Identification Board was established by Livestock Conservation Institute to fill this need, and

WHEREAS, the National Livestock Electronic Identification Board, with representatives from all segments of the livestock industry, has progresses to establish minimum standards for a National System of Electronic Identification and has become recognized as the central coordinating body by manufacturers, distributors and government agencies, while standing firm on the premise that Electronic Identification will be accepted by the producer most rapidly on a voluntary basis as the cost effectiveness for management purposes becomes apparent.

BE IT THEREFORE RESOLVED that USAHA urge all livestock groups, organizations and regulatory agencies to permit the orderly uninterrupted development of the concept on the schedule now established in order that field trial results can be evaluated and implementation start on a voluntary basis before it is publicly discussed or publicly proclaimed as a system that will or may be required in fulfilling any mandatory identification requirements through acknowledging that those Electronic ID systems in use that meet the standards of the National System will fit the prescribed requirement for permanent, nonduplicative identification that can be recorded and traced by computer.

BE IT FURTHER RESOLVED that though not required, all markets and state and federal regulatory agencies prepare to recognize electronic ID, that meets the standards of the National System, as an official means of livestock identification.
How To Become a Member of USAHA

To become an individual member of USAHA, write to:

USAHA
Suite 205, 6924 Lakeside Ave.
Richmond, VA 23228

and request an application. The individual dues are $20.00 per year and this entitles the member to receive the Annual Proceedings and all mailing materials from the USAHA office.
REPORT OF THE COMMITTEE ON ANAPLASMOSIS

Chairman: A.P. Schneider, Boise, Idaho

Co-Chairman: E.J. Richez, Pawhouska, Okla.


The Anaplasmosis Committee met at 1:30 p.m. October 30, 1978 in the Statler Hilton Hotel, Buffalo, New York. Twelve committee members and guests were present.

The committee was informed that Dr. W. E. Brock, one of the previous Anaplasmosis committee chairmen had passed away in March of this year and the group hereby expresses its condolence to Dr. Brock’s family.

The report of the committee in 1977 was read.

The committee discussed the continued Anaplasmosis research in Eastern Oregon titled “A Bovine Anaplasmosis Winter Transmission Study conducted in Eastern Oregon under controlled Natural Exposure.” The study was conducted during 1976-78 winters in an Anaplasmosis enzootic area. It now is reported that half of the herd has been cleared of infection and studies and work is under further continuation to see if the entire herd can be cleared of the infection.

Various aspects of research and proposals of certain new chemotherapeutic treatment were discussed by the members present. A discussion was held on the present extent of the infection in the U.S. and it appeared that from the information obtained from those present that Anaplasmosis was less severe during the last year in at least those states represented by committee members present.

The committee stressed the need for continued research in the use of tetracycline products and regulatory people are extremely concerned over the movement of possible infected animals in interstate traffic.

Other topics included a report from those present as to their experiences with the disease and those persons working in research reported on their proposed projects.

Continuing laboratory and field studies on a new long-acting oxytetracycline formulation (200 mg/ml) confirms previously published reports of efficacy for the treatment of acute anaplasmosis. The greater concentration of active drug and blood levels persisting for several days following a single intramuscular injection decreases the volume and
number of treatments required. This new product, Liquamycin (Terramycin)/LA is being commercialized in several countries. In the U.S., a new animal drug application is on file with the FDA.

A. P. Schneider
A. A. Cuthbertson D. V. M.
Kenneth L. Kuttler D. V. M.
REPORT OF THE COMMITTEE ON
FOOD ANIMAL HYGIENE AND INSPECTION

Chairman: Robert J. Lee, College Park, Md.
Co-Chairman: D. Bedell, Tifton, Ga.


A meeting of the Food Animal Hygiene and Inspection Committee met at the Statler Hilton Hotel, Buffalo, New York on October 30, 1978. Approximately 26 committee members and non-members were in attendance. The Committee submitted the following report:

Dr. Lloyd D. Konyha, Chief Staff Veterinarian, Tuberculosis Epidemiology APHIS reviewed the current status of bovine tuberculosis in the U.S., with special emphasis on the epidemiological affects of bovine tuberculosis in two herds, one in central Maryland, the other in southeast Pennsylvania. His report points up the importance of increased vigilance for the detection of this serious disease of bovine and man.

Dr. John Cobb, Assistant Commissioner, Georgia Department of Agriculture, reported on the status of swine mycobacteriosis in Georgia pointing up the scope of the problem and outlining a proposed Georgia program for control of the disease, including indemnification and research for more effective control. Indemnification would be paid only on properly identified animals and to owners agreeing to cooperate in the development of control measures.

Dr. John Cole, virologist, Veterinary Diagnostic and Investigational Laboratory, Tifton, Georgia, reported on research conducted on swine mycobacteriosis including isolation of organisms from the environment and tissues of affected animals, evaluation of test procedures for identification of infected animals and the prospects for the development of a vaccine to suppress the disease.

Mr. Ralph Johnson, Chief Staff Officer, Microbiological Staff, Science Group, FSQS reported on two points of possible public health hazard significance:

1.) The mechanical pinning of meats and
2.) the vacuum packaging of primal cuts in pliofilm packages.

Through research conducted at his laboratory, it was learned that the mechanical pinning of meats carries surface microorganisms including pathogenic microorganisms into the core of the meat. Unless the ultimate user of the meat properly cooks such pinned meats, the danger of public
health hazard exists. The manner in which beef is traditionally cooked in many instances could be a factor in the survival of pathogenic microorganisms in the core of beef cuts. Since poultry products and pork products are traditionally well cooked before serving, they are considered not to present a problem.

Additional research conducted at his laboratory indicates that vacuum packaged primal cuts in plofilm packages do not present a potential public health hazard.

Dr. William Dubbert, Acting Director of Staffs Technical Services, FSQS reported on the current status of nitrates, nitrites and nitrosamines. He indicated that U.S.D.A. is giving consideration to the possible phase-out or ban on the use of nitrites but is awaiting an opinion from the Justice Department before taking any action in this matter.

Dr. Dubbert next reported on the FSQS publication “A Strengthened Meat and Poultry Inspection Program.” He touched on additional methods under consideration for conducting on-line PM inspection of poultry, without diminishing consumer protection, modified PM techniques on a regional basis for the inspection of livestock carcasses, and a “Quality Assurance” program for processing operations. All these, if and when implemented, will result in more effective use of manpower. A mandatory animal identification is required for the success of a modified PM examination of livestock.

Dr. J. K. Payne, Director, Federal States Relations Division, FSQS reported on the Humane Methods of Slaughter Act of 1978. He stressed four points:

1.) The new law will require all slaughter plants (Federal, State, and foreign exporting to the U.S.) to comply with the provisions of the Act.

2.) Ten states presently have no Humane Slaughter Act.

3.) All states presently administering State Meat Inspection programs will be required to amend their present meat inspection laws and

4.) Handling of livestock on the premises of the slaughtering plant is covered under the Act as well as the slaughter operations themselves.

Inasmuch as all states presently administering state meat inspection programs will be required to amend their State laws accordingly, the committee urges all such States to move in that direction without undue delay.

A resolution regarding proper livestock identification was adopted by the Committee and will be presented to the Resolutions Committee of USAHA for its consideration.
A Preliminary Report on Serological Survey of Blue Tongue Disease in Cattle in U.S. — Dr. Metcalf.

This survey was conducted in the fiscal year 1978 using bovine serum samples collected at brucellosis test laboratories in the U.S. Two major goals were to be accomplished. One was to devise a sample collection scheme to obtain validity of the survey and secondly to determine the distribution of Blue Tongue Disease in the U.S.

The complement-fixation test was used in the survey and as suspected the greater distribution of Blue Tongue was in the western and some southern states. In 1977, two epizootic areas of Blue Tongue were identified, one in California and another in central U.S.

This type of survey should be repeated several times to more accurately determine the per cent of seropositives cattle in the U.S.

A Serological Survey for Akabane, Ibaracki and Enzootic Hemorrhagic Disease. Dr. Anderson.

These diseases are apparently of economic significance in some countries of the world. Akabane has been described as an epizootic of congenitally deformed calves. Some herds have lost as high as 30% of the calf crop.

Using serum neutralization and plague-reduction neutralization technique, there is no evidence of akabane in the U.S. at this time.

A survey for Ibaraki indicated certain areas of the U.S. has a high percentage of seropositive animals.

There is an apparent cross-reaction between Ibaraki virus and enzootic hemorrhage disease virus. There may be a cross-reaction with an unknown 4th virus. EHD virus has been isolated from animals clinically indistinguishable from Blue Tongue disease.

The sub-committee on artificial insemination asked that the Parent Committee again notify APHIS of USDA of the resolution presented to
them several years ago concerning the development of regulations related to Health standards for bulls being used in artificial insemination.

Leukosis in cattle situation was reviewed by Dr. Martin Van der Maaten. He indicated death loss from this disease was not as important as possible loss of sales.

In the U.S. about 2% of beef cattle are infected with bovine leucosis virus. About 20% of the dairy cattle are infected.

There appears to be transmission through the milk and later in life horizontal transmission is accomplished by transfer of infected leucoeytes such as during insect bites or minor surgical operations.

There is a suggestion that the demand for cattle from negative herds will increase for cattle considered for import into foreign countries.
REPORT OF THE COMMITTEE ON RABIES

Chairman: William G. Winkler, Atlanta, Ga.

Co-Chairman: L. N. Butler, Phoenix, Ariz.


The Rabies Committee met on October 31 with a total of 15 members and guests present.

The Committee reviewed recommendations made at the 1977 meeting and noted the following action during the intervening year:

1. The 1978 Compendium of Animal Rabies Vaccines has been accepted by an increasing number of states as the basis for animal rabies vaccine usage.

2. The Subcommittee appointed to work with U.S.D.A. on standardization of a rabies vaccination certificate for international and interstate use has not yet been able to resolve differences in format but continues to try.

The Committee then discussed current topics in rabies including:

1. The recent report of 2 human rabies deaths in which transmission may have been effected by way of corneal transplant surgery.

2. The newly recognized phenomenon of vaccine induced rabies in dogs and the associated prohibition on sale of Low Egg Passage Flury Strain Modified Live Rabies Vaccine in California. The need for additional surveillance to ascertain the exact magnitude of the problem was noted.

The Committee then addressed those topics which it felt might call for specific action:

1. The 1979 Compendium of Annual Rabies Vaccines was reviewed and endorsed. Specifically discussed changes in the Compendium included the addition of new vaccines to reflect those currently marketed; the deletion of any recommendation for vaccination of wildlife; the recommendation for development of a cat vaccine with 3 year immunity; the recommendation that rabies vaccine be administered only by or under direct supervision of a veterinarian; and the inclusion of a definition of “high-risk” areas, to wit, “any area (country, city or town) where indigenous dog to dog rabies transmission is identified by the local health department.”

2. The Committee, in reviewing reported animal rabies in the U.S., agreed that cat rabies remains a threat to human and animal health and is not adequately controlled. To emphasize the need for including cats in rabies vaccination programs, a statement was prepared for issue to appropriate journals:
"The rabies Committee of the U.S. Animal Health Association is concerned that the incidence of cat rabies is approximately equal to that of dog rabies while efforts to control cat rabies are very limited as compared with those to control dog rabies. Data from the Center for Disease Control's Rabies Surveillance Report for 1977 indicate that cat rabies comprises 25% of reported domestic animal rabies. The Committee urges that cats be included in rabies immunization programs and that the Compendium of Animal Rabies Vaccines be used as a guide for cat immunization."

3. The Committee discussed current status of bat rabies and bat control and recommended that appropriate agencies increase efforts to acquire the knowledge needed to effectively control bats, particularly how to effectively rid buildings of bat colonies.

4. The Committee reviewed the current status of the new human deploid cell strain rabies vaccine for human use and urged that every effort be made by the manufacturer and the Food and Drug Administration to expedite a final decision on licensure of this vaccine.

5. The Committee discussed the difficulty in ensuring that legislators are properly informed prior to developing and passing legislation relative to rabies control. After some discussion it was agreed that no formal recommendation on the subject should be made at this time.

6. The Committee agreed that its membership should be increased and accordingly will submit nominations to the chairman within 30 days.

7. There being no further business the Committee adjourned.

Respectfully submitted,

William G. Winkler,
Chairman
Chairman: Dr. G. B. Rea, Salem, Oregon

Members: Mr. Clint Booth, Dallas, Texas; Dr. Ron Caffey, Washington, D.C.; Dr. R.L. Evinger, Salem, Oregon; Dr. John H. Gray, Austin, Texas; Mr. Frank Harding, Geneva, Illinois; Mr. Bert Hawkins, Ontario, Oregon; Dr. Royce Henderson, Austin, Texas; Dr. D.E. Herrick, Bowie, Maryland, Dr. J.L. Hourrigan, Hyattsville, MD; Dr. John L. Hyde, College Park, MD; Mr. T. A. Kincaid, Jr., San Antonio, Texas; Dr. David J. Matthews, Washington, D.C.; Mr. John H. Niemi, Buffalo, South Dakota; Dr. E.C. Sharman, Hyattsville, MD; Dr. Donald H. Spangler, Lacey, Washington; Dr. H.M. Steinmetz, Washington, D.C.; Dr. J.E. Thomas, Roseville, Minnesota; Dr. J.S. Walker, Long Island, N.Y.; and Dr. William Wilson, Pensacola, Florida.

Roll Call—16 Members present.

A quick review was made of last year’s report with special attention to action on the solutions submitted.

We learned that new requirements for importation of wool have been implemented. There are now 3 approved facilities for processing restricted wool. Ship boarding procedures have been changed and are being implemented only as garbage control at the various ports can be effected.

Dr. Sharman and members of the Import-Export staff reported on the past year’s activity. There were 1,486,139 importations (all species) and 81,122 rejections. Changes in the import requirements were reviewed.

The proposed rule published in the Federal Register Volume 43, No. 151, August 4, 1978 which would amend Part 92 of the C.F.R. to permit the entry of horses into the United States at any port designated by the US Customs Service, where quarantine facilities have been provided by the importer, was discussed. After considerable dialogue the committee decided that such a proposal, if implemented, would not be in the best interest of the health & welfare of the National Equine herd and hence should be withdrawn. A resolution to this effect has been forwarded to the Resolutions Committee.

The importation of animal by-products was discussed. Special attention has been and is being given to any product from countries where African Swine Fever exists or through which such products may have transited. Holds have been placed on certain products for special treatment. Ground beef from Argentina is presently not allowed into the United States. We were informed that studies are being made to determine if this product can be treated or prepared in such a manner to insure its safety.
Over 4,000,000 birds including poultry and hatching eggs were imported this past year. Most of these originated in Canada and Mexico with some importations from Europe. Special attention is paid to all European importations with regard for Egg Drop disease. It is reported that the surveillance of these importations consume over 65 man years per annum as compared to 60 man years for all other species.

Slides of the Harry S. Truman Import Station at Fleming Key were shown. It is 75 to 80% complete at this time, and the first shipment is expected in June 1979. Thirty-eight applications, decided by lot, have been granted. The facility will accommodate 400 animals at one time. Procedures for processing these animals were explained.

Dr. Ron Caffey of Plant Protection Quarantine reported his organization’s activity for the past year. He discussed his staff and their relationship to the US Customs Service. He discussed in detail ship boarding procedures and the attempts being made to improve communications between his professional staff—5 veterinarians, including himself—and the inspectors in the field which also have responsibility for plant products.

Slides were shown of garbage control aboard ship and at several air and maritime ports.

Surveillance on the Mexican border was reviewed. The committee had been supplied with reports and statistics referring to the dangers of entry of Sheep Scabs, Fever Ticks, Hog Cholera and other diseases by this avenue.

The committee was impressed with the fact that this border is not only the border between Mexico and Texas but also between Mexico and Montana—in fact every other state in the Union. A resolution speaking to the improvement of border surveillance has been presented to the Resolutions Committee.

The testing procedures for Bluetongue, required by the Canadian Health of Animals Branch, for importation of livestock into Canada was discussed. Representatives from the Canadian Beef Cattle industry and the Health of Animals Branch participated. As a result a resolution calling for changes in testing procedures and setting forth certain criteria has been forwarded to the Resolutions Committee.

A problem concerning certification of animals for exportation was discussed. Since exportation of animals and animal products is a 2.2 billion dollar item anything that will enhance this procedure should be thoroughly evaluated. The committee supports the use of US Origin Health Certificates (17-140) in addition to official Interstate Health Certificates when the livestock so covered are being moved interstate for assembly and/or further processing prior to export from this country. This procedure will provide much needed herd history which is necessary but frequently not available on the usual interstate certification.
REPORT OF THE COMMITTEE ON STATE FEDERAL RELATIONS

The members of the State-Federal Relations Committee:

- Dr. T. F. Zweigart
- Dr. L. W. Hinchman
- Dr. W. L. Bendix
- Mr. B. W. Hawkins
- Dr. J. C. Shook
- Dr. D. H. Spangler
- Dr. R. J. Stadler
- Dr. J. L. O’Harra


The Committee reviewed the resolutions passed at the October 1977 annual meeting of the United States Animal Health Association and reviewed the response by the various departments of U.S.D.A. most concerned with the individual resolutions. The Committee reviewed reports from F.S.Q.S., M.P.I.P.; The Livestock and Veterinary Science Department, S.E.A.; the Bureau of Veterinary Medicine of F.D.A.; and A.P.H.I.S.

Recommendations made to the individual federal agencies were as follows:

**APHIS**

*Poultry Diseases*

This committee recommends that the Secretary of Agriculture transfer the N.P.I.P. to Veterinary Services, APHIS. This has been an ongoing recommendation of the Transmissible Diseases of Poultry Committee of the USAHA for many years. This change will provide greater liaison with all poultry disease control and eradication efforts. The committee recommends that no changes take place in the administration of the N.P.I.P. and stresses the importance of providing the necessary funding for the program. The committee recommends that the N.P.I.P. funding should not jeopardize the overall salmonellosis budget.

It is further pointed out that the USAHA adopted a resolution at the Minneapolis meeting, requesting the Congress to provide funding for research and programming for a national salmonellosis effort. This committee commends the AVMA Council on Public Health and Regulatory Veterinary Medicine for adopting a similar resolution.

The Emergency Disease Section Staff apprised this committee on proposed program changes involving the importation requirements for pet birds.

This committee endorses the effort of quarantining all pet birds including the birds that have been previously exempted under the two bird restriction. This effort is most compatible in protecting against the reintroduction of VVND virus as well as other disease efforts.
The committee was made aware of the importance of the A-127 virus and recommends that all effort be made to prevent this disease from causing losses to our nation's poultry industry.

**Pseudorabies**

Pseudorabies continues to cause great economic loss to the nation's pork industry. Due to the delay in the formulation and presentation of both the proposed federal regulations and program guidelines of control, the committee recommends that the final draft be completed and distributed to state regulatory officials as expeditiously as possible.

This committee continues to stress the necessity for a simplified regulatory diagnostic test as well as a continued search for ancillary and supplemental tests for pseudorabies. The standardized microimmuno gel diffusion antigen should be made available, only to approved laboratories after the antigen has met the requirements of the A.A.V.L.D.

It was shocking, even traumatic, that the committee was informed the budget request for this disease was decreased. The committee recommends that sufficient budget be made available to provide for the necessary research and programming for a disease which has caused a great economic impact as well as some panic within the industry.

This committee continues to stress the need for additional surveillance on the Texas-Mexico border to prevent the introduction of hog cholera, ticks and V.V.N.D. into our nation.

**Fleming Key and Clifton Import Stations**

The Committee congratulates the USDA for the progress made in establishing the two import stations and thus giving the USDA complete control of all imports coming through the United States from restricted areas.

The Committee does have reservations however, on the use of air importations. The short travel time does not give problems that may be inapparent time to develop. In the event of a problem, the plane must be allowed to land and thereby the possibility of introducing an exotic disease.

The Committee feels that imports be allowed only by sea. In the event of any problem, the ship can be held at sea until the problem is resolved. We wish to point out that it was the intent of Congress that these imports would be by sea only.

The quarantine of these animals to be imported in a station in Europe will help to prevent the introduction of exotic disease in the United States.

**Brucellosis**

The Committee notes certain accelerated accomplishments in the brucellosis program following last year's report. We urge the program be
kept on the proposed time schedule and that adequate funding be made available to reach the proposed eradication date on time.

The Committee sees great value in full cooperation with research efforts to develop an immunizing agent that is efficacious and that does not interfere with diagnostic tests.

In view of federal personnel limits, the Committee recommends that contracts be developed with the various states to enable the state to supply personnel with federal funding that manpower may be kept at the proper level to continue the full eradication program.

Regulation and inspection of interstate movements is vital to control of the spread of brucellosis. This Office of General Council continually presents an obstacle in this area in long delayed prosecutions of flagrant violations. The Committee recommends that consideration be given to exploring ways by which this problem can be overcome.

The Committee expresses concern in the manner of the release of the Brucellosis Technical Committee Report. The Committee urges the full report be distributed to the USAHA Brucellosis Committee and Executive Committee, before it is released at the AVMA meeting in Dallas.

**Cattle Scabies**

Cattle Scabies has continued to spread to new states despite the efforts of state and federal regulatory authorities to prevent its further dissemination. It appears that the spread will continue unless the personnel and money needed to commence an eradication program are committed.

The Committee recommends that a program of sufficient size to eradicate cattle scabies within five years be undertaken at the earliest date possible. In the meantime, it is recommended that measures necessary to prevent the spread of cattle scabies to other states be placed into effect. These measures may involve the establishment of quarantine lines and the compulsory dipping of cattle leaving quarantined areas.

**Cattle Ticks**

The Committee deplores the delay by APHIS of instituting a program to eradicate the *Boophilus microplus* and *Amblyomma variegatum* ticks from Puerto Rico. The Committee is gravely concerned that the heavy traffic between Puerto Rico and the mainland will result eventually in the spread of these ticks to other parts of the United States.

It is urged that an eradication program for these ticks be placed into effect as soon as possible.

**Public Information Committee**

On behalf of the USAHA, we want to express our sincere thanks for the direction and assistance given us last year at the Minneapolis
meeting in the area of public information. Miss Kathy Ellis did a splendid job before, during and after the meeting. For the first time, it is felt that the USAHA got its message across to the Agricultural Press of the nation and others we needed to reach. We are truly grateful for the help and guidance Miss Ellis gave us.

We are not so sure about the right road to follow for the future. Some mistakes were made at Minneapolis. This type of operation was new to us—and the USAHA and its operations were new to the USDA Information people. We at least now know some things not to do.

If we are to fulfill our mission and keep the USAHA and its work of interest to the Agricultural Press and industry, we must establish an ongoing and continuous relationship.

USAHA feels this is sufficiently important both to the Association and USDA to try to develop this activity to its maximum potential. A properly informed press can provide powerful support for our jointly developed and proposed programs, both with industry and the Congress. What USAHA needs is more know how.

We are asking that the relationship you sanctioned last year be continued for this year through the Buffalo meeting and possibly also through the San Diego meeting in 1979. We would be most pleased if you would allow Miss Ellis to continue with us until we "become of age," as it were, in this effort. It should prove of great mutual benefit.

S. E. A.

Our Committee commends your agency and APHIS for the increased cooperation and dialogue developed over the past several years regarding the research needs of our livestock and poultry industries. We are gratified to learn that a joint SEA-APHIS panel has been formed to review field requests and suggestions for research.

We are all aware that unpredicted and unexpected disease problems occur, but programs and research done out of reaction to emergencies is not always the most effective, economical and scientifically sound approach. Hopefully, this joint panel of representatives from both agencies will be a step toward sound planning and result in getting the most benefit from the limited funds and personnel available. It should also assist in not having to divert monies from already existing necessary programs to finance crash programs.

We are extremely pleased with the new emphasis on brucellosis research and the additional monies available will hopefully speed up the development of new immunizing agents which will be more effective, will not cause the disease and will not interfere with diagnostic tests. We would hope to eventually have a more efficient, more definitive, more rapid test available to be able to screen more animals in less time.

The research to develop the diagnostic tools to detect those swine diseases caused by parovoviruses should be a real economic boon to the swine industry.
The C.E.M. outbreak in Kentucky has been a crisis to the thoroughbred industry, but points out the quick response your agency is able to provide in such situations in training diagnosticians and increasing knowledge of organisms through efforts of your professional staff at Plum Island.

We are all shocked to learn that the N.P.I.P. program has not been funded for your agency. This program has long been a good example of the accomplishments that can be attained when industry and regulatory agencies work cooperatively. This program has had untold benefits to the industry and consumer at a minimum cost to all concerned. While we are not arguing the point that the program is regulatory in nature and should be transferred to APHIS, we are deeply concerned that the program not be allowed to terminate by default. The other concern of this transfer is the almost total lack of money for salmonella research which is vitally needed in other segments of the industry.

With the increased restrictions from various sections of the country and other countries of the world regarding bluetongue in sheep and cattle, we support increased effort on the part of SEA to provide facilities and staff to research the pathogenesis and diagnosis and initiate control and eradication recommendations. The restricted markets so vitally needed by the industry are being denied due to our present disease situation.

We urge continued observation of the San Miguel Sea Lion Virus and its potential involvement in domestic animal diseases. The source of infection to our swine population through feeding of marine life or secondarily from garbage fed swine to other swine remains a grave concern and answers for the control and eventual eradication of the disease, should it occur, are needed.

F.S.Q.S.

The State-Federal Relations Committee has been adequately appraised of the proposed reorganization of F.S.Q.S. The committee is fully cognizant of the fact that the executive branch has the authority to provide for such reorganization. However, this committee feels the necessity to oppose such reorganization for the following reasons:

1. The rationale of providing for greater economy with such reorganization appears highly improbable in setting up six new offices to house six new deputy administrators.
2. Commodity specialists will lose their identity—deputy administrators cannot possibly have the expertise in meat problems, dairy problems, vegetable commodities, egg products, etc. The programs will also lose their identity which has proven to be very important in past years.
3. It is apparent that such reorganization would provide 26 new top executive positions, which would necessitate again expertise in all commodity areas.
The federal meat inspection program of this nation has been the model for other nations for many years. The reorganization could cause a loss of identity of this program that could jeopardize the import of our nation's meat and meat products.

The committee was most pleased to be informed that there are no apparent problem areas in the respective state meat inspection programs. The committee continues to recommend that the necessary budget be provided to continue the existing federal and federal state programs.

The committee was informed of the possible changes in post mortem procedures for red meat inspection. This change has been needed for some years in order to keep the procedures compatible with modern needs. The committee commends MIPI personnel for such proposals and activity.

This committee continues to stress the importance of coordinating disease control and eradication efforts of APHIS with F.S.Q.S. Ongoing eradication efforts such as Bovine and Swine Brucellosis, and Bovine and Swine Tuberculosis programs are dependent upon inspection procedures and sampling at the time of slaughter.

The committee commends the USDA's proposed Sulfa Task Force. The approach is most realistic and should be of great benefit to the swine producers in coping with the residue problem involving sulfa drugs.

F.D.A.

The Committee is still deeply concerned about the effectiveness of F.D.A.'s proposal to limit the use of penicillin and the tetracyclines at subtherapeutic levels in animal feeds.

The Committee does commend the Bureau of Veterinary Medicine of F.D.A. for holding hearings throughout the United States relative to these proposals and reviewing the hearing reports to be used in F.D.A.'s final proposals. It is recommended that F.D.A. thoroughly review all suggestions coming from these hearings before producing a final proposal.

The Committee looked with favor on the cooperative effort being exhibited between M.P.I.P. of F.S.Q.S. and F.D.A. in the surveillance and monitoring of food supplies for compounds that may be deleterious to human health.
REPORT OF THE COMMITTEE ON
PARASITIC DISEASES AND PARASITICIDES

Co-Chairman: John F. Hudelson, Denver, Colo.


The Committee met on Wednesday, November 1, 1978, with 34 members and visitors present.

Dr. John Gray, Epidemiologist, cattle fever tick program, Austin, Texas brought the committee up-to-date on the Tick Eradication Program. Emphasized was the need for more tick submissions for identification.

A total of 27 new infestations was reported during the past year, 19 of which occurred within the buffer zone. Boophilus micropus ticks were found in Puerto Rico the first week of January, 1978. A federal quarantine was placed on Puerto Rico on January 20, 1978. During FY 1978, 125 infestations of Amblyomma Variegatum were found in Puerto Rico.

Dr. Gray also reported on some field trials on the use of the Co-Ral dip vat analyzer. Results of these trials suggest that the kit may be satisfactorily used as a field test if conducted in a reasonable environment by personnel that have been trained in the use of the kit.

Drs. R. O. Drummond and W. W. Utterback, gave a brief report on their research concerning the "Bioassay and Chemical Determination of Acaracidal Activity of Coumaphos in Dipping Vats in South Texas."

The concentration of coumaphos in the vats was maintained, as required, throughout a year with active vats. The results were similar for inactive vats.

Drs. R. O. Drummond and W. P. Meleneey, U. S. Livestock Insects Laboratory, Agricultural Research, SEA, USDA, Kerrville, Tx., presented to the committee a brief report on research projects underway at the laboratory.

Dr. W. C. Tobin, VS, APHIS, USDA, Colorado, gave a brief report on the cattle scabies eradication program in Colorado. The full report is to be given at the General Session.

Mr. Bill Gallagher, Stephan, So. Dak., chairman of the cattle scabies Sub-Committee of the National Cattlemen's Association's Animal Health
Committee, gave a report on a resolution from the NCA, and requested by motion, that this committee formally support and submit said resolution to the Nominations, Resolutions and Internal Affairs Committee, USAHA. This committee voted and approved said action.

Drs. J. L. Hourrigan and G. O. Schubert, VS, APHIS, USDA, gave reports on the cattle scabies program, nationally, during the past fiscal year. During FY 1978, there were 313 outbreaks reported as follows: Arizona-2; California-3; Colorado-80; Illinois-1; Iowa-21; Kansas-32; Minnesota-7; Nebraska-55; New Mexico-38; Oklahoma-13; Oregon-1; South Dakota-17; Texas-30; Utah-1; Wyoming-12.

It was noted that two more outbreaks were reported each month of the year since January, 1977. During the month of October, 1978, 14 outbreaks were confirmed.

They reported that the federal funds for scabies use in FY 1979 total $5,369 million. Members of this committee are greatly concerned that a reduction of any magnitude would lead to a tremendous increase in cattle scabies outbreaks in the USA and recommended as a part of a resolution that the U.S. Secretary of Agriculture be requested to maintain scabies eradication funds at not less than the level for FY 1979. It was reported that sheep scabies has been confirmed in Mexico, just across the border from Texas.

Also discussed were the proposed changes in 9CFR, Part 73, in regard to interstate movement of cattle with respect to scabies. These changes will be published in the Federal Register for comment.

Dr. Novy, VS, APHIS, USDA, Douglas, Arizona, gave the committee a status report on the screwworm eradication program.

The program suffered a severe setback this year, primarily because of adverse weather. Arizona, New Mexico and California, have reported 3,801; 1,264 and 112 cases this year (through 10-17-78) compared to 154, 21 and 2 cases for the same period last year.

A copy of the various papers is included as a part of the committee's report.

The committee received, considered and voted favorably on a resolution in regard to ticks asking the Secretary, USDA, to amend federal regulations in such a manner that Mexican cattle exposed to cattle ticks or cattle tick fever no longer be permitted entry into the State of Texas.

The thrust of this resolution would be to lessen the risk of cattle fever on the cattle industry of the United States and to encourage the control and eradication of cattle fever ticks in those areas of northern Mexico adjacent to the State of Texas.

The resolutions were prepared in proper format for the consideration of the Resolutions Committee.
<table>
<thead>
<tr>
<th>AREA OR PLACE OF ORIGIN</th>
<th>STATUS OF CATTLE</th>
<th>REQUIREMENTS OR RESTRICTIONS</th>
<th>DESTINATION AND PURPOSE OF MOVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free Area</td>
<td>Uninfected and Unexposed cattle</td>
<td>Inspected, treated once within 10 days prior to moving, so certified.</td>
<td>Any destination or for any purpose.</td>
</tr>
<tr>
<td>Quarantined Area</td>
<td>Exposed cattle</td>
<td>Inspected and treated once within 10 days of movement, so certified.</td>
<td>Cattle moving interstate for any purpose, except immediate slaughter.</td>
</tr>
</tbody>
</table>

**A. Uninfected and Unexposed cattle**

- Free Area: Inspected, treated once within 10 days prior to moving, so certified.
- Quarantined Area: Inspected and treated once within 10 days of movement, so certified.

**B. Exposed Cattle**

- Free Area: Inspected within 10 days of movement, found scabies free, and so certified if cattle not slaughtered within 14 days of shipment, one treatment is required. Vehicles must be placarded.
- Quarantined Area: Inspected within 10 days of movement, found scabies free, and so certified if cattle not slaughtered within 14 days of movement. One treatment is required if cattle not slaughtered within 14 days of movement.

This Guide is NOT a Regulation and is NOT to be used as such. For detailed information relative to each type of Interstate Movement refer to the regulations which appear in Part 73 (as amended) of Title 9, Code of Federal Regulations.

Each State or portion of a State is classified in the regulation as a particular area or areas, namely, (1) Free Area, and (2) Quarantined Area.

Cattle moving interstate for IMMEDIATE SLAUGHTER to a recognized slaughtering center in any area.

Cattle moving interstate for IMMEDIATE SLAUGHTER directly to a recognized slaughtering center in any area.

Cattle moving interstate to any area for any purpose except immediate slaughter.

*Inspected and treated once within 10 days of movement.**
<table>
<thead>
<tr>
<th>STATUS OF CATTLE</th>
<th>AREA OR PLACE OF ORIGIN</th>
<th>DESTINATION AND PURPOSE OF MOVEMENT</th>
<th>REQUIREMENTS OR RESTRICTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. Infected Cattle</td>
<td>1. Any Area.</td>
<td>Cattle moving interstate to any area for any purpose, except immediate slaughter.</td>
<td>Treated twice prior to moving interstate 10 to 14 days apart, and so certified.³⁴</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cattle moving interstate for IMMEDIATE SLAUGHTER to a recognized slaughtering center.</td>
<td>Treated once within 10 days of movement and so certified. If not slaughtered within 14 days, a second treatment is required. Vehicles must be placarded.³³⁴</td>
</tr>
</tbody>
</table>

1. Inspection, supervision of treatment, and certification must be made by a VS State Inspector or Accredited Veterinarian.
2. The cattle for immediate slaughter shall not be diverted enroute and upon arrival shall use facilities reserved for such cattle.
3. Inspection, supervision of treatment and certification must be made by a VS or State Inspector.
4. All treatments must be done in a permitted pesticide at a State and VS approved treatment facility. Cattle may be treated on farm in a facility approved by the VS or State Inspector involved.
5. If other than permitted lime-sulphur or toxaphene dips are used, two treatments rather than one treatment of exposed cattle are required.
PARASITIC DISEASES AND PARASITICIDES COMMITTEE
TICK ERADICATION PROGRAM

John H. Gray, D.V.M., M.P.V.M.
Regional Epidemiologist

The United States Texas cattle fever tick (Boophilus annulatus and Boophilus microplus) program in FY 1978 continued to progress in pushing the tick infestations back to the United States-Mexican border.

We had a total of 27 new infestations this year. Dividing the infestations into our 2 historical categories, the buffer zone, which is the quarantine zone next to the Rio Grande River extending from the Gulf of Mexico at Brownsville, Texas, to the Amistad Dam, about 700 River miles Northwest of Brownsville. We had a total of 19 new infestations in this buffer zone. In our second category, the final area which encompasses the remainder of the state, we had 8 new infestations, all of which bordered the buffer zone.

Fever tick surveillance, within the State of Texas, was up somewhat this FY. Although the number of written submissions regarding Boophilus ticks were up, the number of premises infested were down compared to FY 1977.

Tick surveillance, nationwide, needs to be improved. If we compared the last several years to CY 1973, tick collections from cattle, we had a total of 5728. CY 1974, the year Amblyomma variegatum (the tropical Bont tick) was confirmed as being established in Puerto Rico, we notice a steady over-all decline in our surveillance activities. However, there has been improvement by individual states. If we remove the tick collections from Texas, a state that has an ongoing tick program and remove the collections from Puerto Rico and the Virgin Islands, the surveillance activities are picking up.

<table>
<thead>
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<th>47 States</th>
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<tr>
<td>CY 1973</td>
<td>121</td>
<td>4998</td>
</tr>
<tr>
<td>CY 1974</td>
<td>121</td>
<td>3585</td>
</tr>
<tr>
<td>CY 1975</td>
<td>64</td>
<td>3430</td>
</tr>
<tr>
<td>CY 1976</td>
<td>451</td>
<td>2848</td>
</tr>
</tbody>
</table>

In 1977, we maintained the over-all downward trend in tick collections throughout the nation. However, Oklahoma increased their collections from 7 CY 76 to 225 in CY 1977, and Arkansas and Tennessee showed marked improvement. Louisiana, Mississippi, Alabama, Georgia, South Carolina, and Florida need to increase their tick surveillance considering their risk. We do not have the numbers for 1978, however, we all are aware that Boophilus microplus was discovered in Puerto Rico in
January of 1978. The southern states that were involved in the original eradication program are now open to two routes of infestation—one for Mexico and one for Puerto Rico. There is little question that *Boophilus microplus* could not survive winter beyond southern Texas and southern Florida and possibly a little bit in southern Louisiana.

If any new tick becomes established, will we be able to eradicate them? That question can be approached in a more positive manner if we maintain good surveillance activities that would provide us the opportunity to discover a new infestation rapidly and before it is well established. Even our endemic domestic ticks are on the increase and spreading to new areas.

Last year I mentioned the field trial we were conducting concerning the Co-Ral dip vat analyzer. We have completed this work and very briefly I would like to provide the committee with our results.

First we had a one-and-a-half day training program for the Animal Health Technicians that were involved in the trial. The object of the field trial was to evaluate the use of this analyzer kit in the daily activities of the tick program. This kit had already been proven as an acceptable testing procedure for the acaricide Co-Ral (coumaphous) when used under controlled conditions in the hands of a trained laboratory person. Therefore, the question facing APHIS, Veterinary Services' Tick Program was—"Could this testing procedure be carried out by the Tick Force employees that had a minimum or no laboratory background and who received a minimum of training in the use of the kit?"

We tested 500 field samples by 3 methods. 388 of these samples were statistically analyzed. All correlations were positive and the statistical significance ($P < 0.01$); correlation coefficients between test results for the field trip and the 2 laboratories ranged between .737 and .837. The correlation coefficients between the 2 laboratories was .812. I consider this very good. We have also conducted further tests under laboratory conditions. Dr. Pemberton, head of the Chemistry section, Veterinary Service Laboratories, at Ames, Iowa, has used triplicate samples submitted from the field. The standard deviation between these triplicate portions for the field procedure was 0.0088% and 0.0023°/b for laboratory procedure. This is a standard deviation difference between the two procedures of 65 ten thousandths. I consider this to be very good, and since we are involved in vat concentrations of 0.125 to 0.0250 I am not the least bit concerned about the accuracy of this kit. The standard deviation between results obtained on the same sample was 0.01%.

Since this testing was conducted, the laboratory has established a new slope factor that is 1.4 times larger and results are even closer between the laboratory and field test. Please note I said field test. This field trial was not conducted to establish a vat side test. It was conducted to establish a field test that was to be conducted in a reasonable environment. I suggest that Veterinary Services use the Co-Ral analyzer
kit as a tool to provide better vat management and the tests be considered as official as soon as we are able to establish an adequate monitoring system by the laboratory to take care of any shortcomings that may develop in the field, and we train personnel to conduct the tests. Tentative plans are to train and certify all personnel using the field kit.

Dr. J. E. Novy

The screwworm program suffered a severe setback during this year because of adverse weather and the difficulty experienced by the Mexico-American Commission. Major difficulties involved aircraft maintenance problems in pupae transportation and fly dispersal.

Arizona, New Mexico, and California have reported 3,801, 1,264, and 112 cases so far this calendar year (through October 17) compared to 154, 21, and 2 cases in the same time span last year. Texas has had 994 cases compared to a total of 39 cases in 1977.

Movement of infested animals into Texas from Arizona and New Mexico was believed to have contributed to the spread of the parasite. Cases occurred in central Texas, hundreds of miles from known infestations, but near slaughtering plants receiving sheep from the more western States.

The two sterile fly production facilities in Mission, Texas, and Tuxtla Gutierrez, Chiapas, Mexico, are producing more than 500 million sterile flies per week. The flies are being used in a joint program effort to eradicate screwworms down to the Isthmus of Tehuantepec and there establish a new barrier against northern migration.

A contract aircraft used for sterile fly release in Arizona crashed killing both the pilot and disperser.

A new approach to control screwworms is under testing by Federal research. It is called the Screwworm Adult Suppression System (SWASS). The product consists of a pellet consisting of an attachment, a bait, and a pesticide that will attract and kill wild screwworms that feed on the bait. The product has worked well in reducing native populations, in tests conducted so far. It is hoped this product will function to reduce heavy populations in order to enhance the effects of the sterile fly technique, which performs better against low populations of wild flies.
BIOASSAY AND CHEMICAL DETERMINATION
OF ACARICIDAL ACTIVITY OF COUMAPHOS
IN DIPPING VATS IN SOUTH TEXAS

by R. O. Drummond¹ and W. W. Utterback²

ABSTRACT

Samples of vat contents from 10 "active" official (USDA, APHIS, Veterinary Services, and Texas Animal Health Commission) vats and 4 "inactive" vats were analyzed by a chemical technique and by bioassay with engorged female Boophilus microplus (Canestrini) to determine concentration of coumaphos. There was a general correlation between concentration of coumaphos as determined by chemical analyses and by bioassay although values by bioassay were about 75% of those by chemical analysis. The concentration of coumaphos (0.165 percent or 5½ lb of 25 percent wettable powder/100 gallons water) for initial charge and replenishment as required was maintained throughout a year with active vats. The relationship of concentration of coumaphos in inactive vats was similar to that of active vats.

¹Laboratory Director, U.S. Livestock Insects Laboratory, Agricultural Research, Science and Education Administration, U.S. Department of Agriculture, P.O. Box 232, Kerrville, TX 78028.

²District Veterinarian in Charge, District 1. Veterinary Services, Animal and Plant Health Inspection Services, U.S. Department of Agriculture, 83 Scripps Drive, Sacramento, CA 95825.
Chairman: R. M. S. Temple, Bristolville, Ohio


The Zoological Animal Committee was called to order at 9:30 A.M. Wednesday by Chairman R. M. S. Temple with seven members and nine guests present.

The following items were discussed:

1. Importation of wild pigs.

Dr. Herrick reported that means are available to import from captive bred population and it is now up to the importers.

2. Post-entry quarantine of zoo animals.

Dr. Herrick reported that action has been initiated to allow the Secretary discretion on post-entry quarantine animals. It was indicated that if the change is made, additional tests of these animals may be necessary.

3. Approved Zoos

The importance of maintaining inspection for compliance with reduced personnel was discussed. This discussion resulted in a resolution. The Chairman requested clarification of handling of diagnostic specimens from post-entry quarantine animals from U.S.D.A. The need for foreign animal disease training for Zoo Veterinarians was discussed and resolution was prepared.

4. Tuberculosis in Zoo Animals.

The committee recommended that AAZV continue its effort to accumulate data on prevalence testing procedures, sites, doses and results with the tuberculins available.

5. Quarantine Facility

It was reported that the Newburgh facility will be under construction this winter. Completion is anticipated within two years. It was noted that more and more export countries are restricting their zoological exports.

6. Importation of Birds

Dr. G. Pierson gave a status report on bird importation. He indicated that there was an increase in the number of lots and 34 additional private quarantine facilities had been added (total is 82). It was stated that a user's fee system has been initiated where the importers reimburse the government for all services rendered. This will result in an increase in
the cost at USDA-operated facilities.

The committee indicated its concern with personnel ceilings and their possible effect on commercial bird imports. A resolution resulted.

The disposition of diseases of imported birds other than VVND was discussed. The Chairman requested information from the subcommittee on Aviary and Cage birds of the Transmissible Disease of Poultry Committee. He further requested that a representative of that committee attend future Zoological Animal Committee meetings.

A new system of handling imported pet birds will be implemented during the coming year. Trailers will be used at five sites on the Mexican border, one in Los Angeles. Existing facilities will be used at Honolulu, New York and Miami.

7. Marine Mammal Regulations

Dr. Sherman reported that notice of proposed rule making on revised standards for marine mammals was published September 19 with a sixty day comment period. Due to shortage of published copies, the comment period may be extended.

Meeting adjourned at 11:30.
REPORT OF THE COMMITTEE ON PROFESSIONAL OVERSIGHT

Chairman: J. L. O'Harra, Reno, Nevada
Co-Chairman: Douglas R. Stauffer, Pickerington, Ohio


The U.S. Animal Health Assoc. Committee on Professional Oversight met at 1:30 p.m. Thursday, November 2, 1978.

The following items were considered by the committee:

1) The Holstein-Friesian Association of New York brought to the attention of the Committee the problems associated with the many forms of official health certificates being used in interstate movements. Following discussion a resolution was prepared by the committee for consideration by the U.S.A.H.A. suggesting that a uniform health certificate be adopted by all States for this use.

2) The Committee's attention was directed to the Southern States Animal Health Association Resolution dated April 18, 1978 expressing great concern over the contractual official ear tags and vaccination tags recently supplied to the U.S.D.A.

The Committee commends the U.S.D.A., APHIS, Vet Services for taking appropriate action and re-vamping specifications that will provide a satisfactory tag for future use.

The Committee further recommends that future specifications for contractual tags provide all safeguards to provide the best product available. The committee directs attention to the use of plastic coated orange-yellow steel tags over the present baked enamel tag used in the vaccination program.

3) Problems of accreditation standards and removal of accreditation from veterinarians not adhering to these standards was brought to the attention of the committee. Following discussion a resolution was prepared and unanimously adopted for consideration by the U.S.A.H.A. The resolution requests a feasibility study be made by the A.V.M.A. Council on Public Health and Regulatory Veterinary Medicine and their recommendation in regard to compliance with standards and possible continuing education requirements in regulatory veterinary medicine.
4) The Committee reviewed last year's recommendations and expressed disappointment and concern that no action had been taken in regard to our request for possible changes in accrediting regulations.

5) The Committee recognizes the value of more easily read identification of cattle in certain herds subject to continued testing. The Committee recommends that U.S.D.A.—APHIS recognize and supply suitable durable plastic bangle tags as official supplementary identification in addition to the currently used metal ear tag.
SYNONYMS

Three-day Sickness, Stiffness, Bovine Epizootic Fever, Driedaesiekte, Lazy Man's Disease, Stywesiekte, Dengue Fever of Cattle.

DESCRIPTION

Bovine ephemeral fever is an arthropod-borne, noncontagious, viral disease of cattle and buffalo characterized by an acute febrile reaction, stiffness, and lameness. The morbidity may be high, but the mortality is usually low.

OCCURRENCE

Bovine ephemeral fever was first described in East Africa by Schweinfurth in 1867, and subsequently in Egypt (1895), Rhodesia (1907), South Africa (1908), Kenya (1915), Indonesia (1919), India (1919), Japan (1922), Palestine (1931), Ceylon (1924), and Australia (1936). The disease now occurs both enzootically and epizootically in Africa, Asia, the Middle East, and Australia.\textsuperscript{9,10,14,21}

ETIOLOGY

Ephemeral fever is caused by a rhabdovirus which may either be bullet or cone-shaped as seen under the electron microscope. Vesicular stomatitis virus and rabies virus are also members of this group. Ephemeral fever virus is ether, chloroform, and sodium deoxycholate sensitive.\textsuperscript{13} Inactivation by heat occurs in 10 minutes at 56°C, 18 hours at 37°C, and 120 hours at 25°C. Ultraviolet light and trypsin inactivate the virus. The buoyant density is 1.196.

In cell culture, the virus has been adapted to the following established cell lines: Baby hamster kidney \textsuperscript{21}, calf kidney, calf testis cells, and Aedes albapictus cells with no cytopathogenic effect; while in fetal bovine kidney, Vero and MS monkey kidney cells, there is a cytopathogenic effect. Isolation of the virus in chick embryos was unsuccessful when yolk sacs were inoculated but successful when 10-day-old embryos were intravenously inoculated. When ephemeral fever virus is passaged in mice or tissue culture, its pathogenicity for cattle is markedly reduced.

ECONOMIC LOSS

Monetary losses during initial outbreaks in an area are severe. Loss to international markets occurs because of embargos on live animal shipments of cattle and cattle semen. Generally, there is a .05 to one percent death loss of affected animals. This may vary from year to year.

\textit{Beef animals} . . . Loss of prime "fat" condition occurs when finished cattle cannot be marketed as soon as they are ready. Lameness and protracted recumbency with resultant need for special care disrupts marketing. Death, infertility, or impaired breeding capacity of stud bulls
for as long as 155 days has resulted. Certain strains of the virus appear to cause abortions, but experimentally this has not been produced.\textsuperscript{17}

Dairy animals . . . Reduction in milk production from 10 to 70 percent with a simultaneous reduction in quality of cream and milk has been reported. Mastitis often occurs as a sequela. It has been conservatively estimated that milk production drops 15 percent during epizootics.

Working animals . . . There is the inconvenience of having large numbers of draft cattle not available for work in vital planting seasons or for hauling, etc. The affected animal cannot work for 2 to 3 weeks and often suffers relapses.

Semen . . . There is some risk of transmission by semen, but it is very low as the virus has been found in semen but research has not been able to prove transmission by artificial insemination.\textsuperscript{3, 16}

CLINICAL SIGNS

Following artificial infection, the incubation period is from 29 hours to 10 days — the average being 3 to 5 days. The onset is sudden and, as the name implies, the clinical disease is usually short (2 to 4 days).

Heavier cattle, bulls, and milking dairy cows are generally more severely affected than lighter animals and calves. A sudden rise in the temperature of the animal, which often goes as high as 41°C. (108°F.), is usually the first sign. This fever only lasts a matter of a few hours but may be present for 48 hours or longer. The affected animal is seen standing or lying alone, separated from the rest of the herd. A watery, serous lacrimation and a copious bilateral serous nasal discharge on the first day is not uncommon. By the second day the nasal discharge has become seromucoid and long strings can be seen hanging from the nose. Occasionally a severe salivation and drooling may be present. The affected animal goes off feed on the first day and rumen atony is sometimes present. Feces may be normal or may be hard and contain strings of mucus and blood.\textsuperscript{18} Diarrhea can follow on the second and third day.

Generalized depression can be seen for 24 to 48 hours. The stance is typical with the head down and extended, ears down, and back arched. The animal appears depressed as if it has a severe headache. The conjunctiva of the eyes and mucus membranes of the nose and mouth are often congested on the first and second day of clinical signs. The heart and respiratory rates are increased dramatically on the first day. The respiration may become so fast that the animal is panting (80-90 respirations/minute).

Lameness and stiffness usually start on the second day. It may affect from one to all four legs. A cow lame in one leg may suddenly become lame in another leg. If forced to move, they may soon warm out of the lameness; however, it may increase severity of signs and cause death. When cattle become lame, shivering of some of the muscles of the affected area may be seen. Excess fluid in the affected joints is usually seen in severe cases. Subcutaneous emphysema has been rarely reported, but when present, death usually follows. Affected cattle may go down soon
after developing clinical signs, and the head is often turned back into the flank as in ketosis. Once down, the animal may not arise for several days. Occasionally a severe paresis develops and the animal is down for weeks or months, and weakness of loins and hindquarters may persist for a year or more.

Some nervous signs are seen in animals with ephemeral fever, particularly a change in temperament. A placid animal may become violent, while a violent animal may become placid. The paralysis of the muscles used in swallowing may be due to both muscular and nerve damage. Affected cattle have a tendency to raise the tailhead and hold it 4 or 5 inches from the body. In South Africa, geophagy, or eating of the soil, has been noted.¹¹

Milk production is reduced or stopped. If the disease strikes in early lactation, the animal may regain about 80 percent of previous production. In the later part of lactation, the animal does not regain normal production. Mastitis is a common complication of ephemeral fever. The milk can become thin and watery and blood can be present.¹⁰

There is temporary infertility of bulls for a period of several months after infection occurs.²²

Chart 1 illustrates the frequency of the usual signs.

**Chart 1**

<table>
<thead>
<tr>
<th>Sign</th>
<th>Percentage Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>10</td>
</tr>
<tr>
<td>Complete inappetence</td>
<td>92</td>
</tr>
<tr>
<td>Nasal discharge</td>
<td>67</td>
</tr>
<tr>
<td>Shivering</td>
<td>53</td>
</tr>
<tr>
<td>Respirations greater</td>
<td>53</td>
</tr>
<tr>
<td>than 50/min.</td>
<td></td>
</tr>
<tr>
<td>Lameness</td>
<td>39</td>
</tr>
<tr>
<td>Paresis</td>
<td>4</td>
</tr>
</tbody>
</table>

**EPIDEMIOLOGY**

When bovine ephemeral fever is first introduced into a country, several conditions must be met for the disease to become established. Sufficient susceptible hosts (cattle or buffalo) and suitable vectors must exist.

While bovine ephemeral fever is becoming established, there is a sweeping epizootic which may last 2 years or more. After most animals develop immunity in the area, the epizootic ceases. However, reservoirs of virus may persist.¹⁶ Calves from immune dams may be infected once maternal antibody decreases. Immunity is usually completely protective in recovered animals.

The disease remains quiescent until an increase of susceptible animals and the right climatic factors allow another sweeping epizootic. Generally, it takes 4 to 6 weeks for an area to become free of the clinical disease.
The longer the quiescent period, the more susceptible animals there are in the population and more extensive is the epizootic.

**Vectors** . . . The virus of ephemeral fever has been isolated from *Anopheles bancrofti* collected in Australia, but this does not explain its entire distribution there. Other unidentified vectors must also be involved since outbreaks have occurred where this vector is not present. The virus has also been isolated from a mixed pool of trapped mosquitoes. On trial feedings of mosquitoes, *Culex fatigans*, *Aedes aegypti*, and *Culex annulorostus* all reproduced the virus. In Africa the virus has been isolated in *Culicoides* midges.6

**Hosts** . . . The natural host of ephemeral fever is cattle, both the *Bos taurus* and *Bos indicus* species, as well as the various buffalo species. Antibodies have been found in waterbuck, wildebeest, hartebeest, banteng, deer, and porpoises.

Experimentally, mice 1 to 4 days old become paralyzed and die from intracranial inoculation. Unweaned hamsters are also susceptible to the virus. Experimentally, virus has been recovered from inoculated sheep, but field isolations from sheep have not been made.6 One researcher developed a strain of ephemeral fever virus which, when inoculated intracranially, killed guinea pigs, 3-day-old kittens, adult mice, and suckling rats.

Meat does not pose a threat of spread due to the rapid inactivation of the virus and the inability for transmission to occur by eating the meat. Blood or serum poses little danger unless inoculated into animals.

**LESSIONS**

**Macroscopic** . . . Serofibrinous polysynovitis, tendovaginitis, periarthritis, fasciitis, cellulitis, and localized focal necrosis of skeletal muscles occur in affected animals.2 The synovial membranes most constantly and severely affected are those of the larger joints of the limbs (the stifle, followed by hip, shoulder, and elbow joints), while hock, carpal, tarsal, and fetlock joints are less often affected. Excessive amounts of turbid straw-colored synovial fluid is seen in the more severely affected joints. Yellow-white flakes and plaques of fibrin are visible in the fluid. Similar lesions have been seen in joints of the vertebral column, particularly in the atlantal-occipital and atlantal-axial joints.

Regional lymph nodes of affected limbs may be mildly or markedly swollen and edematous. Small petechiae may be present in the lymph nodes, and hemorrhages may occur in the trachea and heart muscle.4 13 Effusions often occur in the pericardium where 20 to 30 ml or more of fluid may be present. Emphysema of lungs and pleura may occur, and occasionally a subcutaneous emphysema of back and neck has been reported.13 Pleurisy is often present, and focal fibrinous plaques may be seen. Excess pleural fluid can be seen. Edema may be seen in various areas of fascia.

Muscles may be affected, and when the affected muscle is cut transversely a focal necrosis may rarely be present. Congestion of the
abomasal and intestinal mucosa, omentum, the superficial vessels of the brain, eyes and conjunctiva, and mucus membranes of the mouth and nose is seen.

When treatment has been given by mouth, inhalation or foreign body pneumonia is a frequent finding. Throat muscles are affected and swallowing is impaired. No oral medication is indicated.

Microscopic ... Changes are largely limited to venules and capillaries in synovial membranes and tendon sheaths and consist of endothelial hyperplasia and perivascular neutrophilic infiltration. Areas of focal necrosis, thrombosis, and perivascular fibrosis have also been reported. Large numbers of neutrophils can be recovered from synovial fluid of affected joints. The primary lesion appears to be an increase in vascular permeability. It has been theorized that the vascular permeability is caused by an Arthus-type reaction where virus and antibody combine and are deposited along blood vessel walls. Complement is attracted and activated, and chemotactic factors are released which attract neutrophils. Degranulation of the neutrophils causes injury to the wall or release of factors which increases vascular permeability.

Wollerian degeneration of the spinal cord, particularly at cervical vertebra number one, has been reported in paralyzed animals.

DIAGNOSIS

Diseases and conditions causing signs and lesions similar to ephemeral fever are listed in Chart 2.

<table>
<thead>
<tr>
<th>Chart 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ibaraki</td>
</tr>
<tr>
<td>Milk Fever</td>
</tr>
<tr>
<td>Acute Laminitis</td>
</tr>
<tr>
<td>Traumatic Reticulitis</td>
</tr>
<tr>
<td>Anaplasmosis</td>
</tr>
<tr>
<td>Heartwater</td>
</tr>
<tr>
<td>Malignant Catarrhal Fever</td>
</tr>
</tbody>
</table>

In enzootic areas the large number of animals involved, coupled with generally a short course of 2 to 4 days, makes clinical diagnosis relatively easy.

CONTROL

There is no effective treatment for ephemeral fever, and oral medication should be avoided.

Experimentally, several vaccines have been developed and tried in South Africa, Australia, and Japan. After conducting a vaccination program, Japan has not reported ephemeral fever since 1971.

Control programs may be aimed at control of insect vectors in the affected area. Control will depend upon the epizootiology in the outbreak area, the vector species involved, and the techniques available for field application. Additional research is needed on the epizootiology of the disease, biology and control of potential vectors, and the development of a safe, effective vaccine.

REPORT OF THE COMMITTEE ON EPIZOOTIC ATTACK

Chairman: H. Q. Sibley, Austin, Tex.
Co-Chairman: H. A. McDaniel, Hyattsville, Md.


The Epizootic Attack Committee convened at 1:30 p.m., 11/2/78. Approximately 70 members and guests were present.

A status report on resolutions passed last year was given. The Response to most of last year's resolutions were gratifying but was disappointing on a few.

The threat of African Swine Fever, preparedness in the United States was the subject of a lengthy discussion. The attached resolution was passed and forwarded to the committee on resolutions. (Attachment 1)

A resolution stressing the need for diagnostic reagents, equipment, and training for the diagnosis of foreign animal diseases in state and university laboratories was passed and forwarded to the committee on resolutions. (Attachment 2)

It was brought out that exotic diseases producing agents are stored in several laboratories throughout the U.S. that have not been approved for this purpose. A motion was passed to form a subcommittee to study this problem and report next year.

Other items mentioned and/or discussed included FMD vaccine, Egg drop syndrome, foreign animal disease investigations, contagious equine metritis, depopulation, cattle scab, Fever ticks, Rift Valley Fever, Harry S. Truman Import Center, sheep scab, Screwworms, animal disease reporting.
The current bluetongue situation in Australia arose as a series of events were enacted that led up to the isolation and identification of the virus from a mixed pool of *Culicoides spp.* collected in the Northern Territory of Australia.

Australia has several arbovirus infections of both man and animals and a great deal of epidemiological research has been carried out on these diseases. The major animal pathogens are Bovine Ephemeral Fever (BEF) and Akabane Disease (AD) viruses. Bovine Ephemeral Fever has been recognized since the 1930’s and is known to occur in epizootics approximately every ten years. Akabane virus has only recently been identified as a pathogen in 1974 although the congenital malformations it causes have been seen since 1954. The vector or vectors for BEF have yet to be identified while the major vector of AD is known to be *Culicoides brevitarsus*, a biting midge.

The Animal Health Division of the Council for Scientific and Industrial Research Organization has been engaged in studying both these viruses and their diseases. This group also organized and developed the sentinel herd scheme as an early warning system for identifying arbovirus movement following serological conversion of susceptible cattle. Although the sentinel herd scheme was successful, it became obvious that it was important to identify the vector of BEF in order to investigate and develop possible means of control.

Entomologists joined with microbiologists to set up an area where trapping and identification of insects, particularly mosquitoes and *Culicoides spp.*, could be carried out. The original site chosen was at Beatrice Hill near Darwin in the Northern Territory. The decision was partly reached because this area appeared to be the nidus of infection for BEF virus, as the epizootics appeared to spread from these regions in September/October down through the central areas of Queensland and New South Wales, reaching the Victorian Border by February/March.

In two season’s collections, 1973 and 1974, a great number of insects were processed at Beatrice Hill and from these insect pools a large number of viruses were isolated. The viruses that could not be identified in Australia were sent to the World Reference Center for Arboviruses at Yale. There they waited their turn for identification along with other viruses from around the world.

At Yale the virus was recognized as a bluetongue type. The virus was then sent by the Australian authorities to the World Reference Center for Bluetongue Viruses at Onderstepoort, South Africa where the virus
was recognized as a new serotype and designated Serotype 20. The identification and serotyping took place approximately one year ago. Immediately following the alert, testing of cattle and sheep sera collected from all over Australia was carried out using the serum neutralization test. A number of cattle in herds across the Northern areas of Australia were shown to be serologically positive. Although sera from other ruminants (sheep and goats) were tested at this time, only one goat serum has been found positive. At present, BT virus serotype 20 is confined to the original areas outlined by the Australian Disease Control Authorities based on serologic findings in cattle. To date, no virus isolations have been made from any animals in the field and no clinical evidence of disease has been seen. In laboratory experiments the virus has been shown to cause a transitory disease and to be capable of being transmitted by a number of biting gnats of the *Culicoides* spp.

When the state diagnostic laboratories in each state began testing cattle and sheep serums with tests using group antigens, the modified direct complement fixation and the agar gel precipitin tests, it became apparent that there were cattle sera from New South Wales reacting to the tests. The positive sera were checked using the specific serum neutralizing test for BT virus serotype 20. The sera were negative to this test. Selected positive sera were then sent as paired samples to the Animal Virus Research Laboratory at Pirbright in England and to the World Reference Center for Bluetongue Virus at Onderstepoort, South Africa. Both centers suggested that the sera were reacting to BT virus serotype 1 antigen although there were also nonspecific reactions to other BT virus serotypes. As there are a number of orbiviruses present in Australia that appear to be closely related to the bluetongue viruses and some of these orbiviruses, particularly D’Augilar are known to infect cattle, it is possible that there could be cross reactions taking place in the group tests.

In summary, the current position in Australia is that there has still been only the original isolation of virus from the mixed pool of *Culicoides* spp. For all intentional purposes, antibody to BT virus serotype 20 is confined to the designated areas in the North of Australia. No clinical cases of bluetongue virus infection have been seen in the field. Although there has been a great number of sera tested using group antigens to BT virus, so far only a limited number of cattle have shown positive reactions, although the cattle have been present in the Northern Territory, Queensland and New South Wales.

It is planned to carry out extensive serological surveys and attempt virus isolations from both ruminants and insect vectors.

Laboratory experiments using other orbiviruses inoculated into ruminants are being carried out in an attempt to detect any cross reacting antibody to bluetongue virus group antigen.

Work is continuing on the effect of serotype 20 bluetongue virus in ruminants both in Darwin and at the Longpocket Laboratory in Brisbane.
CATTLE SCABIES IN COLORADO

William C. Tobin - V.M.O.
Coordinator Colorado State-Federal Cooperative Scabies Program*

INTRODUCTION

It has been established that the necessary tools for successful Scabies Eradication are available. The problem remains, however, that complacency together with lack of funding and manpower, have long made Cattle Scabies a low priority function on the list of many State and, too often, also of A.P.H.I.S. officials.

The State of Colorado is unique among States in that its Statutes refer specifically to Cattle Scabies and prescribe to the management of outbreaks when diagnosed.

I. Colorado Revised Statutes 1973 as follows:

35-50-109(1) Whenever it becomes known to the State Agricultural Commission that a disease known as...Scabies...exists among the cattle...of any county...it is the duty of the State Agricultural Commission to take such steps as will prevent the spread of such disease within the state. The Commission has the power, as a sanitary measure, to inspect and compel the dipping, box spraying or other sanitary treatment as may be determined by said Commission, of all such animals in the State of Colorado...under such rules and regulations as the Commission may adopt.

35-53-111(1) The State Agricultural Commission may make and adopt such quarantine and sanitary regulations effecting the movement of livestock into and out of the State of Colorado and within the borders of said State...to prevent the...spread within the State of any contagious or infectious disease...

The policy of the State Veterinarian's Office as prescribed by the Colorado Agricultural Commission has been to keep the livestock industry well informed concerning the incidence of various livestock disease problems in the State. This policy has been followed closely and the Colorado Cattlemen's Association, Colorado Cattle Feeders Association, Livestock Market Association and other interested parties had been kept apprised of the Scabies situation, both on a national scale as well as in Colorado.

In late 1977 it had become apparent that there were an extraordinary number of cases of Cattle Scabies in Colorado. Thirty five cases had been diagnosed from July 1, 1977 to January 1, 1978; the highest incidence of Scabies in such a period for over twenty years.

The high incidence of Scabies prompted the Colorado Agricultural Commission to conduct a series of hearings, as prescribed by Statute, to

*Dr. Tobin previously was Colorado State Veterinarian from 1958 to 1978.
adopt rules and regulations pertaining to the control and/or eradication of Cattle Scabies. Hearings were conducted in February, 1978, at which time temporary emergency regulations were passed, becoming effective March 1, 1978.

Final hearings were conducted in May and June 1978 and permanent regulations were adopted for a period to May 1, 1979. At this date, further hearings are scheduled to determine whether the program will be continued.

Basic Scabies Regulations Adopted by the Colorado Agricultural Commission are as follows:

1. All cattle leaving public livestock markets, or purchased, sold or handled by any livestock dealer or any cattle sold or traded in private transactions will be officially treated with an approved scabicide.

2. All cattle moving from Colorado Counties east of the Continental Divide to Counties West of the Divide, and from Counties West of the Continental Divide to Counties East of the divide shall have been officially treated within ten days prior to such movement.

Exceptions:

a. Cattle—positively identified—which have been officially treated in Colorado within the previous ten days.

b. Cattle—positively identified—which are being moved directly to a premises which has an officially approved treatment facility—to be treated upon arrival (within 24 hours) and before being placed with or adjacent to any other cattle.

c. Cattle positively identified and consigned directly to federally inspected slaughter establishment for immediate slaughter, SHALL require only a movement permit.

d. Lactating dairy cows and dairy calves (under two weeks) originating from dairy farms may be sold without being treated for scabies.

e. Breeding cattle and their progeny may be sold or traded in county transactions without treatment for scabies in counties which have not had cattle scabies diagnosed since July 1, 1977, provided they do not cross county lines and it is agreeable with both buyer and seller.

EXECUTIVE ORDER

In addition to the Basic Scabies Regulations, the following Proclamation by the Governor of Colorado controls the importation of cattle to Colorado as follows:

All cattle consigned to Colorado from any point outside the State of Colorado, be accompanied by an entry permit issued by the Colorado Department of Agriculture. The permit must accompany the shipment in addition to an official Health Certificate from the state of origin of the shipment, certifying that the cattle have been officially treated with an
approved scabicide within ten days of shipment; or the cattle may be moved under permit to a certified treatment facility within Colorado for official treatment.

SUMMARY

1. Colorado Revised Statutes provide that cattle scabies be treated expeditiously and within specific guidelines.

2. Colorado's Cattle Industry has been kept informed by the State Veterinarian's Office through the various media, informational meetings, public hearings and the extension service.

3. The Colorado Agricultural Commission has, as prescribed by Statute and following public hearings, established specific regulations pertaining to Cattle Scabies management within the State.

4. All segments of the Cattle Industry within the State, Producers, Feeders, Livestock Markets and Dealers, apparently have been convinced of the seriousness of the Cattle Scabies situation nationwide and particularly in Colorado. Therefore, the Colorado Scabies Program has been extremely well supported with a minimum of complaints.

5. Adequate funding—both State and Federal has, to date, been made available to provide manpower and equipment with which to carry on this rather ambitious undertaking.

6. All full-time field employees sixteen (16) plus seven (7) supervisory employees both State and Federal have completed the "Scabies Identification and Eradication Training Course."

7. Six area meetings were conducted at various locations throughout the State for the purpose of orientating State Brand Inspection personnel and local practicing Veterinarians in the Colorado Scabies Program, and to solicit their assistance in locating Cattle Scabies infestations.

8. As of October 20, 1978, there have been 232 official dipping facilities certified by the State of Colorado.

COLORADO CERTIFIED DIP FACILITIES

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swim.</td>
<td>134</td>
</tr>
<tr>
<td>Toxaphene</td>
<td>136</td>
</tr>
<tr>
<td>Custom</td>
<td>148</td>
</tr>
<tr>
<td>Cage</td>
<td>47</td>
</tr>
<tr>
<td>CoRal.</td>
<td>88</td>
</tr>
<tr>
<td>Private</td>
<td>84</td>
</tr>
<tr>
<td>Box</td>
<td>51</td>
</tr>
<tr>
<td>Prolate</td>
<td>23</td>
</tr>
<tr>
<td>232</td>
<td></td>
</tr>
</tbody>
</table>

Location of the Certified Facilities indicated on accompanying map.

The numbers of cattle officially treated are as follows: (March 1 thru Sept 1, 1978)

Infected . . 67,008
Exposed . . 2,342

69,350 TOTAL
Numbers of cattle treated at Certified Facilities to comply with intra and interstate movement regulations (March 1 thru Sept 30, 1978).

Certified Vats within Colorado . . . . . . . . . . . . 1,451,331
Treated at origin of shipments to comply with Colorado Import Regulations . . 411,420
\[1,862,751\]

9. We are optimistic that the Colorado Scabies Program will prove to be effective thereby indicating a workable method by which cattle scabies can ultimately be eradicated from the entire United States.

KEYS TO SUCCESS

1. Acceptance of the program and cooperation by the livestock industry.
2. Surveillance and control of cattle movements—both interstate and intrastate.
3. Vat management to assure the quality of dipping.
4. Proper management of outbreaks to prevent spread and/or re-breaks.
5. Adequate Epidemiological Investigations to locate sources of scabies and to notify other interested parties of possible spread from outbreaks.
REPORT OF COMMITTEE ON ANIMAL WELFARE

Chairman: John C. MacFarlane, Pembroke, Mass.
Co-Chairman: E. Mickey Stewart

There were 25 people in attendance. The committee members present were: Charles Jungmichel, E. Mickey Stewart, Christine Stevens, John A. Smiley, Robert Temple, Paul Zillman, Dale Schwindaman, J. C. MacFarlane.

The Animal Welfare Committee respectively submits the following recommendations.

We encourage the research and criteria reassessments regarding crate design, for transportation of animals, to be expedited.

We recommend that this committee go on record supporting the present livestock transportation research, as it relates to diesel fumes; temperatures and air movement; as these factors may relate to the shipping fever complex.

We commend Congress and President Carter for passing the appropriation for an increase for the Animal Welfare Act.

We request the President and Secretary Bergland to make these funds available to the enforcement agencies promptly. We further request that next year's appropriation include a fifty percent increase in order to properly fund the Act.

This committee recommends that the proposed standards and regulations for the humane handling, care, treatment and transportation of marine mammals, (Federal Register, Sept. 19, 1978) (APHIS) be modified before final promulgation in the following ways:

1. Double the size of pool area available to cetaceans
2. Require a study to determine whether salinization is necessary for the comfort and well being of sea lions
3. Require compliance with minimum standards within a period of three years
4. Require three (3) tests weekly for water quality, to ensure adequate sanitation at all times

We urge the USDA to expedite promulgation of standards for exercise for laboratory dogs.

The Animal Welfare Committee recommends that the regulations proposed by the Animal and Plant Health Inspection Service, (Federal Register, October 17, 1978) be adopted with respect to the reduction in upper temperatures, (95°F. to 85°F. permitted for dogs, cats, rabbits, hamsters, primates and guinea pigs in transit). However, the committee recommends that the present minimum temperature of 45°F. be retained for all species regulated, and not lowered to 35°F.
The Animal Welfare Committee wishes to express deep appreciation to Senator John Melcher for his leadership in obtaining appropriations for veterinary research, including animal birth control research, and to Secretary Bergland for his statesmanship in making this important work possible.

Respectfully submitted,

John C. MacFarlane
The swine brucellosis regulations became effective May 22, 1978, following a 60 day delay to permit market operators and others who deal in the interstate movement of sows and boars additional time to gear up to meet the identification requirements required for this class of swine moving interstate for slaughter. Since the accelerated effort has only been underway for approximately 4 months, solid information on the current status of the program is difficult to obtain because of the rapid changes that are occurring. Preliminary data indicate that we should shortly be collecting blood samples from approximately 50 percent of the test eligible swine slaughtered or at a rate of 2.4 million annually.

I would anticipate that the percentage of test eligible animals sampled at slaughter can be increased to 80-90 percent by the close of FY 1979, or at the rate of approximately 4 million animals sampled annually. Approximately 1.4 million sows and boars will be sampled at slaughter in FY 1978.

It has been difficult due to the wide ranging movement of this class of swine to slaughter, to tailor the identification techniques employed to fit the particular slaughtering procedure (i.e., skinning versus scalding). Much of our work has been directed to evaluating and adapting identification techniques and devices currently available for adaptation to swine. Work is also continuing on the development of the plastic “ETSA” tag (External Tag subcutaneously attached). Dr. Donald Bridgewater, Regional Epidemiologist and Animal Identification Coordinator, has been spearheading this project.
The New Prototype
External Tag Subcutaneously Attached
(ETSA)

Figure 1

Figure 2

(NOTE: Not Drawn to Scale)
The concept of the “ETSA” tag (External Tag Subcutaneously Attached) remains the same. A new prototype, however, has now been designed that penetrates the skin. This eliminates the need for a needle applicator to insert the original prototype tag. The tag remains cuff link-shaped. Figure 1.

A prototype non-automatic applicator has been designed and built to attach the ETSA tag. It inserts the tag through the skin, behind the ear where subcutaneous injections are given, on contact. Figure 2. Plans are to eventually develop an automatic applicator.

Currently, only a few prototype tags have been hand crafted. Studies are now being carried out to design a point on hand crafted tags to provide the best penetration.

Several 200-pound pigs were used for this study. When the desired tag is obtained, studies will be conducted to determine the necessary design required to provide the best retention. Retention studies will then be conducted.
## COMPARISON OF ON-THE-FARM TESTS AND MCI TESTS
### 1963-1978

<table>
<thead>
<tr>
<th>Year</th>
<th>Tests on Farm</th>
<th>MCI Tests</th>
<th>No. Backtagged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1963</td>
<td>8,800,000</td>
<td>2,493,750</td>
<td>1,368,797</td>
</tr>
<tr>
<td>1966</td>
<td>6,600,000</td>
<td>4,927,385</td>
<td>5,795,902</td>
</tr>
<tr>
<td>1968</td>
<td>7,233,342</td>
<td>4,686,579</td>
<td>9,139,686</td>
</tr>
<tr>
<td>1971</td>
<td>5,100,000</td>
<td>5,400,968 (3,152,668)</td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>4,500,000</td>
<td>7,266,150 (4,520,000)</td>
<td></td>
</tr>
<tr>
<td>1973</td>
<td>5,149,562</td>
<td>8,460,000 (5,426,472)</td>
<td>21,614,420</td>
</tr>
<tr>
<td>1974</td>
<td>5,566,585</td>
<td>8,989,563 (5,421,008)</td>
<td>20,368,057</td>
</tr>
<tr>
<td>1975</td>
<td>6,490,467</td>
<td>11,242,871 (7,712,128)</td>
<td>22,537,427</td>
</tr>
<tr>
<td>1976</td>
<td>7,350,397</td>
<td>14,628,284 (10,030,612)</td>
<td>29,862,423</td>
</tr>
<tr>
<td>1977</td>
<td>7,492,990</td>
<td>13,481,275 (9,019,247)</td>
<td>27,754,966</td>
</tr>
<tr>
<td>*1978</td>
<td>6,992,206</td>
<td>13,778,094 (8,511,229)</td>
<td>26,451,119</td>
</tr>
</tbody>
</table>

( ) SAMPLES COLLECTED AT SLAUGHTERING ESTABLISHMENTS

1973 - SLAUGHTER SAMPLES FROM CATTLE ID’D W/BACKTAG 4,000,000
1974 - SLAUGHTER SAMPLES FROM CATTLE ID’D W/BACKTAG 3,800,000
1975 - SLAUGHTER SAMPLES FROM CATTLE ID’D W/BACKTAG 5,850,000
1976 - SLAUGHTER SAMPLES FROM CATTLE ID’D W/BACKTAG 7,835,000
1977 - SLAUGHTER SAMPLES FROM CATTLE ID’D W/BACKTAG 7,083,000
1978 - SLAUGHTER SAMPLES FROM CATTLE ID’D W/BACKTAG 6,554,000

*1978 - DATA SUBJECT TO SLIGHT REVISION
Chairman: J. Ralph Bishop, Chairman


Dr. G. R. Snyder described briefly the new organization of Food Safety and Quality Service which in effect is a separation of the Meat and Poultry Inspection Program from the Animal and Plant Health Inspection Service. He emphasized the effort to strengthen the service and described the educational success with large producers on residue problems and a program that would be aimed at small producers.

Pertinent to the identification committee was his announcement of the development of a legislative package which, if passed, would lead to mandatory identification of all animals arriving at a slaughtering plant in order that any animal could be traced to at least the last owner. This legislative package will not be developed before next summer, he added. He also pointed out the plan for a more flexible post mortem procedure that will more nearly fit area needs.

Dr. E. C. Roukema reported first on the progress in identifying Sows and boars under the new brucellosis Regulations that become effective May 22, 1978. He estimated that by the close of FY 1979 nearly 80 to 90 per cent of the test eligible animals will be sampled, totaling about 4 million annually.

He pointed out that it has been difficult to tailor the identification techniques employed to fit the slaughtering procedure. Much of the work has been directed to evaluating and adopting identification techniques and devices currently available for adoption to Swine.

Dr. Donald Bridgewater then gave a progress report describing the prototype of the "External tag Subcutaneously attached." This cuff link type tag is attached behind the ear with a mechanical spring loaded applicator.

Mr. Mike Nolan of the American Horse Council enumerated various identifying methods used in the horse industry with these being quite variable. He indicated that more satisfactory systems were needed after alluding to several problems of fraud and theft.

After, Dr. Roukema further commented on cattle identification, noting particularly the progress in the use of back type. He pointed out that while MC1 testing reached unprecedented levels in 1976 & 77 because of the large number of cattle available for testing, the cattle cycle was now reversing and the number would drop dramatically. This will reduce the effectiveness of this surveillance program, increasing the need for more
He noted several of the findings and recommendations of the National Brucellosis Task Force with special emphasis on;

"Finding: of all the alternatives which the commission has examined to accommodate the expressed desires of the Livestock Industry for increased flexibility of programs, and which do not compromise principles of sound disease control, require the development and implementation of a non-duplicative individual animal identification system."

The Committee acted formally on motions duly made and seconded to recognize this finding as a challenge to be faced by the Identification Committee, inasmuch as the implication was industry-wide applying to all species, diseases and residues. The Committee then acted to meet in a working session with the date tentatively set for May 10, 1979.

The Committee gave substantial attention to potential strengthening and improving identification systems and procedures presently in use but lacked preparation for specific recommendations.

Dr. Gary Seawright of the Los Domos Scientific Laboratory in New Mexico updated the committee on the progress of Electronic Identification showing the minimum standards established by the National Electronic Livestock Identifications Board, pointed out that bids for field test units were in final stages of evaluation, and he identified the possible field test sites that were visited and evaluated with the ranking assigned each site.

The Committee unanimously endorsed a resolution recognizing the progress of the development of Electronic Identification under the direction of the National Livestock Electronic Identification Board. The committee urges all livestock groups, organizations and regulatory agencies to permit the orderly uninterrupted development of the Electronic Identification concept on the schedule now established. Field trial results could then be evaluated and implementation started on a voluntary basis before it is publicly discussed or publicly proclaimed as a system that will, or may be required in fulfilling any mandatory identification requirements. We endorse acknowledgment that those electronic ID Systems in use meeting the standards of the National System, will fit the prescribed requirement for permanent nonduplicational identification that can be recorded and traced by computer.

It is further urged that all markets and state and federal regulatory agencies prepare to recognize electronic ID, that meets the standards of the national system, as an official system of livestock identification.
REPORT OF THE COMMITTEE ON WILD AND MARINE LIFE DISEASES

Chairman: F. A. Hayes, Athens, GA


In accordance with the parameters of responsibility established in 1977 for the Committee on Wild and Marine Life Diseases, seven major items were considered during the meeting of this committee on October 30, 1978. Summary statements with brief analysis of these deliberations are cited as follows:

A. Memorandum of Understanding between the Animal and Plant Health Inspection Service (APHIS) of USDA and the Fish and Wildlife Service (FWS) of USDI.

For approximately four years concerted efforts have been made toward developing a memorandum of understanding between APHIS and FWS, in which the jurisdiction of authority and responsibilities of both federal agencies are clearly defined in the event of future animal disease emergencies. Both parties involved in this memorandum have desired to keep The International Association of Fish and Wildlife Agencies (IAFWA) informed on this interdepartmental agreement with input earnestly solicited from that organization.

On September 20, 1978, this memorandum of agreement was finalized by the Administrator of APHIS and the Director of FWS. This truly is a step in the right direction, from which this nation's poultry industry and migratory waterfowl resources will inevitably benefit. Both APHIS and FWS are commended for the foresight manifested through this agreement.

B. Proposed Memorandum of Understanding between APHIS and State Fish and Wildlife Agencies.

In considering the ramifications of the memorandum (A) between two federal agencies, it should be noted that only migratory and endangered species of wildlife in the United States, or wildlife on FWS refuges, are under jurisdiction of FWS; indigenous wildlife in the United States is under state authority.

In the event of an animal disease emergency, a majority of wildlife species therefore is not covered by the memorandum of understanding between APHIS and FWS. APHIS subsequently is
encouraged to develop a similar agreement with individual state wildlife agencies, which will afford far more coverage than currently exists. The purpose of this memorandum of understanding should be to provide for cooperation as mutually agreed upon in the control, prevention, and eradication of diseases and parasites that may be spread among wild mammals and birds and domestic livestock and poultry which now exist or may become active in the State. New and unknown diseases or parasites that are discovered should be considered as coming within the provisions of this agreement provided both parties, through correspondence or other means deemed advisable, agree to cooperate in the control of the particular diseases or parasites.

C. Compensation for relocation of wildlife in the event of depopulation as an essential measure for preventing spread of a dangerous communicable disease.

Under certain circumstances where foreign animal diseases may involve significant segments of the wildlife resources of one or more states, it may be essential to depopulate high numbers of big game animals in order for control or eradication to be achieved. For example, in the event Foot-and-Mouth Disease is introduced into Alabama, it may be necessary to kill one-fourth of the estimated one-million-plus white-tailed deer in that state. This would virtually eliminate these animals from a substantial portion of the state where the disease occurs.

At present, there are no provisions in existing regulations of APHIS to cover costs for subsequent restocking programs necessary to restore wildlife populations. This is an unrealistic situation that will precipitate severe clashes of interests relating to future animal disease eradication efforts.

Conservation-oriented individuals and organizations have gained tremendous influence since 1925, when it was necessary to kill more than 22,000 deer in California in order for Foot-and-Mouth Disease to be eradicated and since liquidation of an estimated 20,000 deer in Florida during the Cattle Fever Tick Eradication Program of the late '30s and early '40s. Today, public sympathies associated with wildlife conservation often match or exceed those for agriculture. This must be taken into account by all concerned individuals and agencies before the next national emergency involving diseases transmissible between wild and domestic animals.

This subject precipitated very realistic concern by an informal Ad Hoc Work Group of Veterinary Services (APHIS, USDA) that assembled January 9, 1975, at the Emergency Programs Information Center, Hyattsville, Maryland. There it was decided that a workable formula should be devised to circumvent controversy that might allow a foreign disease to become firmly entrenched in the United States.
It should be pointed out that indemnity, as such equates to the livestock industry, is not the issue. Rather, relocation cost for breeding stock is the point in question, which should not be misleading in respect to payment for public property by one governmental agency to another. What actually is sought are prior arrangements for retribution in part to the millions of sportsmen who, through self-imposed taxes and license fees, have restored, preserved, and protected for more than five decades this nation's multi-billion dollar wildlife resources.

Until this is accomplished, domestic livestock and wildlife interests alike become increasingly vulnerable to the ravages of a multitude of foreign diseases that threaten significant aspects of this nation's economy. A simple modification in regulations is far too small an item, in comparison with benefits to be realized, for this matter to be further ignored.

It is for these reasons that USDA's legislative program for the First Session of the 96th Congress has incorporated provisions that will give the Secretary of Agriculture standby authority to borrow from the Commodity Credit Corporation to compensate State Fish and Wildlife Agencies for relocation of wildlife that may have to be depopulated in the event of an animal disease emergency. Veterinary Services of APHIS, USDA, hereby is commended for this foresight, and this Committee urges USAHA to support pending legislation through which such can be realized.

D. African Swine Fever (ASF) in the Western Hemisphere with potential involvement of wildlife of North America.

In 1971, ASF was diagnosed in Cuba. Immediate eradication measures were initiated which necessitated killing more than 400,000 head of domestic swine. The disease was eradicated after depopulating the entire swine resource of the Havana Province. Until May 30, 1978, this was the first and only time that ASF had gained entrance into the Western Hemisphere.

Because of this and ensuing events, the accompanying resolution is recommended for consideration by the Resolutions Committee of USAHA.

WHEREAS, on May 30, 1978, the presence of African Swine Fever (ASF) was confirmed in Brazil from which this disease may spread throughout South America, thus posing an ominous threat to the entire swine industry of that continent; and

WHEREAS, on July 6, 1978, ASF was confirmed in the Dominican Republic with spread of infection anticipated for a significant segment of islands in the Caribbean, thus accentuating possibilities for introduction into Central America, Mexico, the United States, and Canada; and
WHEREAS, ASF virus has capabilities for devastating the swine industry of the Western Hemisphere, thus exerting a profound impact upon the economy of many nations; and

WHEREAS, the wildlife fauna of the Western Hemisphere has not been exposed previously to ASF virus and the potentials of various wildlife species becoming victims to or serving as reservoirs for this foreign animal disease have not been defined;

THEREFORE BE IT RESOLVED, that the U.S. Animal Health Association (USAHA) go on record in expressing grave concern for introduction and spread of ASF in the Western Hemisphere; and

BE IT FURTHER RESOLVED, that USAHA not only express support of ongoing ASF research programs but also urge expansion of such investigative efforts into biologic parameters as may be necessary to identify the means and vectors by which African Swine Fever could spread in the Western Hemisphere.

E. Need for determining the status of wildlife as reservoirs of Pseudorabies in enzootic areas.

In citing from Dr. Frank J. Mulhern's excellent Questions & Answers section relating to pseudorabies featured in the September 15, 1977, issue of the JOURNAL OF THE AMERICAN VETERINARY MEDICAL ASSOCIATION, The American Meat Institute has estimated that in the absence of a control program, costs associated with this disease will increase to $183 million in 1979. In reply to questions relating to potential involvement of wildlife in the epizootiology of pseudorabies, Dr. Mulhern pointed out that wildlife may be a factor in enzootic areas and that the role of wildlife will have to be better understood before any eradication goal can be set.

As resources and funding become available, this Committee therefore recommends that APHIS pursue this line of thought and develop a program that will afford definitive information on the status of various forms of wildlife as reservoirs of pseudorabies.

F. The U.S. Animal Health Association as an Affiliate Organization of the International Association of Fish and Wildlife Agencies.

The objectives of the International Association of Fish and Wildlife Agencies (IAFWA) are to promote the rational management of fish and wildlife and to foster the conservation of all natural resources by cultivating friendly relationships and mutual understanding; to coordinate the work of public conservation agencies in North America; and to review, evaluate, and act on problems associated with the programs of conservation agencies. The Association holds meetings, publishes its proceedings, a newsletter, and reports on issues of immediate or special concern.

Through its committees, representation in Washington, and participation in study commissions, the Association brings its ex-
pertise and prestige to bear in behalf of needed advances and reforms in fish and wildlife management at both the state and national levels. Its concerns include related problems and programs in Canada and Mexico. It represents the interests of its membership in sound wildlife conservation before congressional committees and executive departments, and in judicial proceedings.

In considering the similarity in intents and purposes of USAHA and IAFWA, this Committee desires to go on record in recommending that the Executive Committee of USAHA investigate the desirability and potentialities of becoming an affiliate organization of IAFWA. In view of the fact that IAFWA is an affiliate member of USAHA, if the by-laws of the former permit, reciprocal membership would be highly desirable.

G. Need for name change to better describe the currently designated Committee on Wild and Marine Life Diseases.

In view of the fact that all fishes and mammals of the oceans are technically considered wildlife, and that plant life does not come under the jurisdiction or constitute a responsibility of this Committee, it is suggested that the name of this Committee be shortened to Committee on Wildlife Diseases.
THE DEVELOPMENT OF AN EXPERIMENTAL VACCINE AGAINST *FASCIOLA HEPATICA* IN CATTLE

Richard F. Hall, D.V.M. and Bruce Z. Lang, Ph.D.
Presented to the U.S.A.H.A., November 2, 1978
Buffalo, New York

INTRODUCTION

*Fasciola hepatica* and *Fascioloides magna* are the only 2 types of liver flukes of great concern in livestock in the continental United States. Their distribution is confined chiefly to the states bordering or near the Pacific Coast, Great Lakes, or the Gulf of Mexico. *F. hepatica* is the most common of the 2 flukes.

*Fasciola hepatica* is responsible for a great deal of loss throughout the world. *F. hepatica* and *F. magna* account for the condemnation of 1 to 1.5 million bovine livers annually in the United States. In addition to liver condemnation, limited studies have shown that production losses in cattle may amount to approximately 8% in dairy cattle and 8.28% in beef cattle depending upon the levels of infection. Unpublished data from this laboratory would indicate a decrease in production in calves of 6-18% as compared to non-infected herd mates.

It has been shown for many years that certain domestic and laboratory animals develop an immunity against *Fasciola hepatica* following exposure to the parasite. Cattle, rats, and mice exhibit the ability to produce antibodies and cellular immunity against *F. hepatica*. Unfortunately, sheep show no evidence that previous infection confers a significant resistance.

Lang discovered that young migrating flukes are responsible for the induction of immunity in mice. Twelve- to 18-day-old *F. hepatica* larvae are responsible for this phenomenon.

Mice were successfully vaccinated with both culture incubate antigens and sonicated immature worm antigens. Vaccinated mice showed a reduction of worm counts as compared to nonimmunized infected controls of 54-86% from culture incubate antigens and 82-86% from sonicated antigens. Because of the success of the vaccine in mice it was decided to test the ability of these antigens to protect cattle against *F. hepatica* when artificially exposed to metacercariae.

From the Research and Extension Center, Veterinary Research Laboratory, University of Idaho, Caldwell, ID 83605 (Hall) and the Department of Biology, Eastern Washington University, Cheney, WA 99004 (Lang).
MATERIALS AND METHODS

Culture incubate antigens and sonicated antigens were prepared using 16-day-old *F. hepatica* larvae recovered from mice as described by Lang et al.11 Trials were conducted on limited numbers of cattle during the years 1976, 1977, and 1978 using various combinations of prepared antigens each year.

1976 (Trial I)

Four 2-year-old angus cows were used in the first trial. Because of herd history and the conditions under which they were raised, all animals were free from flukes at the beginning of the trial. One cow was injected with culture incubate antigens (CI) at day 1, 24, and 42. The second cow was injected with sonicate antigens (S) plus CI at day 1, 24, and 42. The vaccines were administered intramuscularly (IM) in the neck. The 2 vaccinated animals plus 1 nonvaccinated animal were challenged with 200 metacercariae each on day 42. The remaining animal was not vaccinated or challenged and was used as a normal control for comparative blood parameters.

The 3 challenged animals were necropsied at day 124 (82 days following challenge).

Blood was drawn approximately every 10 days from each animal starting at day 1. Blood chemistry determinations and blood cell counts were made for each animal at each bleeding. Albumin and globulin levels were also determined.

1977 (Trial II)

Eight mature angus cows were used in this trial. Six cows were vaccinated with a single injection of the sonicate antigen subcutaneously in the neck at day 1. Two of the animals remained as nonimmunized controls. All 8 cows were challenged with 200 metacercariae 100 days after vaccination, and were necropsied 115 days after challenge. The livers were removed for worm counts. Fecal egg counts were done on the day of slaughter.

1978 (Trial III)

Efforts were made to assess the effect of different challenge times after vaccination. Twenty-three 3-4 month old angus steers and 1 holstein steer were used making a total of 24. Sixteen steers were vaccinated subcutaneously in the neck on day 1 with the sonicate antigen. Seven angus steers and 1 holstein steer were used as controls with no vaccination. Eight of the vaccinated steers and 4 nonvaccinated steers were challenged 38 days after vaccination. The remaining 8 vaccinated and 4 nonvaccinated steers were challenged 200 days after vaccination. All animals were weighed at 65 days after vaccination and again just before slaughter.
RESULTS

1976 (Trial I)

The 2 vaccinated animals had a 79.1% and a 73.6% worm reduction for the CI antigen and CI + S antigen, respectively, compared to that of the challenged control. Both vaccinated animals had more gross liver damage, characterized by necrosis and fibrosis of the parenchyma, than the challenged control.

Immunized animals showed an increase in gamma globulin production and a decrease in albumin/globulin (A/G) ratios of the blood after vaccination. After challenge the nonimmunized animals showed the same general A/G pattern. Serum glutamic oxaloacetic transaminase (SGOT) activities were consistently higher after challenge in the immunized animals as compared to the challenged control. Other blood parameters were within normal limits.

1977 (Trial II)

A total of 14 worms were recovered from the 6 vaccinated animals as compared to a total of 233 from the 2 nonimmunized challenged controls. This reduction of worm count was significant (P < 0.05) or a 98% reduction as compared to the challenged controls. The 14 worms recovered from the vaccinates were also significantly (P < 0.001) smaller than those of the challenged controls.

Gross pathology of the livers of the challenged controls was much more severe than the challenged vaccinates. The gross pathology of the challenged control livers consisted of hyperplasia of the bile ducts and areas of hemorrhage and fibrosis in the liver parenchyma. Little or no pathology was found in the challenged vaccinates.

Fecal egg counts of the challenged controls averaged 76 eggs per gram of feces, while fecal egg counts of the vaccinates were 0 eggs per gram of feces.

1978 (Trial III)

An error was made in vaccination and challenge in 2 of the animals in the 200 day challenge group. One was not vaccinated and 1 was challenged twice. One animal in the 38 day challenge group died from being caught in a feed bunk. With these 3 animals discounted from the trial, the results are as follows:

The group challenged 38 days after vaccination had a worm reduction of 90.6% as compared to the nonvaccinated challenged control groups (an average of 15 worms per animal as compared to 159 worms per animal). The vaccinated group also gained 17% more weight than the controls from 65 days post vaccination to slaughter.

The 6 remaining animals challenged at 200 days in the vaccinated group had a mean recovery ratio of 0.2 worms per animal while the recovery rate from the controls challenged at 200 days was 45 worms per
VACCINE AGAINST *FASCIOLA HEPATICA* IN CATTLE

animal. This is a 99.6% reduction. Finally, from 65 days post vaccination to slaughter, the vaccinated group gained 1.52 lbs/day while the controls gained 1.35 lbs/day/head.

**DISCUSSION**

In Trial I it was shown that multiple doses of CI or CI + S antigens can cause a hypersensitivity resulting in liver damage. Protection from the multiple dosages of vaccine was also not as good as a single dose of sonicate antigen.

Even though there were some problems in executing the last trial with 3 animals, results from a composite of the trials indicate that it is possible to offer some degree of protection for cattle at 38, 100, and 200 days post vaccination against *F. hepatica* in a single 200 metacercariae challenge.

Further questions must be answered about a *F. hepatica* vaccine before it will be economically feasible or practical. Some of the questions are:

1. Can the specific antigens from the fluke larvae be isolated?
2. Can a vaccine be economically produced?
3. Do simulated natural infections act the same as one dose infections?
4. Can infected animals be safely vaccinated?

**REFERENCES**


CLOSTRIDIAL HEPATITIS IN CATTLE
(BLACK DISEASE AND BACILLARY HEMOGLOBINURIA)

Bennie G. Erwin, DVM, MS
Director of Clinical Research Jensen-Salsbery Laboratories
Kansas City, Kansas 66103

SUMMARY

The similarities between two clostridial diseases caused by closely related pathogens (\textit{Cl. novyi} Types B and D) having a predilection for the liver are presented. The desirability of intrahepatic challenge to more consistently reproduce the diseases experimentally in relationship to the natural pathogeneses is discussed. The results of studies to evaluate the efficacy of vaccines containing \textit{Cl. novyi} Type B toxoid or \textit{Cl. novyi} Type D bacterin by direct challenge of cattle are presented.

The two highly fatal clostridial diseases caused by closely related organisms for which the liver is the principal site of infection are black disease and bacillary hemoglobinuria. Black disease (infectious necrotic hepatitis) is caused by \textit{Cl. novyi} Type B (\textit{Cl. oedematins}), while bacillary hemoglobinuria (redwater disease, icterohemoglobinuria) is caused by \textit{Cl. novyi} Type D (\textit{Cl. haemolyticum}).

Similarities in the bacteriological properties and pathogenic characteristics of these two pathogens make it practical to discuss black disease and bacillary hemoglobinuria as a disease complex. Similarities in \textit{Cl. novyi} infections are shown in Table 1.

Both diseases affect animals of all ages, breeds and sex, the highest incidence being in those over 4 months old. The potential for disease is always present, irrespective of geographical location or season, since the causative organisms are part of the normal microbial flora of soil and animal body, and are shed in the feces and urine of apparently healthy and clinically ill animals. It is believed, however, that these disease are more likely to occur in cattle and sheep consuming forage in poorly drained or irrigated areas, regardless of altitude, that are infested with snails, the intermediate host for liver flukes.

Pathogenesis

Spread of disease is by ingestion of spores with contaminated food and water. Spores are transported from the gastro-intestinal tract to the liver where they remain latent until conditions favorable for their vegetation occur. Both organisms have an apparent predilection for hepatic tissue and have been isolated from the livers of apparently healthy cattle and sheep. The pathogenesis of both diseases is dependent on a focus of hepatic insult within which latent spores can germinate and produce their lethal toxins. Prerequisites for development of disease are: a susceptible host, the presence of latent spores, and inflammation and/or
necrosis in the liver which results in the formation of a hypoxic milieu favorable for spore germination and growth of toxin producing vegetative cells. Some of the more common causes of hepatic insult include: 1) parasite migration, which in most cases is the common liver fluke (*Fasciola hepatica*); 2) telangectiasis (sawdust liver); 3) liver abscesses; 4) chemicals; 5) fatty changes; 6) traumatic injury; 7) plant toxins; and 8) bacterial hepatitis.

The principal exotoxins produced by strains of *Cl. novyi* Type B are the highly necrotizing and lethal alpha toxin and a beta toxin which is necrotizing and hemolytic but not usually formed in lethal amounts. *Clostridium novyi* Type D, however, produces large amounts of the highly lethal beta toxin (phospholipase C). Although the alpha toxin of *Cl. novyi* Type B occasionally causes gas gangrene, its primary pathological effect is damage to the capillary endothelium resulting in extensive infiltration of fluid into connective tissue (edema). Accumulation of gas is seldom marked unless infection is well advanced. In contrast, the lecithinolytic beta toxin of *Cl. novyi* Type D is responsible for the marked intravascular hemolysis of red blood cells. It should be noted that *Cl. novyi* Types B&D appear to possess a common somatic antigen, the beta toxin of both are serologically indistinguishable, and conjugates prepared from *Cl. novyi* Type B. antisera cross react with *Cl. novyi* Type D; however, there is no known cross-immunity between them.

**CHALLENGE PROTECTION STUDIES AGAINST CLOSTRIDIUM NOVYI TYPES B AND D IN CATTLE**

I. *Clostridium novyi* Type B

*Clostridium novyi* Type B challenge studies have been conducted in sheep using the intramuscular route for inoculating spores suspended in 2.5 to 5.001 mg CaCl₂ as the tissue debilitant (Macheak et. al., 1972 and Brown et. al., 1976)).

In our laboratory the intramuscular challenge route was used in cattle to evaluate the degree of immunity provided by the *Cl. novyi* Type B component of a multivalent clostridial bacer-in/toxoid*. In this study 26 yearling cattle (227 to 364 kg), each with a prevaccination titer of ≤ 0.1 unit/ml of antitoxin against *Cl. novyi* Type B alpha toxin, were used. Twenty were vaccinated twice, as recommended on the label, and 6 served as unvaccinated controls. All cattle were challenged 33 days following the second vaccination. Material for challenge was prepared, immediately prior to challenge, by suspending *Cl. novyi* Type B spores (IRP

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*Electroid-7, Clostridium chauvoei - septicum - novyi - sordellii - Perfringes Types C and D Bacterin-Toxoid. Jensen-Salsbery Laboratories, Kansas City, Missouri.*
79** in sufficient sterile 5.0% CaCl₂ to provide dilutions of 1:50 and 1:100. The vaccinates, which were challenged first, and 3 of the controls were challenged intramuscularly (deep gluteals) with 10.0 ml of the 1:50 dilution. The other 3 controls were challenged with 10.0 ml of the 1:100 dilution. All vaccinates (100%) and 33.3% of the controls survived the 1:50 spore challenge level. Two of the 3 (67%) controls challenged with the 1:100 dilution survived. These results provided evidence that vaccinated cattle had a high degree of protection against C. novyi Type B. It would be desirable, however, in vaccine challenge studies to be able to produce death in ≥ 80% of susceptible controls. It has subsequently been demonstrated that this can be achieved by intrahepatic challenge using Cl novyi Type B spores suspended in 40% CaCl₂.

II. Clostridium novyi Type D

Early attempts to induce bacillary hemoglobinuria by inoculating Cl novyi Type D spores into cattle experiencing liver fluke migrations were unsuccessful (Records and Vawter, 1945). More recently, some success in inducing bacillary hemoglobinuria in cattle, sheep and rabbits by intravenous or oral inoculation of Cl novyi Type D spores, followed by liver biopsies has been reported (Olander et. al., 1966). Attempts in our laboratory to reproduce the disease in this manner were unsuccessful.

Before Cl novyi Type D vaccine efficacy studies could be initiated, there was a need to develop a more reliable method for experimentally including bacillary hemoglobinuria in cattle with a high degree (≥ 85%) of reproducibility, and at the same time, simulating the natural conditions believed to be responsible for causing the disease. An effective and readily performed intrahepatic challenge procedure for reproducing bacillary hemoglobinuria in cattle was developed and the procedures published (Erwin, 1977). Briefly, this open-surgery technique for intrahepatic inoculation of spores, suspended in 40% CaCl₂ as the hepatic debilitant, simulates the simultaneous occurrence of hepatic necrosis and the presence of viable spores, a relationship which apparently exists in the causation of bacillary hemoglobinuria in cattle under natural conditions.

Using the open surgery technique for intrahepatic challenge, the lethal activity (LD₅₀) of a Cl novyi Type D spore preparation

**Internal Reference Preparation (IRP) 79 is prepared by The Veterinary Division, Agricultural Research Services, U.S. Department of Agriculture, National Animal Disease Center, Ames, Iowa.
(IRP 135*) was titrated in susceptible cattle. Twenty-nine cattle, all with agglutinin titers ≤1:2 to \textit{Cl. novyi} Type D were challenged with 10 different spore dilutions (range 1:10 to 1:1,000,000) prepared in sterile 40% CaCl₂. Two to 4 animals were challenged at each dilution. Each of the 29 cattle received 10.0 ml of suspended spores intrahepatically. Three additional animals (calcium chloride controls) were inoculated intrahepatically with 10.0 ml of 40% CaCl₂ without spores.

There were no deaths in the calves inoculated with only calcium chloride or in those at spore dilutions ≥1:25,000. Of 23 animals challenged with dilutions < 1:25,000, 21 died. The LD₅₀ was established for use in subsequent vaccine evaluation studies.

Using the selected spore dilution, the efficacy of \textit{Cl. novyi} Type D bacterin was tested in 50 vaccinated cattle and 12 unvaccinated controls. All cattle were challenged intrahepatically with 10.0 ml of the dilution of IRP 135 containing 10 LD₅₀'s. All (100%) vaccinates were protected against virulent challenge, while 11 of the 12 (92%) controls died. The sole surviving control developed severe clinical signs following challenge. The results of 4 studies are summarized in Table 2.

After each group of cattle was inoculated, the challenge material was titrated in guinea pigs to establish a correlation between the LD₅₀ of the challenge material for cattle and the LD₅₀ for guinea pigs.

Serum agglutination titers against \textit{Cl. novyi} Type D were determined on all test animals on the day of initial vaccination, 2 weeks following the second vaccination and on the day of challenge. Agglutinin titers at the time of initial vaccination were ≤1:4. Titers of the vaccinates 2 weeks following the second vaccination ranged from 1:128 to 1:2048. At the time of challenge titers ranged from 1:32 to 1:1024, while titers in the controls remained ≤1:4.

**CLINICAL AND PATHOLOGICAL FINDINGS FOLLOWING CHALLENGE WITH \textit{CL. NOVYI} TYPES B & D**

The average post-challenge death interval for the \textit{Cl. novyi} Type B controls was 82 hours (range 60 to 120 hours) as opposed to 36 hours (range 18-76 hours) for the \textit{Cl. novyi} Type D controls. All cattle that died

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*Internal Reference Preparation (IRP) 135 is prepared by the Veterinary Division, Agricultural Research Service, U.S. Department of Agriculture, National Animal Disease Center, Ames, Iowa.*
in the titration studies and the vaccination/challenge studies were necropsied shortly after death. Thirty percent of the cattle that died ≤ 24 hours following challenge with *Clostridium novyi* Type D had no hemoglobin in the urine. The necropsy lesions in these cattle, which were primarily those indicative of an acute toxemia, were similar to those that died of *Clostridium novyi* Type B. In those challenged intrahepatically, the challenge site was pale and conical in shape, closely resembling the ischemic hepatic infarct that occurs in natural cases of bacillary hemoglobinuria. Hepatic necrosis caused by *Clostridium novyi* Type D was readily visible; however, the liver had to be examined carefully to locate the smaller areas of focal necrosis caused by *Clostridium novyi* Type B. Gram stains of impression smears taken from areas of liver necrosis contained numerous gram-positive organisms that were morphologically characteristic of *Clostridium novyi* Type B or D. Slides stained with FA conjugate gave characteristic positive fluorescence.

REFERENCES


## Table I

**Similarities in Clostridium novyi Infections**

<table>
<thead>
<tr>
<th>Bacterial Species</th>
<th>Cl. novyi Type B</th>
<th>Cl. novyi Type D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synonyms</td>
<td>Cl. oedematiums</td>
<td>Cl. haemolyticum</td>
</tr>
<tr>
<td>Disease</td>
<td>Black Disease</td>
<td>Bacillary Hemoglobinuria</td>
</tr>
<tr>
<td></td>
<td>(Infectious Necrotic Hepatitis)</td>
<td>(Ictero-hemoglobinuria)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Redwater Disease)</td>
</tr>
<tr>
<td>Principal Species Affected</td>
<td>Cattle and Sheep (all ages)</td>
<td>Cattle and Sheep (usually adults)</td>
</tr>
<tr>
<td>Geographical Occurrence</td>
<td>Wide spread</td>
<td>Wide spread (endemic areas)</td>
</tr>
<tr>
<td>Seasonal Incidence</td>
<td>All seasons</td>
<td>All seasons</td>
</tr>
<tr>
<td></td>
<td>In fluke infested areas, incidence may be higher during summer and fall.</td>
<td></td>
</tr>
<tr>
<td>Pathogenicity</td>
<td>Both are dependent on hepatic insult for development of disease.</td>
<td></td>
</tr>
<tr>
<td>Principal Exotoxins</td>
<td>Alpha +++ and Beta +</td>
<td>Beta +++</td>
</tr>
<tr>
<td>Action of Toxins</td>
<td>Necrotizing and Lethal (edema)</td>
<td>Hemolyzing and Lethal (hemolysis)</td>
</tr>
<tr>
<td>Antigens</td>
<td>Both produce beta toxin and possess a common somatic antigen; however, there is no known cross immunity</td>
<td></td>
</tr>
<tr>
<td>FA Tests</td>
<td>Conjugates prepared from Cl. novyi B antisera cross react with Cl. novyi Type D.</td>
<td></td>
</tr>
</tbody>
</table>
Table 2

**Clostridium novyi** Type D Protection Studies in Cattle

<table>
<thead>
<tr>
<th>Study Number</th>
<th>No. of Vaccinates</th>
<th>No. of Controls</th>
<th>Challenge No. of Days After 2nd Vacc.</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No. of Survivors/No. Dead Vaccinates Controls</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>6</td>
<td>77</td>
<td>5/0</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>95</td>
<td>3/0</td>
</tr>
<tr>
<td>3</td>
<td>12</td>
<td>3</td>
<td>28</td>
<td>12/0</td>
</tr>
<tr>
<td>4</td>
<td>30</td>
<td>0*</td>
<td>27 to 29</td>
<td>30/0</td>
</tr>
</tbody>
</table>

All cattle were vaccinated twice 28 to 30 days apart.

All cattle were challenged with 10.0 ml of IRP-135 suspended in 40% CaCl<sub>2</sub> containing 10 cattle LD<sub>50</sub>s.

*The spore challenge material was titrated in guinea pigs immediately after each group of cattle were challenged to determine the guinea pig LD<sub>50</sub> for the purpose of confirming spore viability.*
REPORT OF THE COMMITTEE ON BIOLOGICS

Fourteen members of the U.S. Animal Health Association Biologics Committee and 28 others were present at the committee meeting at 1:30 p.m., November 1, 1978.

Chairman: Richard F. Hall, Caldwell, Idaho
Co-Chairman: James W. Glosser, Helena, Mont.


On October 12, 1978 Senator William C. Wampler of Virginia introduced with Congressmen Grassley and Leach of Iowa a bill known as the Animal Biological Products Act of 1978 which would repeal the Virus-Serum-Toxin Act of March 4, 1913 and extend the provisions of this present act. Senator Wampler stated that he, Congressman Grassley and Congressman Leach welcome correspondence and comments from interested parties regarding this legislative measure with respect to ways it may be improved upon before its reintroduction in the 96th Congress.

Almost the entire session of the 96th congress will occur prior to the Eighty Third Meeting of the USAHA. Therefore the Biologics Committee proposes to obtain copies of this bill and review it at an early date. At that time the Committee will determine the need for a special meeting. In any event the Committee will develop a statement relative to the bill which upon endorsement by the Executive Committee will be transmitted to the sponsors of the bill, to national livestock organizations and such others to be determined appropriate at that time.

Dr. Robert Bushnell (University of California, Davis) reported on the need for improvement in existing bluetongue vaccine for sheep to include antigens for serotypes BT 11 and BT 17 which are associated with most California bluetongue outbreaks.

Dr. Lynn Barber (USDA Laboratory for Arthropod-Borne Diseases of Animals, Denver, Colorado) reported on work cooperatively underway with the University of California; Davis on inactivated monovalent chicken embryo origin bluetone vaccines for serotypes RT 17 and BT 11 which hopefully would eventually be useful for all ruminants.

Dr. Jeff Stott, University of California, Davis, reported that blue tongue isolates from non-clinical bovine infections (and occasional clinical cases) are generally the same serotypes prevalent among sheep in the same area.
Dr. Paul Nicholetti presented a report on “The Effects of Adult Cattle Vaccination with Strain 19 and the Incidence of Brucellosis in Dairy Herds in Florida and Puerto Rico.” The results of the study indicate that there was a reduction greater than 85% in infected cattle removed from the herds by the third postvaccinal test. A more detailed report will appear in the proceedings and is a part of this report.

The Committee recognizes the need for an adjusted standardized dose of Brucella abortus Strain 19 vaccine (in volume and number of viable cells/milliliter for use in the vaccination of adult cows in problem herds. The Committee is concerned that the dose presently used (approximately $3 \times 10^8$ cells in 0.2 ml quantity) constitutes a serious risk of increased error in administering this small quantity. Therefore, the Biologus Committee requests that the USAHA Brucellosis Committee consider a standardized dose that would consist of a 2 milliliter volume containing a maximum of $5 \times 10^8$ and a minimum of $1 \times 10^8$ viable cells of the reconstituted product at its next meeting.

Dr. Ben Erwin gave a summary of his paper, entitled “Bovine Necrotic Hepatitis and Bacillary Hemaglobinuria” to be presented to the general session.

Dr. Richard F. Hall also gave a summary of his paper entitled “The development of an Experimental vaccine against Fasciola Hepatica in Cattle,” to be presented at the general session.
EFFECT OF CHANGES IN MANAGEMENT PRACTICE AT CALVING ON PACE OF ERADICATING BRUCELLOSIS IN CHRONICALLY INFECTED DAIRY HERDS

L. C. Vanderwagen, D.V.M., M.P.V.M., California Department of Food and Agriculture, Sacramento, California
Margaret E. Meyer, Ph.D., University of California, School of Veterinary Medicine, Davis, California
John Sharp, M.S., D.V.M., Veterinary Services, United States Department of Agriculture, San Bernardino, California
E. T. Tamm, V.M.D., California Department of Food and Agriculture, Palo Cedro, California

The milk shed of Southern California geographically consists of the four counties of Los Angeles, Riverside, San Bernardino, and San Diego. Within this area there are 525 dairy herds with a total population of approximately 250,000 adult cows. Within this milk shed there is a six mile by eleven mile strip of land on the border joining Riverside and San Bernardino counties where the majority of the animals are concentrated. This 66 square mile area contains 405 herds with a population of 200,000 adult cows. Between 25,000 and 50,000 dairy replacement animals are annually imported into these herds from out of state. California mandates that imported cows show evidence of having been vaccinated in calfhood.

Brucellosis was eradicated from the dairy herds in Southern California in the mid 1960's and the area remained free of brucellosis for several years. However, the disease reappeared in several herds in the latter part of 1972, and from then until January 1, 1978, it had been detected in 87 herds. The majority of these infected herds were restored to brucellosis free status by the routine test and slaughter procedures. Herds that could not be restored to brucellosis free status were designated as high risk herds. A previous study revealed that these herds shared several characteristics. (1) They usually, but not always, have a population of 500 or more animals. (2) Calving routinely occurs in the dry pen which often contains several hundred animals (as compared to "close up" or maternity pen calving with only a few animals.). (3) They contain at least one and usually several non-vaccinated reactor animals.

This present paper reports on a study to determine if a change in management practices at calving affected the level of infection in these high risk herds.

MATERIALS AND METHODS

A total of 12 high risk herds are included in this study. They ranged in size from a population of 220 to 1,500 adult animals and averaged 785 animals. Brucellosis was detected in these herds between October 1972 and February 1975. Management practices within each herd were inconsistent. Two of the owners haphazardly used "close-up" pens and all
12 owners allowed parturition to occur spontaneously in dry pens that contained up to several hundred animals. Each of the herds had one or more non-vaccinated reactor animals.

When the herds could not be restored to a brucellosis free status by routine test and slaughter procedures, each of the owners was advised (urged) to (1) revise their management practices at calving and exclusively use individual calving units, or maternity stalls which could hold only 4 cows, or use close up pens with a limited number of animals. (2) Also, discontinue adding any additional animals to the existing dry pen and provide a new dry pen in which to put replacement animals and animals from the lactating herd at the completion of their lactation period.

Among the 12 herd owners, 4 altered their management practices by providing maternity stalls, and 8 by providing an alternate dry pen. An additional 4 herds in which no changes in management were made are included as controls.

Quarterly reactor rates in terms of calendar year quarter, i.e., January-March, April-June, July-September, October-December, were determined from each of the 12 herds. Changes in management of the herds were also noted by the calendar year quarter in which changes were made.

Table 1 shows the number of reactor animals and the number of quarters the herds were known to be infected before management changes at calving were made. These four owners changed from dry pen to maternity stall. The drop in number of reactors after the change in management is also shown in Table 1. In each herd the number of reactors was reduced in the first quarter after change in calving practice. By the end of the first year post change, three of the herds were negative and released from hold order. The fourth herd was negative after 18 months and also was released from hold order.

Table 2 presents the data on the 8 owners who provided alternate dry pens. Among these 8 owners, 4 of them (owners of herds C, E, F, G) also limited routine calving to close up pens containing a limited number of animals. Within one year following the changes, two herds (A and G) were released from quarantine. Two additional herds (B and E) were released in 18 months.

The four remaining herds which were still quarantined 18 months post calving management change, had a markedly reduced level of infection.

Among these 8 herds the total number of reactors found during the year preceding the management change (calendar quarters 4,3,2,1) was 601. During the year following the change (calendar quarters 1,2,3,4) this had dropped to 154. During the following 2 quarters (numbers 6 and 7) this dropped to 33 reactors.
The quarterly reactor rate for these 8 herds is shown in Figure 1.

Table 3 shows the number of reactors that occurred in 4 high risk herds in which no changes were made in management at calving.

During a time period of testing that was comparable to the testing period of the 8 herds that made management changes, there was no decline in the level of infection. The quarterly reactor rate for these herds is also in Figure 1.

Table 4 summarizes the effect that changes in management at calving had on number of reactors found in 12 herds compared to the control herds wherein no changes were made.

DISCUSSION

The results of this study show conclusively that high risk dairy herds, which could not be restored to a brucellosis free status by routine test and slaughter methods, could be “cleaned up” or have a marked reduction in their level of infection within a year to 18 months following a change in management practice at calving time.

The herds restored to a brucellosis free status most rapidly were those that went from dry pen calving to calving in maternity stalls. In three of four herds that made the change, no reactors were found 9 months after this type of change was made. In the fourth herd there was a marked reduction in the number of reactors in the first quarter following the change, and the herd was released from quarantine in 21 months.

Even though going to alternate dry pen calving does not cause reduction in the number of reactors as rapidly as does changing to maternity stalls, none-the-less, it restored brucellosis free status to high risk herds when other methods had failed.

One of the 8 herds wherein this change was made was released from quarantine in 6 months. Of the remaining 7 herds, 2 were released from quarantine a year following the management change, and 2 at 18 months. Four herds still have infection, but at a greatly reduced level.

Among the four herds that have not been restored to a brucellosis free status, there is still some carelessness in handling the herds. For example, the owner of herd H did not closely supervise his employees and calves occasionally were found in the dry pen. Gates were left open and cattle from the new and old dry pen commingled on one occasion.

PROGRAM SAVINGS

Cost of eradication was considerably reduced in the four herds utilizing maternity stalls when compared to the four herds making no changes in calving management.

During the 12 months period following initiation of maternity stalls, a total of 62 reactors were removed from the four herds, three of which achieved eradication during the period. The four control herds of similar
size revealed 222 during a comparable testing period, which represented 160 reactors above those disclosed in the herds using maternity stalls.

Current Federal indemnity of $150 for commercial dairy reactors, when combined with an average of $200 from State funds provide a total of $350 indemnity for each reactor. The 160 reactors represents therefore, a savings of $56,000 in indemnity costs alone during the year subsequent to the changes in calving management.

The cost benefit providing an alternate dry pen is equally significant. The extra pen is usually available at minimal cost. The eight herds in which an alternate dry pen was initiated suffered a loss of 601 reactors during the four quarters preceeding the quarter of change, and only 154 following the change. The difference of 447 represents a savings in Federal indemnity of $67,050 at today's rates ($150 per reactor) and a savings of $89,400 in State indemnity ($200 per reactor). Total savings in indemnities would be $156,450 or an average of $19,556 per herd in the year following inception of the new dry pen.

Clearly, until such time as herd owners are convinced that calving management has a profound effect on maintenance of infection, brucellosis will be expensive to eradicate in these high risk dairy herds in Southern California.

REFERENCES

TABLE 1

NUMBER OF QUARTERS
IN WHICH BRUCELLOSIS REACTORS WERE FOUND
AND NUMBER OF REACTORS PER QUARTER
FOLLOWING INSTALLATION OF MATERNITYStalls
FOUR LARGE DAIRY HERDS

<table>
<thead>
<tr>
<th>HERD NUMBER</th>
<th>SIZE CATEGORY</th>
<th>*2</th>
<th>*1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td>500</td>
<td>62</td>
<td>12</td>
<td>23</td>
<td>11</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M2</td>
<td>500</td>
<td>22</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>M3</td>
<td>500</td>
<td>12</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M4</td>
<td>1500</td>
<td>96</td>
<td>69</td>
<td>18</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTALS</td>
<td>3000</td>
<td>62</td>
<td>108</td>
<td>126</td>
<td>39</td>
<td>12</td>
<td>9</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

*Number of quarters herd was infected prior to changing management practice at calving.
TABLE 2

NUMBER OF BRUCELLOSIS REACTORS QUARTERNLY AND ANNUALLY
PRECEEDING AND FOLLOWING PROVISION OF ALTERNATE DRY PEN
8 LARGE DAIRY HERDS

Reactors Per Quarter

<table>
<thead>
<tr>
<th>Herd</th>
<th>Size</th>
<th>Preceeding Change</th>
<th>Following Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>12 11 10 9 8 7 6 5 4 3 2 1 0</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>A</td>
<td>220</td>
<td>9 23 50 10 41 38 24 18 13 21</td>
<td>1 0 0</td>
</tr>
<tr>
<td>B</td>
<td>350</td>
<td>1 7 21 25 25</td>
<td>7 2 1 0 3 0</td>
</tr>
<tr>
<td>C</td>
<td>500</td>
<td>5 5 3 0 10</td>
<td>9 12 2 2 1 1 1</td>
</tr>
<tr>
<td>D</td>
<td>650</td>
<td>17 14 17 18 12 27 9 3 25 28 27</td>
<td>8 0 8 7 6 7</td>
</tr>
<tr>
<td>E</td>
<td>700</td>
<td>8 8 2 23 16 14</td>
<td>16 10 7 1 1 1 0</td>
</tr>
<tr>
<td>F</td>
<td>1000</td>
<td>2 9 4 0 26 17 10 8 47</td>
<td>15 6 2 3 1 2</td>
</tr>
<tr>
<td>G</td>
<td>1500</td>
<td>70 55 32 14 0 28 26 18 36 29</td>
<td>11 3 1 0</td>
</tr>
<tr>
<td>H</td>
<td>1500</td>
<td>25 16 16 26 23 26 52 29 27 23 54 35 30</td>
<td>13 8 8 15 10 1</td>
</tr>
<tr>
<td>8</td>
<td>6420</td>
<td>25 16</td>
<td>33 119 120 135 100 110 136 126 162 177 204</td>
</tr>
</tbody>
</table>

Annual Totals

| Cattle Tested (Ave.) | 2255 | 5345 | 6420 | 6325 |
| Reactors Disclosed  | 193  | 465  | 601  | 154  |
| Annual Reactor Rate | 8.56 | 8.69 | 9.36 | 2.40 |
FIGURE 1

QUARTERLY BRUCELLOSIS REACTOR RATES
PRECEEDING AND FOLLOWING ALTERNATE DRY PEN
8 LARGE DAIRY HERDS
COMPARED TO 4 CONTROL HERDS
TABLE 3

BRUCELLOSIS REACTORS PER QUARTER 
SHOWING QUARTERLY AND ANNUAL REACTOR RATES 
CONTROL HERDS - CALVING PROCEDURES UNCHANGED 
FOUR LARGE DAIRY HERDS

<table>
<thead>
<tr>
<th>HERD NUMBER</th>
<th>HERD SIZE</th>
<th>CALENDER QUARTER</th>
<th>TOTAL REACTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1    2   3    4</td>
<td>5    6    7   8</td>
</tr>
<tr>
<td>C1</td>
<td>500</td>
<td>4    16   5    16</td>
<td>8    14   14   12</td>
</tr>
<tr>
<td>C2</td>
<td>500</td>
<td>17   14   17   11</td>
<td>11   8    10   5</td>
</tr>
<tr>
<td>C3</td>
<td>500</td>
<td>6    15   5    15</td>
<td>3    8    5    4</td>
</tr>
<tr>
<td>C4</td>
<td>1500</td>
<td>25   16   16   26</td>
<td>23   26   52   29</td>
</tr>
<tr>
<td>Totals</td>
<td>3000</td>
<td>52   61   43   68</td>
<td>45   56   81   50</td>
</tr>
</tbody>
</table>

Reactor Rate: 1.7 2.0 1.4 2.3 1.5 1.9 2.7 1.7

Reactors Annually: 225 222
Reactor Rate Annually: 7.5% 7.4%
**TABLE 4**

**EFFECT OF CALVING PROCEDURE CHANGES**
**ON NUMBER AND RATE OF BRUCELLOSIS REACTORS**
**12 LARGE DAIRY HERDS VERSUS**
**4 SIMILAR HERDS MAKING NO CHANGES**

<table>
<thead>
<tr>
<th>Changes in Calving Management Procedures</th>
<th>Installed Maternity Unit</th>
<th>Alternate Dry Pen</th>
<th>Management Unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Herds</td>
<td>4</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Cattle Represented (Approx.)</td>
<td>3000</td>
<td>6420</td>
<td>3000</td>
</tr>
<tr>
<td>Number of Reactors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Preceding Change</td>
<td>NA</td>
<td>601</td>
<td>225</td>
</tr>
<tr>
<td>Year Following Change</td>
<td>62</td>
<td>154</td>
<td>222</td>
</tr>
<tr>
<td>Percent Reactors (Approx.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year Preceding Change</td>
<td>NA</td>
<td>9.36</td>
<td>7.50</td>
</tr>
<tr>
<td>Year Following Change</td>
<td>2.07</td>
<td>2.40</td>
<td>7.40</td>
</tr>
<tr>
<td>Herds Disclosing Reactors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Year Following Change</td>
<td>1/4</td>
<td>6/8</td>
<td>4/4</td>
</tr>
<tr>
<td>1-1/2 Years Following Change</td>
<td>0/4</td>
<td>4/8</td>
<td>4/4</td>
</tr>
</tbody>
</table>
BRUCELLA ANTIBODY IN MILK FOLLOWING VACCINATION OF ADULT CATTLE WITH A REDUCED DOSE OF *BRUCELLA ABORTUS* STRAIN 19

Jan D. Huber, DVM, MS, and Richard P. Crawford, DVM, MS, MPH, PhD

**SUMMARY**

Forty-eight lactating dairy cattle were inoculated subcutaneously with $3 \times 10^8$ viable *Brucella abortus* strain 19 cells. Blood and quarter-milk samples were collected on days 0, 30, 57, and 128 post-vaccination. *Brucella abortus* was not isolated from the milk samples following vaccination. The card tests using buffered brucella antigen were negative on whey from all milk samples. The whey plate test (WPT) was positive on 3 quarter samples from 2 cows at 30 days post-inoculation. Nineteen quarter samples from 7 cows had positive serial dilution brucellosis ring test (SDBRT) titers of 1:8 or 1:16 at 30 days post-vaccination. WPT results were negative at 57 and 128 days and the SDBRT titers did not exceed 1:4 and 1:2 respectively. Agglutination tests (card, tube, and rivanol) on serum samples remained positive longer than the WPT and SDBRT which indicates that milk tests would help differentiate vaccination reactions from infection.

It has been reported that 9 of 10 cattle infected with *Brucella abortus* continually or periodically shed *Brucella* in milk.¹ Milk does not normally contain a significant amount of antibody activity until after the udder becomes infected when antibodies are produced locally by the mammary gland.²³ In a study of composite milk samples made from quarter samples, Nicoletti and Murashi reported that the whey plate test (WPT) was positive on 71 (73%) of 97 milk samples that contained *Brucella*; and 89 (92%) of the 97 samples had brucellosis ring test (BRT) titers $\geq 1:8$.⁴ In a more recent report, 93 (89%) of 105 milk samples from which *Brucella* was isolated had BRT titers $\geq 1:8$.⁵ Cunningham reported that 17 of 18 composite milk samples from which *Brucella* was isolated had BRT titers greater than 1:4.⁸

Results from a study of approximately 40 cattle that had been vaccinated as calves and again as lactating adults with $60 \times 10^8$ viable *B abortus* strain 19 cells suggested that the WPT could be utilized to detect brucella infection of the udder.⁷ Nine weeks after adult vaccination, the whey tests were negative on all vaccinated cattle except for 4 cows that were excreting field strain *B abortus*.

Cunningham and O'Reilly reported on 8 lactating cows that were vaccinated subcutaneously with $60 \times 10^8$ viable strain 19 cells and from

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which quarter milk samples were collected. The BRT titers did not exceed 1:16 and receded to less than 1:2 by the 40th day post-vaccination. Suspicious BRT reactions persisted in undiluted milk from 4 cows for at least 117 days.

In selected areas of the U.S., adult cattle are currently being vaccinated with *B abortus* strain 19 with a reduced dose of approximately $3 \times 10^8$ viable organisms. Studies have not been reported on the brucella antibody titer in milk following the injection of this dose in adult cattle. A current effort is being made to develop diagnostic criteria that will help differentiate those cattle which have detectable serum antibodies resulting from vaccination from those with antibodies resulting from infection.

The objective of this experiment was to measure the quantity of brucella antibody in milk following subcutaneous inoculation of $3 \times 10^8$ viable *B abortus* strain 19 cells and to determine the temporal pattern of that antibody activity.

**MATERIALS AND METHODS**

**Experimental Animals** — Forty-eight non-calfhood vaccinated Holstein-Friesian cows, 2 through 9 years of age, were injected subcutaneously with $3 \times 10^8$ viable *B abortus* strain 19 cells. The stage of lactation at the time of vaccination varied from 2 to 280 days with the majority of the cattle (39) being no more than 60 days post-parturient. Although these cattle were part of a herd quarantined for brucellosis, repeated serologic tests (see serum tests below) over a period of 10 months prior to vaccination failed to identify any as serologic reactors.

**Vaccination Procedure** — Reconstituted *B abortus* strain 19 vaccine was diluted with a 1% peptone-saline solution so that each ml of the final bacterial suspension contained $3 \times 10^8$ viable cells. One ml of the bacterial suspension was injected subcutaneously on the left side of the neck.

**Sampling Procedures** — Milk samples from each mammary quarter were collected and cooled to 4 C. Blood samples were collected from the middle coccygeal vessels using vacuum tubes and 20 gauge needles. Milk and blood samples were collected the day of vaccination and 30, 57, and 128 days following vaccination.

**Bacteriologic Examination of Milk** — Ten to 20 ml samples of milk were centrifuged at 2,500 x g for 20 minutes. Combined samples of cream and sediment were inoculated onto the surface of a selective bacteriologic culture medium by means of a sterile cotton swab. When sufficient milk

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*aSerial No. 376, Jensen-Salsbery Laboratories, Kansas City, MO.*

*bCorvac Integrated Serum Separator Tubes (no. 82967-10), Corning Glass Works, Corning, NY.*
was not available for centrifugation, gravity cream was used as the inoculum. The culture medium was prepared using the following constituents: (1) 960 ml distilled water; (2) 43 g Bacto Brucella Agar Dehydrated; (3) 25 ml sterile bovine serum, previously heat inactivated at 56°C for 30 minutes; (4) 25,000 units bacitracin; (5) 12,500 units polymixin B sulfate, and (6) 100 mg cycloheximide. The inoculated culture plates were incubated at 37°C in 10% CO₂ and examined on the 4th and 7th days post-inoculation for *Brucella* colonies.

*Milk Tests*—Formaldehyde (40%) solution was added to that portion of each milk sample that had been reserved for antibody testing to produce an approximate final concentration of 1:2,500. The formalinized milk samples were stored at 4°C.

Whey was prepared by adding 1 drop of rennin to 4 to 5 ml of milk. Following incubation overnight at room temperature or 2 hours at 37°C the milk samples were centrifuged at 1,100 x g for 10 minutes and the cream aspirated leaving whey and the curd.

A test on whey was conducted utilizing the card test procedure. One drop (0.015 ml) of buffered brucella antigen (BBA) was mixed with 0.03 ml of whey and incubated for 4 minutes. The presence or absence of agglutination was recorded as positive or negative. The whey plate test (WPT) and serial dilution brucellosis ring test (SDBRT) were conducted according to standard USDA protocol. WPT reactions of 3 and SDBRT titers of ≥ 1:8 are interpreted as positive reactions.

*Serum Tests*—Serum was obtained from the clotted blood samples by centrifugation at 1,100 x g. A portion of the serum was tested at the State-Federal Brucellosis Laboratory by the buffered brucella antigen (card), tube agglutination (tube), and rivanol precipitation plate (rivanol) tests. The remaining serum was frozen and stored at -20°C. Serum was subsequently thawed and tested by the complement-fixation (CF) tube test procedure.

**RESULTS**

*Bacteriologic Examination of Milk*—no isolations of *Brucella abortus* were made from the milk samples collected from the 48 vaccinated cattle during the testing period.

*Milk Tests*—The results of milk tests on abnormal milk samples were excluded from this study. Milk was considered normal if it was the

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*cDifco Laboratories, Detroit, MI.*  
*dFischer Chemical Company, Houston, TX.*  
*e702 Colorado Street, Austin, TX.*  
secretion of a lactating quarter without mastitis, blood, or colostrum, and did not produce cloudy whey. The BBA tests on whey were negative.

The results of the WPT are summarized in Table 1. One hundred seventy-five quarter-milk samples were collected on the day of vaccination and all were WPT negative. Thirty days post-vaccination, 152 samples were WPT negative, 8 had a reaction of 1, 5 had a reaction of 2, and 3 samples had a reaction of 3. WPT antibody activity was not detected in either the 171 samples collected at 57 days post-vaccination or the 130 samples collected at 128 days post-vaccination.

The results of the SDBRT are summarized in Table 2. On the day of vaccination 174 quarter-milk samples were negative by the SDBRT and 1 sample had antibody activity at the 1:2 dilution. Thirty days following vaccination 101 samples were SDBRT negative, 34 had end point titers of 1:2, 14 of 1:4, 17 of 1:8, and 2 of 1:16. Fifty-seven days post-vaccination 158 samples were SDBRT negative, 11 had endpoint titers of 1:2, and 2 of 1:4. One hundred twenty-eight days after vaccination 127 samples were negative and 3 had end point titers of 1:2.

**Serum Tests** — The results of the card, tube, rivanol and CF tests are presented in Table 3. The serum tests on the 48 cows the day of vaccination were interpreted as negative. Thirty days post-vaccination the sera from 36 of the 47 cows sampled were card test positive, 21 had tube tests titers ≥ 1:100, 16 had rivanol tests titers ≥ 1:25, and 11 had CF test titers ≥ 1:40. Fifty-seven days following vaccination the sera from 12 of 47 cows were card test positive, 5 had tube test titers ≥ 1:100, 3 had rivanol test titers ≥ 1:25, and none of the 46 CF test titers exceeded 1:20. One hundred twenty-eight days post-vaccination the sera from 3 of 46 cows were card test positive, 1 had a tube test titer of 1:100, all 46 rivanol tests were negative at the 1:25 dilution, and the CF titers did not exceed 1:10.

The results of positive milk and serum tests following vaccination are compared in Table 4. Serum tests were excluded when a companion milk sample was not also examined. Thirty days post-vaccination sera from 33 of 44 cows were card test positive, 21 were tube test positive (≥ 1:100), 13 were rivanol test positive (≥ 1:25), and 9 were CF test positive (≥ 1:40). Two cows had WPT positive quarter samples (reaction of 3) and 7 had SDBRT positive quarter samples (≥ 1:8). Fifty-seven days following vaccination sera from 11 of 46 cows were card test positive, 4 were tube test positive, and 3 were rivanol test positive. None of the milk antibody tests were positive. One hundred twenty-eight days post-vaccination the serum from 1 of 39 cows was card test positive but none of the other serum or milk tests were positive.

**DISCUSSION**

Previous reports that vaccination with *Brucella abortus* strain 19 rarely produces a persistent udder infection are supported by the data
that no strain 19 isolations were made from milk samples during this study. It is possible that undetected shedding did occur in some cows for a brief period but persistent shedding of \textit{Brucella} was not detected. The reduced dose of strain 19 apparently does not pose a significant public health hazard in that it does not frequently result in a persistent strain 19 infection of the mammary gland.

The BBA test on whey was less sensitive in detecting antibodies in milk compared to the WPT and SDBRT. The use of a higher ratio of whey to antigen for increased sensitivity is indicated if further investigations of the BBA test are to be made. The acid pH of BBA and whey solution may have inhibited the activity of the antibodies that were present in milk or the concentration of antibodies in the milk following vaccination may have been too low to produce visible agglutination.

The data presented in Tables 1 and 2 suggest that the WPT is less sensitive than the SDBRT. The WPT detected antibody activity in 16 quarter-milk samples compared to 84 samples by the SDBRT. Thirty days after vaccination there were 3 WPT positive (≥3) quarter samples compared to 19 positive (≥1:8) by the SDBRT. However, differences between the 2 tests should be noted. The ratio of antibodies to antigen is different in favor of increased sensitivity of the SDBRT and the dilution at which a positive interpretation is made also differs in favor of the ring test. Like the card test reactions, the acid pH of whey may have prevented some of the antibodies present from participating in the agglutination reaction. The testing of whey might be made more comparable to the SDBRT by using the tube agglutination procedure and lower dilutions of whey.

Nicoletti and Muraschi interpreted agglutination in 0.02 ml of whey (reaction of 3) as a positive WPT and reported that a SDBRT titer ≥1:8 correlates well with udder infection with \textit{Brucella}. Table 4 demonstrates that antibody activity levels usually associated with infection persisted longer in serum than in milk. These data suggest that 60 days or more after vaccination, a WPT reaction of ≥3 and a SDBRT titer of ≥1:8 should be considered evidence of possible udder infection with \textit{B. abortus} and would provide useful information to supplement serum test results. It appears that the accuracy of identifying infected cattle following adult vaccination could be improved by utilizing the results of the milk tests.

REFERENCES


9. USDA, APHIS, VS: Supplemental Procedures for the Diagnosis of Brucellosis, Diagnostic Reagents Manual 65E.


11. USDA, APHIS, VS: Standard Agglutination Test Procedures for the Diagnosis of Brucellosis, Diagnostic Reagents Manual 65D.


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The authors thank James Coker, Joan Bonin, Pat Mims, and Modene Botter at College Station and John Williams and Richard Nabors of the State-Federal Brucellosis Laboratory at Austin for technical assistance.

Approved by USDA and by Texas Agricultural Experiment Station TA-14700.
Table 1 — Results of Whey Plate Tests on Quarter Milk Samples Collected from 48 Cows Vaccinated Subcutaneously with $3 \times 10^9$ Viable *Brucella Abortus* Strain 19 Cells.

<table>
<thead>
<tr>
<th>Days Post-Vaccination</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>175</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>175</td>
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<td>152</td>
<td>8</td>
<td>5</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>171</td>
</tr>
<tr>
<td>128</td>
<td>130</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>130</td>
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<td>628</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>644</td>
</tr>
</tbody>
</table>

*0 — no agglutination in 0.08 ml whey; 1 — agglutination in 0.08 ml whey; 2 — agglutination in 0.04 ml whey; 3 — agglutination in 0.02 ml whey; 4 — agglutination in 0.01 ml whey; 5 — agglutination in 0.005 ml whey; results from quarters with abnormal milk were excluded.
Table 2 — Results of Serial Dilution Brucellosis Ring Tests on Quarter Milk Samples from 48 Cows Vaccinated Subcutaneously with $3 \times 10^8$ Viable *Brucella Abortus* Strain 19 Cells.

<table>
<thead>
<tr>
<th>Days Post-Vaccination</th>
<th>End Point Titers*</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Neg</td>
</tr>
<tr>
<td>0</td>
<td>174</td>
</tr>
<tr>
<td>30</td>
<td>101</td>
</tr>
<tr>
<td>57</td>
<td>158</td>
</tr>
<tr>
<td>128</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td>560</td>
</tr>
</tbody>
</table>

* Results from quarters with abnormal milk were excluded.
Table 3 — Test Results on Serum Samples Collected from Cows Vaccinated Subcutaneously with $3 \times 10^8$ Viable *Brucella Abortus* Strain 19 Cells.

<table>
<thead>
<tr>
<th>Days Post-Vaccination</th>
<th>Card*</th>
<th>Tube Titers †</th>
<th>Rivanol Titers ‡</th>
<th>CF Titers§</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cows</td>
<td>N</td>
<td>P</td>
<td>25</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>48</td>
<td>48</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td>47</td>
<td>11</td>
<td>36</td>
</tr>
<tr>
<td>57</td>
<td></td>
<td>47</td>
<td>35</td>
<td>12</td>
</tr>
<tr>
<td>128</td>
<td></td>
<td>46</td>
<td>43</td>
<td>3</td>
</tr>
</tbody>
</table>

* Card (buffered brucella antigen) test recorded as negative (N) or positive (P); † Tube (tube agglutination test), ‡ Rivanol (rivanol precipitation plate test); § CF (complement-fixation test); results recorded as negative (N) or the reciprocal of the highest dilution positive
Table 4 — A Temporal Comparison of the Number of Cows with Positive Serum Tests and Positive Milk Tests Following Vaccination with $3 \times 10^9$ Viable *Brucella Abortus* Strain 19 Cells.

<table>
<thead>
<tr>
<th>Days Post-Vaccination</th>
<th>Cows with Positive Serum Tests</th>
<th>Cows with Positive Milk Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Card Pos.</td>
<td>Tube $&gt;1:100$</td>
</tr>
<tr>
<td>30</td>
<td>44</td>
<td>33</td>
</tr>
<tr>
<td>57</td>
<td>46</td>
<td>11</td>
</tr>
<tr>
<td>128</td>
<td>39</td>
<td>1</td>
</tr>
</tbody>
</table>

Serum test data excluded if milk was not sampled or was abnormal; Card — buffered brucella antigen test, pos. — positive; Tube — tube agglutination test; Riv. — rivanol precipitation plate test; CF — complement-fixation test; WPT — whey plate test; SDBRT — serial dilution brucellosis ring test.
THE EFFECTS OF *BRUCELLA ABORTUS* ON SEROLOGY, BACTERIOLOGY, AND PRODUCTION IN THREE TEXAS CATTLE HERDS

R. P. Crawford, DVM, J. D. Williams, PhD, A. B. Childers, DVM
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Two issues commonly discussed by regulatory officials, veterinarians, and livestock producers are: (1) the serologic tests used in the identification of cattle with brucellosis; and (2) the effects of *Brucella abortus* infection on production of beef and milk. Many of the questions being asked about brucellosis and the concerns expressed about the appropriateness of current eradication or control methods have a basis in these 2 issues. A study of the effects of *B. abortus* on serologic reactivity, bacteriologic isolations, the outcome of pregnancies, and production of beef or milk of culture positive reactor cows in 3 Texas herds has provided data that addresses these important concerns about brucellosis in cattle. The objectives of this study of naturally occurring bovine brucellosis in vaccinated and non-vaccinated cattle were:

1. To study the duration of serologic reactivity of culture positive reactor cows;
2. To determine the distribution of *B. abortus* is tissues of culture positive reactor cows;
3. To investigate the effects of stage of gestation, Strain 19 vaccination, and *B. abortus* biotype on the outcome of pregnancy; and
4. To estimate the effects of *B. abortus* on beef or milk production.

MATERIALS AND METHODS

*Experimental Animals*—A dairy and 2 beef herds were selected for this study. A blood sample was obtained from each animal in the herd. Brucellosis reactor cattle that were not pregnant were slaughtered approximately 3 months after the initial test. The pregnant cows and beef cows with calves were separated from the non-reactor cattle in the herd but maintained on the owner’s premise and slaughtered following the termination of the pregnancy or weaning of the calf.

From the College of Veterinary Medicine, Texas A&M University, College Station, Texas. Financial support for this study was provided by the Texas Agricultural Experiment Station (Project H-6194) and approved as publication No. 14737. Drs. Crawford, Williams, and Childers are in the Department of Veterinary Public Health and Dr. Boyd is in the Department of Large Animal Medicine and Surgery. Dr. Hidalgo is currently Director of Research, College of Veterinary Medicine, Mississippi State University, and Dr. Huber is now USDA station epidemiologist at Jacksonville, Florida. The authors thank John Williams and Richard Nabors and their staff at the State-Federal Brucellosis Laboratory in Austin, Texas for technical assistance and the Texas Animal Health Commission for providing assistance in collecting the samples in the field.

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Serology—Blood samples (10 ml) were collected from the middle coccygeal vessels in the tail. The buffered brucella antigen (card), rivanol precipitation-plate agglutination (rivanol), and the serum agglutination tube (SAT) tests were conducted at the State-Federal Brucellosis Laboratory in Austin, Texas using standard USDA procedure. Maximum serum dilutions tested by rivanol and SAT were 1:200. The complement fixation (CF) tests were performed at College Station according to the procedure described by Jones et al. The maximum serum dilution tested by CF was 1:80. Cattle were declared brucellosis reactors if: (1) the card test was positive or the SAT titer was 1:100 and (2) if the rivanol titer was 1:50 or the CF titer was 1:40 on the initial serum sample. Cattle with detectable card and SAT reactions on the initial sample that had rivanol titers < 1:50 and CF titers < 1:40 were retroactively declared brucellosis reactors if the rivanol and CF reactions were increased to ≥1:50 and ≥1:40 in subsequent samples.

Bacteriology—Milk samples were collected from the mammary gland and cooled to 4 C. Cream, and sometimes sediment, were streaked on the surface of Brucella Agar medium (Difco) supplemented with bovine serum (5%) and antibiotics (6000 units Polymyxin B sulfate, 25,000 units bacitracin, and 100 mg cycloheximide per liter). At slaughter a supracharyngeal, an internal iliac, and a supramammary lymph node were obtained for bacteriologic culture. The lymph nodes were chilled to < 4 C immediately after collection and stored at –20 C. After thawing, a 10 mm³ sample of lymph node was minced and streaked on Brucella Agar medium. Media inoculated with milk or lymph node samples were incubated at 37 C in 10% CO₂ for a minimum of 5 days. Isolates of B abortus were confined and biotyped by Veterinary Services Diagnostic Laboratories, USDA, APHIS, Ames, Iowa.

For purposes of this paper, infected cattle are cattle from which a field strain of B abortus were isolated from milk or tissues.

Vaccination—Cattle were considered to have been calfhood vaccinated with B abortus strain 19 if an official vaccination tattoo was in the right ear. The adult vaccination procedure, which consisted of subcutaneously injecting 3 x 10⁸ viable B abortus strain 19, has been described.

Production—The stage of gestation of brucellosis-reactor cows was determined by rectal palpation and supplemented with artificial insemination records when available. The pregnant cattle were maintained on the owner’s premises and the outcome of the pregnancy determined. For purposes of this paper, abortion is the premature expulsion of a non-viable fetus 30 days or more prior to expected parturition. A dead calf is the parturition of a non-viable fetus less than 30 days from the expected

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4Difco Laboratories, Detroit, Michigan.
THE EFFECTS OF **BRUCELLA ABORTUS** ON SEROLOGY

Parturition date. A weak calf is a viable fetus that had difficulty in walking or nursing or was born more than 2 weeks prior to the expected parturition date. A live calf is a viable fetus born within 2 weeks of the expected parturition date. The surviving calves in the 2 beef herds were weighed on the day they were weaned. The weaning weight was adjusted to 205 days post-parturition to allow for comparisons of weaning weights of different age calves and was calculated by the following formula:

\[
\text{weaning weight (lbs)} - \frac{\text{birth weight (lbs)}}{\text{days post-parturition when weaned}} \times 205 \text{ days} + \text{birth weight}
\]

The dairy cattle that calved and produced milk were placed in the milking herd until slaughtered. Milk weight is the weight of milk in pounds from a morning and an evening milking.

RESULTS

The results of the initial serological testing and isolation of **Brucella abortus** are presented in Table 1. The dairy herd of 822 Holstein cattle had 60 brucellosis reactors and **B. abortus** biotype 4 was subsequently isolated from 31 of these reactors. The beef herd of 219 cross-bred and registered Brahman cattle had 44 brucellosis reactors and **B. abortus** biotype 1 was isolated from 14 reactors. The beef herd of 455 registered Brahman cattle had 49 brucellosis reactors and **B. abortus** biotype 2 was isolated from 18 reactors.

Table 2 lists the results of 4 serologic tests on serums collected from vaccinated and non-vaccinated cattle at the time milk or tissue samples first yielded an isolation of **B. abortus**. Six calfhood vaccinated cattle were card test positive and also had positive titers for SAT (≥1:100), rivanol (≥1:50) and CF (≥1:40) tests. The 21 reactor cattle vaccinated with 3 x 10⁶ **B. abortus** strain 19 at the time of the initial test were card positive and 20 had positive SAT, rivanol and CF reactions at the time isolations of field strains of **B. abortus** were made. All but 1 of the 36 non-vaccinated cattle were card, SAT, and rivanol test positive. Only 17 serums from non-vaccinated cows were tested by CF and 14 had titers ≥1:40.

There was no statistically significant difference in serologic reactivity between vaccination groups at the time of **B. abortus** isolation. When the data from all 3 groups were combined, serums from 62 (98%) of 63 infected cattle were card test positive and 61 (97%) had SAT titers ≥1:100 and rivanol titers ≥1:50. Serums from 40 (91%) of 44 cattle had CF titers ≥1:40.

The median rivanol and CF titers of culture positive cows for the year following the serological identification of the reactor cattle are presented in Figure 1. The geometric median rivanol titer of the infected cattle remained >1:100 for 12 months. The geometric median for CF titer of infected cattle remained >1:40 for at least 9 months.

The distribution of isolations of **B. abortus** field strains from the lymph nodes and milk samples of culture positive cows is presented in Table 3.
From calfhood vaccinated cattle, \emph{B abortus} was isolated from 3 (50%) of 6 supramammary, 2 (40%) of 5 internal iliac, and 1 (20%) of 5 suprapharyngeal lymph nodes. Reactor cattle that were vaccinated with 3 x 10^9 \emph{B abortus} strain 19 yielded isolations from 11 (52%) of 21 supramammary, 6 (29%) of 21 internal iliac, and 5 (24%) of 21 suprapharyngeal lymph nodes. Non-vaccinated cattle had isolations from 23 (66%) of 35 supramammary, 9 (36%) of 25 internal iliac, and 10 (34%) of 29 suprapharyngeal lymph nodes. Isolations of \emph{B abortus} field strains were also made from the milk of 1 (50%) of 2 calfhood vaccinated, 12 (67%) of 18 adult vaccinated, and 10 (59%) of 17 non-vaccinated cows.

There was no statistically significant difference in the distribution of \emph{B abortus} between vaccination groups of culture positive cows. When the data from all 3 groups were combined, \emph{B abortus} field strains were isolated from 37 (60%) of 62 supramammary, 17 (33%) of 51 internal iliac, and 16 (29%) of 55 suprapharyngeal lymph nodes and from the milk of 23 (62%) of 37 cattle. Isolations of \emph{B abortus} were made from 2 to 12 months after the cattle were declared brucellosis reactors.

At the time of the initial herd test, 39 of the infected cows were pregnant. Fourteen (36%) cows aborted, 4 (10%) had dead calves, 11 (28%) had weak calves, and 10 (26%) had live calves.

The stage of gestation at the time of the initial test and the outcome of the pregnancy are presented in Table 4. Live and dead calves occurred in cows that were 1 to 8 months in gestation when declared a reactor. Ten (83%) of 12 cows that were in the first trimester of pregnancy aborted or had dead or weak calves compared to 8 (67%) of 12 cows that were in the last trimester of pregnancy and aborted or had dead or weak calves.

\emph{Brucella abortus} strain 19 vaccination and the outcome of pregnancy is presented in Table 5. Only 3 pregnant cows had been calfhood vaccinated of which 1 aborted and 1 had a weak calf. The 20 adult vaccinated cattle, which were serologic reactors on the day of vaccination, had 14 (70%) abortions 2 to 16 weeks after vaccination, or had dead or weak calves. By comparison, 13 (81%) of 16 non-vaccinated cows either aborted or had dead or weak calves.

The different \emph{B abortus} biotypes and the outcome of pregnancy is presented in Table 6. \emph{Brucella abortus} biotype 1 was isolated from 13 beef cows of which 9 (69%) aborted or had dead or weak calves. Biotype 2 was isolated from 5 pregnant cows of the other beef herd and 4 (80%) had dead or weak calves. In the dairy herd, 16 (76%) of 21 cows infected with biotype 4 aborted or had dead or weak calves.

Eighteen of the pregnant cows were beef cattle. These 18 cows had 9 live calves of which 4 were weak and 3 died before weaning. Four of the weaned calves were from single sire breeding herds and Table 7 lists the weaning weights of calves from infected dams and the weaning weights of control calves from pregnant non-reactor cows in same herd—calves adjusted for sex, sire, and season of birth. Two of the calves from infected
dams weighed more than their control. The total weaned weight of 4 calves from infected dams was 1427 lbs compared to 1525 lbs from non-reactor cows. Table 8 shows that only 4 (29%) of 14 fetuses from infected cows in single sire herds survived to weaning age compared to 12 (86%) of 14 fetuses from non-reactor control cows. A Chi Square test ($X^2 = 9.33$; $P < 0.01$) indicates a highly significant difference in the ratio of dead to live calves between infected and non-reactor control cows in the same single sire herds.

Eleven of the 21 pregnant cows in the dairy herd were placed in the milking line after calving. These 11 cows produced 1156 lbs of milk from 29 samples—39.9 lbs/sample. In Table 9, the milk production of these infected cattle is compared to non-reactor cattle that calved and began lactation the same week as the infected cows. The 11 non-reactor cows produced 1438 lbs of milk from 29 samples collected at the same time—49.6 lbs/sample. Student’s $t$ test results of 2.48 with 56 degrees of freedom suggests a highly significant ($P < 0.01$) difference between the milk production of infected and non-reactor dairy cows.

**DISCUSSION**

Isolation of *Brucella abortus* was selected as the criteria of infection because speakers at the International Symposium on Brucellosis held at Texas A&M University in 1977 agreed that the standard of reference for defining cattle with brucellosis was to culture *B. abortus*, although failure to do so is not definitive proof of lack of infection. The authors of this paper, therefore, recognize that isolation is a conservative estimate of true infection. The speakers also agreed that multiple tests increase the confidence of diagnosis, and that sequential tests over time provide better insight than single tests. The results of this study support the aforementioned statements on diagnosis of brucellosis in that *B. abortus* was isolated from 63 (41%) of 153 serologic reactors (Table 1). Also, 63 (100%) infected cattle had positive rivanol titers, and of the 42 cows that were tested by CF 2 or more times, 41 (98%) had positive CF titers at least once during the study whereas the serologic reactions of 4 different tests at the same time *B. abortus* was isolated were positive from 91 to 98% of the time.

The bacteriologic results of this study support the conclusion that the supramammary lymph node is the tissue of choice for isolation of *B. abortus* from cattle. An isolation was made from 60% of the supramammary lymph nodes cultured from infected cattle, compared with 33% of the internal iliac and 29% of the suprapharyngeal lymph nodes. Milk continues to be a good antemortem source of *B. abortus* because isolations were made from the milk of 62% of the infected cows cultured. It should be remembered, however, that *B. abortus* can, and often does, localize in other tissues, e.g., iliac and pharyngeal lymph nodes and the uterus.
The effect of strain 19 vaccination on the serologic reactions and the distribution of *B. abortus* in tissues was not statistically significant (*P* > 0.05) at the time of *B. abortus* isolation.

The most common clinical sign of brucellosis are abortions and dead or weak calves. The percentage of abortions in unvaccinated pregnant cows that acquired brucellosis naturally was reported to be 33 and 64%. The percentage of abortions in pregnant cows exposed to $8.24 \times 10^8$ *B. abortus* strain 2308 at mid-gestation was 88% with the remaining 12% having premature and weak calves. The data from the present study of unvaccinated, naturally infected Texas cattle (50% dead or aborted; 31% premature and weak; and 19% live) agree generally with previously published data with the differences apparently being related to virulence and/or dosage.

No previous serologic data were available from the beef herds; therefore it is possible that some of the 18 cattle were in their second gestation following exposure because abortions were reported in both herds in the previous 12 months. Abortions are less likely to occur during the second gestation of infected cattle; therefore the percentage of abortions observed could have been influenced by this factor. However, the 21 pregnant dairy cows were considered to be in their first gestation following infection, because 3 herd tests with removal of card test positive cows were conducted in the 9 months prior to the initial test of the present study. There was no significant difference in the ratio of dead to live calves between the beef herds and the dairy herd.

Although abortions and dead calves occurred in cows that were 1 to 8 months in gestation, 7 (58%) of the 12 cows in the first trimester of pregnancy aborted or had dead calves compared with 3 (33%) of the 12 cows in the last trimester of pregnancy which agrees with the statement that cattle might be unusually sensitive to exposure during early pregnancy. The exact time of exposure to *B. abortus* could not be determined. Since the ratio of dead to live calves between the 1st and 3rd trimester is not statistically significant, we assume that the stage of gestation of reactor cows should not be used to predict the outcome of pregnancy.

The observation that 8 (45%) of the 20 pregnant, adult vaccinated, infected cows in the present study aborted or had dead calves compared to 8 (50%) of the 16 non-vaccinated cows supports the reports that strain 19 will not alter the natural course of the disease and vaccination of serologically positive cows is of doubtful value. Only 3 of the pregnant cows were calfhood vaccinated; 1 aborted, 1 had a weak calf, and 1 had a live calf. These numbers are too small to make any conclusions about the effect of calfhood vaccination on the outcome of pregnancy.

The data in the present study (Table 6) do not suggest a difference in the virulence of the 3 biotypes of *B. abortus* in Texas cattle because 54%, 40%, and 43% of the pregnant cattle infected with biotype 1, 2, and 4
respectively aborted or had dead calves. In addition to virulence, the biotype of the agent did not influence the serologic reactivity or the distribution of *B. abortus* in the tissues.

The difference between the weaning weights of beef calves from infected cows and from non-reactor cows (Table 7) is difficult to assess. The sample size was too small to suggest statistical methodology. The most important finding is that only 29% of the fetuses from infected dams survived to weaning age compared to 86% from non-reactor dams in single sire herds. The losses due to brucellosis in beef herds appears to be associated with calf or fetus mortality and the results of the Chi Square test indicate a highly significant difference in the ratio of dead to live calves at weaning time between infected and control cows.

The majority of the milk weights in the present study of 11 infected lactating cows were obtained during the first and second months of lactation. The data in Table 9 suggest that infected cows produce a mean of 9.7 lbs (20%) less milk per day than non-reactor controls. This agrees with the statement that brucellosis may lead to a 20% reduction in milk yield. The results of Students's t test indicated that the difference in milk production between infected and control cows was highly significant.

**SUMMARY AND CONCLUSIONS**

1. Culture positive reactor cattle remained serologically positive for at least 12 months.
2. Supramammary lymph nodes and milk from both vaccinated and unvaccinated cattle most frequently yielded *B. abortus* isolations.
3. Naturally infected pregnant cows had 46% dead and 28% weak calves.
4. Adult vaccination of culture positive reactor cows did not prevent abortions or dead calves.
5. The biotype of *B. abortus* did not influence the outcome of pregnancy in naturally infected pregnant cows.
6. Calf production and milk production were reduced significantly when cows were infected with *B. abortus* field strains.

**REFERENCES**


Table 1. Isolation of *Brucella abortus* from Initial Serologic Reactors in 3 Texas Cattle Herds.

<table>
<thead>
<tr>
<th>Type</th>
<th>Cattle at Risk</th>
<th>Reactors*</th>
<th>Isolation**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>822</td>
<td>60</td>
<td>31</td>
</tr>
<tr>
<td>Beef</td>
<td>219</td>
<td>44</td>
<td>14</td>
</tr>
<tr>
<td>Beef</td>
<td>455</td>
<td>49</td>
<td>18</td>
</tr>
<tr>
<td>Total</td>
<td>1496</td>
<td>153</td>
<td>63</td>
</tr>
</tbody>
</table>

* Card test positive or serum agglutination tube test titer of 1:100 plus rivanol plate-agglutination test titer of 1:50 or complement fixation (tube) test titer of 1:40.

** *B. abortus* isolated from lymph nodes or milk.
Table 2. Serologic Results from Reactor Cows at the Time *Brucella abortus* was Isolated

<table>
<thead>
<tr>
<th>Strain 19 Vaccination</th>
<th>Cattle</th>
<th>Card Pos.</th>
<th>SAT* $\geq 1:100$</th>
<th>Rivanol* $\geq 1:50$</th>
<th>CF* $\geq 1:40$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calfhood</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Adult**</td>
<td>21</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Non-Vaccinated</td>
<td>36</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>14***</td>
</tr>
<tr>
<td>Total</td>
<td>63</td>
<td>62 (98%)</td>
<td>61 (97%)</td>
<td>61 (97%)</td>
<td>40 (91%)</td>
</tr>
</tbody>
</table>

* Card = buffered brucella antigen; SAT = serum agglutination (tube); Rivanol = rivanol precipitation-plate agglutination; CF = complement fixation (tube).

** $3 \times 10^9$ viable *B. abortus* strain 19 injected subcutaneously into brucellosis reactors.

*** Only 17 serums tested by CF test.
Table 3. Distribution of *Brucella abortus* Field Strain in Lymph Nodes and Milk From Culture Positive Cows.

<table>
<thead>
<tr>
<th>Vaccination</th>
<th>Cattle</th>
<th>Supramammary</th>
<th>Internal Iliac</th>
<th>Suprapharyngeal</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calfhood</td>
<td>6</td>
<td>3/6*</td>
<td>2/5</td>
<td>1/5</td>
<td>1/2</td>
</tr>
<tr>
<td>Adult**</td>
<td>21</td>
<td>11/21</td>
<td>6/21</td>
<td>5/21</td>
<td>12/18</td>
</tr>
<tr>
<td>Non-Vaccinated</td>
<td>36</td>
<td>23/35</td>
<td>9/25</td>
<td>10/29</td>
<td>10/17</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>63</td>
<td>37/62 (60%)</td>
<td>17/51 (33%)</td>
<td>16/55 (29%)</td>
<td>23/37 (62%)</td>
</tr>
</tbody>
</table>

* Numerator is the number of isolations of *B. abortus*; denominator is the number of samples cultured from cattle in which *Brucella abortus* was isolated from milk or tissues.

** 3 x 10^9 viable *B. abortus* strain 19 injected subcutaneously into brucellosis reactors.
Table 4. The Stage of Gestation when Declared a Reactor and the Outcome of Pregnancy in *Brucella abortus* Infected Cows.

<table>
<thead>
<tr>
<th>Month of Gestation</th>
<th>Cattle</th>
<th>Abortion</th>
<th>Dead</th>
<th>Weak</th>
<th>Live</th>
<th>Total Affected*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0/12</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td></td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1/10</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>11/15</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td></td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>8/12</td>
</tr>
</tbody>
</table>

Total (% total) 39 14 (36%) 4(10%) 11(28%) 10(26%) 29 (74%)

* Fetuses that were aborted, dead, or weak at birth; denominator is the number of pregnant cows.
Table 5. Strain 19 Vaccination and the Outcome of Pregnancy in *Brucella abortus* Infected Cows.

<table>
<thead>
<tr>
<th>Strain 19 Vaccination</th>
<th>Cattle</th>
<th>Abortions</th>
<th>Dead</th>
<th>Weak</th>
<th>Live</th>
<th>Total Affected*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calfhood</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2 (67%)</td>
</tr>
<tr>
<td>Adult**</td>
<td>20</td>
<td>8</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td>14 (70%)</td>
</tr>
<tr>
<td>Non-Vaccinated</td>
<td>16</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>13 (81%)</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14</td>
<td>4</td>
<td>11</td>
<td>10</td>
<td>29 (74%)</td>
</tr>
</tbody>
</table>

* Fetuses that were aborted, dead, or weak at birth.

** $3 \times 10^9$ viable *B. abortus* strain 19 injected subcutaneously into brucellosis reactors.
Table 6. *Brucella abortus* Biotype and the Outcome of Pregnancy in Infected Cows

<table>
<thead>
<tr>
<th>Brucella abortus Biotype</th>
<th>Cattle</th>
<th>Outcome of Pregnancy</th>
<th>Total AFFECTED*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Abortions</td>
<td>Dead</td>
<td>Weak</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>14</td>
<td>4</td>
</tr>
</tbody>
</table>

* Fetuses that were aborted, dead, or weak at birth.
Table 7. Weight of Beef Calves at 205 Days from Pregnant Cows Infected with \textit{Brucella abortus} Compared to Calves from Pregnant Non-Reactor Dams in Single Sire Herds.

<table>
<thead>
<tr>
<th>Infected Dam</th>
<th>Sex</th>
<th>Non-Reactor Dam</th>
</tr>
</thead>
<tbody>
<tr>
<td>295 lbs Fe</td>
<td></td>
<td>363 lbs</td>
</tr>
<tr>
<td>353 lbs M</td>
<td></td>
<td>328 lbs</td>
</tr>
<tr>
<td>358 lbs M</td>
<td></td>
<td>463 lbs</td>
</tr>
<tr>
<td>421 lbs M</td>
<td></td>
<td>371 lbs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Sex</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>died M</td>
<td></td>
<td>431 lbs</td>
</tr>
<tr>
<td>died Fe</td>
<td></td>
<td>died</td>
</tr>
<tr>
<td>died Fe</td>
<td></td>
<td>died</td>
</tr>
<tr>
<td>dead Fe</td>
<td></td>
<td>356 lbs</td>
</tr>
<tr>
<td>aborted Fe</td>
<td></td>
<td>292 lbs</td>
</tr>
<tr>
<td>dead Fe</td>
<td></td>
<td>301 lbs</td>
</tr>
<tr>
<td>aborted M</td>
<td></td>
<td>417 lbs</td>
</tr>
<tr>
<td>aborted M</td>
<td></td>
<td>468 lbs</td>
</tr>
<tr>
<td>aborted M</td>
<td></td>
<td>406 lbs</td>
</tr>
<tr>
<td>aborted Fe</td>
<td></td>
<td>343 lbs</td>
</tr>
</tbody>
</table>

Table 8. Status of Fetus at Weaning Time from Dams Infected with \textit{Brucella abortus} Compared to Non-Reactor Control Cows in Same Single Sire Herd.

<table>
<thead>
<tr>
<th>Brucellosis Status</th>
<th>Total</th>
<th>Dead</th>
<th>Alive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infected Dam</td>
<td>14</td>
<td>10</td>
<td>4*</td>
</tr>
<tr>
<td>Non-Reactor Dam</td>
<td>14</td>
<td>2</td>
<td>12</td>
</tr>
</tbody>
</table>

* $\chi^2 = 9.33; P < 0.01$. 
Table 9. Milk Weights from Dairy Cattle Infected with *Brucella abortus*
Compared to Non-Reactor Cows that Freshened the Same Week.

<table>
<thead>
<tr>
<th>Brucellosis Status</th>
<th>Cattle</th>
<th>Samples</th>
<th>Total Milk</th>
<th>Average/Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infected Cattle</td>
<td>11</td>
<td>29</td>
<td>1156 lbs</td>
<td>39.9 lbs*</td>
</tr>
<tr>
<td>Non-Reactor Cattle</td>
<td>11</td>
<td>29</td>
<td>1438 lbs</td>
<td>49.6 lbs</td>
</tr>
</tbody>
</table>

* Student's t test = 2.48; 56 df; P < 0.01.
Figure 1. Geometric Median of Rivanol and Complement-Fixation Titers of Reactor Cows from which Brucella abortus was isolated.

Reciprocal of Titer

Log (10) Reciprocal of Titer

R = Rivanol
CF = Complement Fixation
(n) = Number of Samples

Months After Reactor Identified

1 2 3 4 5 6 7 8 9 10 11 12

200 100 40 10

-40

-100

-200
RESULTS OF TRIAL USE OF H-38 VACCINE
FOR IMMUNIZING BEEF HEIFERS AGAINST
EXPERIMENTAL EXPOSURE TO BRUCELLA ABORTUS,
STRAIN 2308

Margaret E. Meyer, Ph.D., School of Veterinary Medicine
University of California, Davis, California
and
Robert W. Gibbons, D.V.M., M.P.V.M.
Veterinary Medical Officer, U.S. Department of Agriculture

Investigators long have worked to develop the ideal agent to immunize
cattle and other animals against brucellosis. Such an agent would be non-
viable, not induce marked or prolonged local or systemic reactions, would
prevent both infection and abortion, would require only one dose that
could be administered at virtually any age, and would not interfere with
sero-diagnostic tests.

Although H-38 vaccine was developed originally for immunizing sheep
and goats against *Brucella melitensis*, it reportedly also is an effective
agent for immunizing cattle against bovine brucellosis. Information on
whether or not it meets most of the criteria of the ideal vaccine is con-
tradictory. In fact, whether or not it is superior to *Brucella abortus*,
strain 19, is unclear. The purpose of this investigation was to assess the
effectiveness and usefulness of H-38 vaccine in a controlled trial. A
preliminary report on number of abortions, recovery of challenge
organisms from fetuses and milk, and summary of antibody titers by the
standard tube agglutination tests has already been presented. This
paper provides additional information on the results of the trial use of H-
38 vaccine for immunizing cattle against brucellosis.

MATERIALS AND METHODS

The overall plan of this trial was to purchase 77 young (ten month old)
heifers, hold them for testing and observation for two months, and when
they were a year old to vaccinate 52 of them with a dose of H-38 vaccine.
Three months later, 26 animals would receive a second dose of vaccine.
Breeding the heifers would start when they were 15 months old. All of
this was done. In contrast to the breeding program in the therapeutic
trial, artificial insemination was not used in this trial. Instead, three
young bulls with marking harnesses were used, and in four months 76 of
the 77 heifers were pregnant.

At approximately their mid-gestation periods, on February 17, 1977,
they were exposed to brucellosis by instilling 0.5 ml saline suspension of
*Brucella abortus*, strain 2308 (U.S.D.A. challenge strain), into both the
right and left conjunctival sacs.
Post challenge status of the animals was monitored by culturing vaginal swabs and by assessing serum-antibody titers by the standard, tube, rivanol, mercaptoethanol, card, and CF tests.

Fetuses and/or weak calves were cultured immediately upon abortion or calving. Milk for culture was collected from the dam within 48 hours post abortion. Animals with confirmed (bacteriologic positive) infection were sent to slaughter and no tissues were collected for culture. Animals that were negative on culture of milk, fetus or calf, and vaginal swabs were retained for reculturing of milk and vaginal swabs. If they continued to be negative, tissues for additional culturing were collected from the carcass at slaughter.

Conventional bacteriologic techniques were used throughout this trial. The media was tryptose agar and tryptose-serum agar. Milk and tissue that was negative on direct culture was inoculated into guinea pigs.

At post-vaccination, the cattle were observed for both systemic and local reactions. Rectal temperatures were taken daily for four days, and periodic measurements were taken of swellings at site of administration for the duration of the trial.

**Housing of animals:**

The cattle for the immunizing trial were housed in the isolation buildings previously described. As the animals in the therapeutic trial were moved out of the buildings, the outside pens were scraped to remove the litter and covered with slaked lime. All fences, gates, etc., were scrubbed to remove organic debris and sprayed with disinfectant. The same was done to the stanchions, mangers, inside equipment, etc.

**Distribution of animals within the isolation facility:**

Tables 4, 5, and 6 show the distribution of the animals in the isolation buildings and also the sequence in which abortions occurred within each isolation unit (T-building). The animals were moved from the breeding area and holding pens to the isolation units several weeks prior to challenge. Post challenge, all control animals remained in the original building in which they were placed until they were moved to slaughter. In contrast, when a vaccinated animal aborted, she was immediately moved to a spare isolation building (T-8). Her fetus was collected upon abortion and the contaminated area in the original pen was disinfected. When (and if) her infection status was confirmed bacteriologically, she was moved to slaughter. Once the abortion period started, there was a fairly rapid rotation of animals into T-8 and out to slaughter. Vaccinated animals with full-term calves were not moved. Moving animals that aborted was the only method available to us to reduce exposure to animals that had not aborted.

**RESULTS**

Tables 1, 2, and 3 contain the data on the age of the fetus at the time the dam was exposed to *Brucella abortus*, 2308, the age and viability status of
the fetus or calf, and the results of culture on milk, fetus, and vaginal swabs obtained at the time of abortion. Calves were determined to be non-viable if they could not get up and nurse. Using viability and non-viability as criteria to evaluate differences between the immunized and non-immunized animals, 100% of the controls were non-viable, 50% of the animals immunized with one dose of vaccine gave birth to normal animals, and 70% (16 of 23) of those immunized with two doses of vaccine gave birth to normal calves. However, the organism was recovered from material obtained at the time of calving in 7 of the 11 normal births in the 2 dose group. If the organism was not recovered from material obtained at calving, aliquots of stomach contents and milk were inoculated into guinea pigs and tissue for culture was obtained from the carcass at slaughter. Tissues were collected from six animals in the 1 dose group (nos. 113, 130, 134, 122, 166, and 167). Brucella was recovered from supramammary lymph nodes of animals no. 122 and 134. The organism was also recovered from the guinea pigs inoculated with milk from cow 134. Thus, only four animals in the 1 dose group were bacteriologically negative. In the 2 dose group, this same procedure was used and there were five animals from which no organisms were recovered from abortion material or from tissues at slaughter (nos. 169, 109, 112, 173, and 174). Cow 169 had a non-viable calf, thus, only four of the animals that had viable calves were free of infection.

Table 4, 5, and 6 show the distribution of the animals within the isolation buildings, sequence in which abortions occurred in each house, status of the fetus or calf, and the final infection status of the dams for the controls, 1 dose, and 2 dose groups.

A summary of the data on abortions, calf viability at birth, and number of infected and non-infected dams in the control and vaccinated groups of animals is given in Table 7.

Serum antibody titers by the STT from one week pre-exposure to slaughter:

A table summarizing the tube titers of all animals in this vaccine trial from one week post-vaccination to one week pre-exposure, a period of ten months, was presented in our earlier report.4 Tables 8, 9, 10, and 11 show the tube titers at one week pre-exposure, 30 days post-exposure, at abortion, and at slaughter, i.e., the tables continue from ten months post-vaccination through 16 months post-vaccination, at which time all animals had aborted or calved and the trial was completed. The sentinel animals (table 11) was a group of six animals, three from the 1 dose group and three from the 2 dose group, selected randomly just prior to exposure. They served to monitor the serologic response to the vaccine in the absence of exposure. In addition to maintaining tube titers, the sentinels were also card and rivanol positive.

Systemic and local reactions:

During the first 24 hours following vaccination with the first dose of vaccine (administered subcutaneously in the cervical region), there was a
slight temperature rise, but not really remarkable. Also, for 48 hours some of the animals were mildly depressed, but there was no serious systemic reaction. Swelling at site of administration was observable in 24 hours. These reached a size similar to or slightly smaller than that of the lesions reported in the therapeutic trial (size of baseball).

In the 26 animals that received a second dose of vaccine, the post-vaccination reaction was marked. Rectal temperatures in some of the animals rose as high as 108°F and receded over a period of three days. All of the animals were depressed for several days. The second dose of vaccine was administered on the opposite side of the first dose. Localized lesions were similar to or larger than those that occurred after the first dose. In all but three animals, the lesion persisted until slaughter.

DISCUSSION

This trial was designed to assess first hand the effectiveness of H-38 vaccine as an immunizing agent against bovine brucellosis to enable a determination of its potential value for increasing the pace of the control and eradication program under circumstances that prevail in the United States. The trial was not designed to resolve the contradicting results reported by investigators in other countries. In fact, because of differences in the challenge strain of Brucella, the results are difficult to compare. European investigators routinely use Brucella abortus 544 as the standard challenge strain. In the United States, the standard challenge strain is Brucella abortus, 2308. Due to differences in virulence between the two strains, the standard challenge dose of strain 544 is 15 million organisms while that of strain 2308 is 750,000 organisms.

Under the conditions of this trial, one dose of H-38 vaccine protected 50% of the animals against abortion but protected only 18% against infection. Two doses protected 70% of the animals against abortion and, again, only 18% of them against infection.

It certainly cannot be denied that housing the animals in groups of three caused some additional exposure during abortion. The amount of this exposure was minimized by immediate collection of fetuses, disinfecting the area, and moving the freshly aborted animal to another pen. The data on tables 5 and 6 suggest that multiple exposure did not have a pronounced affect on the outcome of the trial. Among the eight vaccinated animals that were bacteriologically negative and had viable calves, all but one was either the first animal in the pen to calve and did not further expose her pen mates or was the last in the pen to calve and was obviously unaffected by exposure from aborting pen mates.

In any event, since multiple exposure occurs in the field not only from the abortion per se, but also from vaginal exudates and derelict fetuses, it was not considered experimentally adverse to test the vaccine under these conditions.

That H-38 vaccine induces high and persistent titers is abundantly
clear. As long as 16 months post vaccination, all the sentinals (unexposed) still had positive card and rivanol tests, and five of the six sentinals had tube titers at the suspicious and reactor levels.

Even though the four animals in the two dose group of vaccinates that were bacteriologically negative and had had viable calves had tube titers equivalent to the two-dose sentinals, several of the bacteriologically positive animals were also in that titer range. Thus, in the face of vaccine dosage that affords protection from abortion at about the same level as *B. abortus*, strain 19, the sero-diagnosis of infection is seriously compromised.

The systemic reactions induced by the vaccine did cause some elevation of temperature and transient depression of the animals. There was no marked loss of appetite. The local reactions were unsightly, persistent, and would, no doubt, be unacceptable.

In summary, under the conditions of this trial, H-38 vaccine did not meet several of the criteria of an ideal immunizing agent. While it is non-viable and, therefore, innocuous to man, it caused unacceptable and prolonged local reactions, persistent titers that would interfere with sero-diagnosis of infection, required two doses to provide the protection against abortion provided by one dose of *B. abortus*, strain 19, and provided almost no protection against infection.

REFERENCES


ACKNOWLEDGMENTS

The work reported herein was supported by cooperative agreement No. 12-16-4-125, United States Department of Agriculture, Animal and Plant Inspection Service.
Table 1. Age of Fetus at Time of Exposure to *Brucella abortus*, 2308, Age of Fetus and Infection Status of Fetus and Dam at Time of Abortion or Calving for 24 Control Animals in H-38 Immunization Trial.

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164* Euthanized April 1 - injured

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*NC = not collected or not collected at time of death.
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<th>Status of Fetus</th>
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<th>Pen</th>
<th>Days Between Abortions</th>
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<th>Status of Fetus</th>
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<th>Moved to T-8</th>
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Table 7. Summary of Data on Abortions, Viability Status of Calves at Birth and Numbers of Infected and Non-Infected Dams in Control, 1 Dose, and 2 Dose Groups of Animals

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Table 8. Standard Tube Agglutination Titters of Control Animals One Week Prior to Exposure to Brucella abortus, 30 Days Post-Exposure, at Abortion, and at Slaughter

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Table 9. Standard Tube Agglutination Titer of Animals Immunized With One Dose of M-38 Vaccine One Week Prior to Vaccination, One Week Prior to Exposure to Brucella abortus, 30 Days Post-Exposure, at Abortion, and at Slaughter

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<th>SIT 1 week Pre-exposure (10 mo. post vacc.)</th>
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<th>STT at abortion on calving</th>
<th>STT at slaughter</th>
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<td>1 800</td>
<td>+ 3200</td>
<td>1 6400</td>
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</table>
### Table 10. Standard Tube Agglutination Titers of Animals Immunized With Two Doses of H-38 Vaccine One Week Prior to Vaccination, One Week Prior to Exposure to Brucella abortus, 30 Days Post-Exposure, at Abortion, and at Slaughter

<table>
<thead>
<tr>
<th>Cow no.</th>
<th>STT 1 week Pre-exposure (post 2 doses vaccine)</th>
<th>STT 30 days Post exposure</th>
<th>STT at abortion or calving</th>
<th>STT at slaughter</th>
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<tr>
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<td>Pre-vacc.</td>
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<td>+ 1600</td>
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<td>+ 100</td>
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<td>1 400</td>
<td>+ 200</td>
</tr>
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<td>1 3200</td>
</tr>
<tr>
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<td>+ 800</td>
</tr>
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### Table 11. Standard Tube Agglutination Titers of Sentinel Animals (Vaccinated, Unexposed) at One Week Prior to Vaccination, on February 8, 1977, on March 15, 1977, at Calving, and at Slaughter

<table>
<thead>
<tr>
<th>Cow no.</th>
<th>STT 1 week pre. vacc.</th>
<th>STT on Feb. 8, 1977</th>
<th>STT on March 15, 1977</th>
<th>STT at calving</th>
<th>STT at slaughter 474 days post. vacc.</th>
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<tr>
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<tr>
<td>128</td>
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<td>i400</td>
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<tr>
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<td></td>
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<tr>
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<td>Neg. at 25</td>
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<td>+200</td>
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<td>1200</td>
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RESULTS OF USING H-38 BRUCELLA VACCINE AS A THERAPEUTIC AGENT IN BEEF CATTLE EXPERIMENTALLY INFECTED WITH BRUCELLA ABORTUS, STRAIN 2308

Margaret E. Meyer, Ph.D., School of Veterinary Medicine University of California, Davis, California
and
Robert W. Gibbons, D.V.M., M.P.V.M.
Veterinary Medical Officer, U.S. Department of Agriculture

Over the course of the last several years, there has been a marked increase in the cost of replacing dairy cows withdrawn from herds because of infection with brucellosis. From the years 1973 to 1976, the cost to an owner after indemnification and to replace with just a cull cow, rose from an average of $79.00 to $214.00 per cow replaced.1 In view of the constantly increasing costs and of the continuing need to try to salvage purebred and high producing animals, the time has come to explore therapeutic measures for use as possible adjuncts or alternatives to slaughter of infected animals. Even though the information available on any previous use of H-38 vaccine as a therapeutic agent was only tentative, under the prevailing circumstances, it was considered sufficient to justify undertaking a controlled trial to assess more precisely its potential for therapeutic use in bovine brucellosis. Reported herein are the results of the trial use of H-38 vaccine as a therapeutic agent in beef cattle experimentally infected with Brucella abortus, strain 2308.

MATERIALS AND METHODS

The initial plan of this trial called for 80% of 85 head of beef heifers to be bred by artificial insemination within approximately a 90-day period. At their midgestation period, they would then be exposed to brucellosis. The status of each animal would be assessed at the time of abortion or calving. Animals found to be uninfected or of indeterminate status would be eliminated from the experiment and the infected animals would be divided into three equal groups. One group would serve as a control, one would receive one dose of H-38 vaccine, and the third group would receive two doses of vaccine. The infection status of each animal would then be ascertained again at slaughter, five to six months after having received H-38 therapy.

Selection and pre-exposure care of animals:

On January 11, 1975, 85 Hereford and Hereford-Angus beef heifers that had not been vaccinated against brucellosis and were 15 to 16 months old were selected from a large brucellosis free herd in Northern California. There, animals were separated from the rest of the herd, tested, and found negative for brucellosis by the card, standard tube, and rivanol tests before being transported to the animal holding facility at the School of Veterinary Medicine, University of California, Davis, January 14, 1975.
After being delivered, the cattle were eartagged and numbered consecutively from 1 to 85. They were held for observation and surveillance for four and a half months before the breeding program was initiated. During this time, they were tested for anaplasmosis, Q-fever, BVD, IBR, leptospirosis, tuberculosis, and retested on several occasions for brucellosis. They also were treated for any external and internal parasites.

**Breeding program:**

On June 1, 1975, breeding by artificial insemination was initiated. The original schedule of 80% bred in 90 days was based on three to four inseminations of each heifer during the 90-day period. For a variety of reasons, including the fact that the inseminator refused to visit the herd more than once a day and sometimes not that often, this schedule could not be kept. In any event, pregnancy examinations revealed that only 35 of the animals were pregnant at the end of 90 days. In order to have as uniform a stage of pregnancy as possible at the time of exposure to brucellosis, the 35 pregnant animals were separated from the herd and the trial was necessarily carried out with the animals divided into two lots, differing from one another in breeding dates and, therefore, in the date of exposure to brucellosis.

Lot 1, consisting of 35 animals, was moved from the holding pens to the isolation facility in late November, 1975. The remaining 50 animals were maintained in the holding facility and a more intensified breeding program was carried out for a second 90-day period. Lot 1 was exposed to brucellosis on December 16, 1975.

Of the remaining animals, 39 were pregnant by mid-January, 1976. They were moved to the isolation facility in February and exposed March 11, 1976. Two additional animals were retained as sentinels and were not exposed. They were not assigned to either lot of animals and were housed together in a separate building in the isolation facility.

Thus, by March 11, 1976, of the 85 animals originally purchased, 76 were in the isolation facility, 74 had been exposed to brucellosis. Of the remaining animals, one died suddenly and inexplicably and eight were not pregnant and were sold at slaughter.

**Description of isolation facility:**

The isolation facility is a cyclone-fenced compound containing 16 identical cement buildings and is located in a remote corner of the land area managed by the Animal Research Services Unit of the School of Veterinary Medicine. Each of the buildings contains two separate rooms, i.e., the inside of the building is divided by a ten foot high cement wall with ventilation space between the top of the wall and the roof. Both sides of the buildings have separate front and rear exits, and both sides have attached outside fenced exercise pens in the rear. The outside pens are separated from one another by a double cyclone fence. Thus, when the animals were quartered in the isolation facility, they were generally...
in groups of three, and the groups could not come into direct contact with any other group.

**Distribution of animals within the isolation facility:**

When the cattle were put in the isolation buildings (known as T buildings because of the letter-number designation on the buildings), they were placed in groups of three according to similarity in stage of pregnancy. They later were regrouped according to abortion or calving sequence. This was done to reduce exposure to animals that had not aborted or calved.

**Methods of exposing animals to brucellosis:**

The animals were exposed to infection by instilling 0.5 ml saline suspension of *Brucella abortus*, strain 2308 (U.S.D.A. standard challenge strain, obtained from NADC, Ames, Iowa) into both the right and left conjunctival sacs. The organism suspension was prepared and counted according to conventional techniques and the dose contained approximately 830,000 organisms.

**Method of determining status of infection:**

In the post-challenge period, blood samples were drawn at weekly intervals and serum antibody titers were obtained by the plate, tube, card, rivanol, and CF tests. This latter test was done by NADC, Ames, Iowa. At the time of abortion or calving, the fetus was collected, the stomach double ligated at the esophageal and duodenal ends, and taken to the laboratory for culture. For cuulture, the stomach contents were withdrawn aseptically and plated out on tryptose serum agar. An aliquot of the sample was frozen to use for guinea pig inoculation in the event direct culture was negative.

The vaginal swabs were streaked onto tryptose serum agar plates then placed in tubes containing 5.0 ml tryptose broth, incubated 72-97 hours, and plated out again.

Approximately 100 cc of milk, pooled from quarter samples, was centrifuged. The cream and sediment were cultured and then mixed with 10-15 ml of the middle milk and reserved for guinea pig inoculation in the event direct cultures were negative or contaminated.

**Administration of H-38 vaccine as therapy:**

The vaccine used in this trial was produced by Veterinary Department of the Merieux Institute, Lyon, France, and was obtained by the U.S. Department of Agriculture. It consists of 100 billion cells per ml of inactivated *Brucella melitensis*, strain 53 H38, dispersed in an excipient. It is commercially known as “Arborlane,” but commonly referred to as H-38 vaccine. It is supplied in one-dose vials containing 3.0 ml of vaccine.

Only animals whose infection status was confirmed by recovering the organism from the fetus, milk, and/or the vaginal exudate, or whose blood antibody titer was indicative of infection, were retained for the trial. All
of the animals in lot 1 were retained. Of the 39 animals in lot 2, 1 died of a prolapsed uterus and 13 were not infected at the time of calving and had had little or no antibody response to exposure. Of the 25 animals retained, the infection status were confirmed by recovery of the in 21, and the remaining 4 had had diagnostic antibody titers. The animals were assigned to control group or therapy groups essentially according to time of abortion.

The first dose of vaccine was given 21-28 days post-abortion and half of those animals received a second dose 60 days later. The vaccine was administered subcutaneously in cervical region at the end point of the shoulder. Animals in the 2 dose group were given the second dose on the opposite side.

**Surveillance of animals during post-abortion and post-treatment until slaughter:**

Blood samples and milk samples or udder secretions were obtained from each animal at 14-day intervals until slaughter. Blood antibody titers were followed by all of the tests previously mentioned. The milk was cultured and/or inoculated into guinea pigs. The animals were held in the isolation buildings during the five months after the administration of the vaccine. The controls were held for this same length of time.

The animals were slaughtered in a nearby slaughter house in groups of four to six animals. Tissues collected included the whole spleen, uterus, udder, a piece of liver, and the mesenteric, internal iliac, and retropharyngeal lymph nodes. In the laboratory, the supramammary lymph nodes were retrieved from the mammary glands. The tissues were prepared for culturing and cultured according to the methods conventionally recommended.²

**RESULTS**

Tables 1 and 2 show the data on the grouping of the animals in the isolation buildings, age of fetuses at the time the dams were exposed to *B. abortus*, dates of abortion or calving, number of days post-exposure abortion or calving occurred, blood antibody titer according to standard tube test, and information on recovery of the organism from vaginal exudates, fetal stomach contents, and from milk of dam for each cow in lots 1 and 2. Infection was confirmed by recovering the organism from the milk of each of the 35 cows in lot 1 and from 32 of the fetuses. Many of the vaginal exudates also yielded positive cultures. Without exception, all of the cattle had standard tube serum antibody titers at or above i400.

Infection was not confirmed in all 39 cows in lot 2. In fact, 13 cows apparently were not infected (nos. 3, 6, 12, 16, 25, 46, 47, 49, 50, 53, 71, 74, and 81). Each of these animals had a normal length gestation period and gave birth to a live calf. All attempts to recover *Brucella* from vaginal swabs, milk, and stomach contents and tissues of the calves were negative. In addition, none of these animals had had a significant rise in serum antibody titer during the period from exposure to calving. These
13 animals were excluded from the trial. One animal (no. 23) died of a prolapsed uterus. Even though animals no. 83, 41, 76, and 82 had normal gestation periods, live calves, and the milk and vaginal swabs were negative, each of these animals had had a positive card test and a tube titer of from +100 to +400 during the post-exposure, pre-calving period. Thus, the combined number of infected animals was 60, 56 in which infection was confirmed by recovery of the organism and 4 in which infection was evidenced by only blood antibody titer. Each of the test groups (controls, 1 dose, and 2 doses of H-38 vaccine) contained 20 animals.

During the five-month period between the initiation of therapy with H-38 vaccine and slaughter of the animals, their status of infection was monitored by milk culture at approximately 14-day intervals. Table 3 shows the results of milk cultures for each animal at the time of abortion and at the time of slaughter. In the control group, there were four animals whose milk was culture negative at the time of abortion and six whose milk was negative at the time of slaughter. Among these six animals were the four who were negative at abortion.

In the group that received one dose of H-38 vaccine, one animal (no. 54) was milk negative at abortion and four animals, including no. 54, were negative at slaughter. In the group that received two doses of vaccine, all were milk positive at the time of abortion. At slaughter, one animal was milk negative and one other was dry.

During this five-month period, serum antibody titers also were monitored at 14-day intervals. Table 4 shows the titer according to the standard tube agglutination test at the time of abortion, on the day the vaccine was administered (first dose 21-28 days post abortion, second dose 60 days after first), and at slaughter for the controls, 1 dose and 2 dose groups. Tables 5, 6, and 7 show the tissues from which organisms were recovered from each group of animals at slaughter. After the fresh tissues were cultured, the liver, spleen, and uterus were discarded, and the lymph nodes were frozen to reculture and, when necessary, to use for guinea pig inoculation.

In the control group, there were four animals from which no organism recovery was made (no. 33, 41, 76, 82). These are the same four animals that were negative on all milk cultures. In the 1 dose group, cow 54, which was negative on all milk cultures, was negative on tissue cultures. The organism was recovered from all other animals and from more than one set of tissues. In the 2 dose group, the organism was recovered from every animal in the group.

DISCUSSION

Irrespective of any other results obtained during the course of this trial, use of H-38 vaccine as a therapeutic agent for bovine brucellosis, the comparative findings involving cow number 54 certainly point to the fact that this vaccine would not be useable for therapy in field conditions even
if it has been found effective in reducing or eliminating infection. Cow 54 was in lot 2, exposed to brucellosis on March 11, 1976. She had a normal length gestation period and had a viable calf on July 7, 1976. At that time, her milk and vaginal swabs were negative on culture. Her tube titer was +50 and she was card test negative. However, two weeks later her tube titer had risen to +100, and ten days after that, she was card test positive. Because of the positive card test, she was retained in the trial and was in the group that received one dose of vaccine. Ten days post-therapy, her tube titer had risen to +200. It reached 3200 on November 16, 1976. At slaughter on June 12, 1977, her milk and tissues were culture negative and her tube titer remained at 3200. She was also card, CF, and rivanol positive. Clearly, the vaccine in the absence of infection had stimulated a high level of serum antibodies. Many other animals in both the 1 dose and 2 dose groups had similar patterns of test results and some even had lower tube agglutination titers, but they were culture positive at slaughter. Thus, after receiving H-38 vaccine therapy, it is impossible to distinguish the infected from the non-infected animal. The subsequent use of H-38 vaccine as an immunizing agent in a trial involving an additional 75 animals confirmed the fact that this product does stimulate high serum antibody titers and they recede but slowly.

Irrespective, though, of the titer problems, the results on the infection status of the cows at the time of slaughter show that five months after the initiation of therapy, there was no reduction in the number of infected animals in the therapy groups versus the control group. Additionally, the administration of vaccine did not reduce the number of organs and tissues from which brucellae could be recovered. In short, the organism was as widely distributed in the animals that received therapy as in those that did not. In fact, the organism was recovered on more occasions in the therapy groups than in the controls.

In addition to inducing prolonged elevation of serum antibody titers, the vaccine also induced undesirable local reactions at the site of administration (near point of shoulder). A somewhat diffuse swelling appeared within 24 hours. It localized and reached maximum size in 96+ hours and remained essentially unchanged in size for the duration of the trial. Most of the swellings were very firm and about the size of a baseball, although some were larger—measuring up to six inches in length, four inches in width, and four inches in depth. Histologically, these were granulomatous inflammatory lesions. Many of the lesions were collected at slaughter and all were sterile on culture. They were unsightly on the live animal and caused a loss of that part of the carcass at slaughter.

In addition to the local reactions to the vaccine, most of the animals also had a systemic reaction. Rectal temperatures rose within 48 hours post administration, some reaching 106°F. The temperature receded and generally returned to normal within two to three days after reaching its peak.
During the course of culturing the tissues obtained at slaughter, we observed that among the animals in the therapy groups, the uterus generally had not receded to normal size, some still had evidence of a lingering metritis, and the supramammary lymph nodes were enlarged and edematous. We tentatively interpreted this finding as a hypersensitivity reaction resulting from the imposition of the vaccine on active infection. In any event, there were marked differences between the control and therapy animals in the size and consistency of the uterus and supramammary lymph nodes.

The results of this trial use of H-38 vaccine as a therapeutic agent for treatment of bovine brucellosis clearly shows that this product has no therapeutic value. Because of the obvious differences in size and consistency of organs and tissues in treated animals versus controls, possibly resulting from hypersensitivity, the vaccine may actually have been harmful to infected animals.

H-38 is not the first Brucella vaccine to be examined for its possible therapeutic use. Brucella abortus, strain 19, has been found to be ineffective for therapy. Ray and Hendricks reported similar results, i.e., enhancement of infection in animals given 45/20 vaccine.

Clearly, therapy of bovine brucellosis cannot be achieved with H-38 vaccine 45/20 bacterin, or Brucella abortus, strain 19. Since immunizing agents have not proven to be effective therapeutic agents in this disease, other approaches to therapy should be explored.

ACKNOWLEDGMENTS

The work reported herein was supported by cooperative agreement No. 12-16-4-125, United States Department of Agriculture, Animal and Plant Inspection Service.

REFERENCES

### Table 1. Data on Age of Fetus at Time of Exposure of Dam, Arrangement of Cows in Isolation Buildings, Date of Abortion, Days Post Exposure that Abortion Occurred, Tube Titer, and Data on Recovery of *Brucella abortus* at Time of Abortion on 35 Cows in Lot 1. Exposed December 16, 1975

<table>
<thead>
<tr>
<th>Cow No.</th>
<th>Isolation Group</th>
<th>Housing Side</th>
<th>Age of Fetus in Days When Dam Was Exposed</th>
<th>Date of Abortion</th>
<th>Days Post Exposure</th>
<th>STT at Abortion</th>
<th>Recovery of <em>Brucella abortus</em> from Vaginal Swab</th>
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Table 5. Recovery of *Brucella abortus* From Tissues Obtained at Slaughter of Control Animals

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**Tissues Cultured**

**Lymph Nodes**
Table 6. Recovery of *Brucella abortus* From Tissues Obtained at Slaughter of Animals in the 1-Dose Group

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A COMPARISON OF THE SUSCEPTIBILITY OF STRAIN 19 CALFHOOD VACCINATED ANIMALS VERSUS NON-VACCINATES IN A BRUCELLOSIS OUTBREAK

Francis J. Drazek, D.V.M., N.Y.S. Department of Agriculture & Markets and N.Y.S. College of Veterinary Medicine

A well-managed free-stall dairy herd of 233 Holstein cattle with a production average of over 17,000 lbs. of milk became infected with *Brucella abortus* Biotype I.

Source of the infection was not established. For many years most of the herd replacements were home-raised except for the purchase of some show cattle. Beginning in early 1976 the owners decided to increase the size of the herd and added cattle as follows:

a. One cow from an area dairymen.
b. Three cows from another dairymen
c. Groups of cows from a large cattle dealer, including thirty that were leased.

Most of the dealer-furnished cattle were Canadian imports. All were qualified to enter the country and were subsequently released into New York State. Approximately eighty cows were delivered by the dealer between early 1976 and March of 1977. Any of these cows that were not satisfactory were replaced by the dealer upon request of the owners.

All herd additions entered the existing loose housing barn upon arrival. No isolation precautions were taken. Commercial cattle were intermixed with purebred animals.

The herd was divided into high and low production groups and milked separately in the milking parlor.

The following summary covers the period of initial detection in May, 1977 and ends on October 31. All culture attempts were made at the Diagnostic Laboratory of the New York State College of Veterinary Medicine in Ithaca:

*May, 1977*

233 Milking-age Holsteins

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<th>Description</th>
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<tr>
<td>Non-reactors</td>
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<td>Proof of Strain 19 calfhood vaccination</td>
<td>95 (41%)</td>
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67 Reactors

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<td>A. Aborted fetus, abomasal fluid culture</td>
<td>1* Negative culture</td>
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<tr>
<td>B. Milk (all quarters) of random reactors</td>
<td>3* Positive cultures</td>
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<tr>
<td>Proof of vaccination (inc. A &amp; 2 of B)</td>
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<td>No proof of calfhood vaccination</td>
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</table>
June 13, 1977

166 Non-reactors

New reactors 3
(Proof-calfhood vaccination) 1
Non-reactors 163

June 27 to October 31, 1977

163 Non-reactors

New reactors (culture attempts) 50*
Non-reactors 113

*Total cultures = 54 (incl. 4 cultures from May 77)

Positive cultures (Br. abortus Biotype I) 35 (65%)
  a) Proof of calfhood vaccination 18 (51%)
  b) No proof of calfhood vaccination 17 (49%)

Negative cultures 19 (35%)
  a) Proof of calfhood vaccination 9 (47%)
  b) No proof of calfhood vaccination 10 (53%)

During the Six-Month Study:

Total Reactors 120 of 233 or 51 1/4 %
Calfhood Vaccination Reactors 47 of 95 or 49 1/4 %
Not Calfhood Vaccinated 73 of 138 or 53 %

Abortions:

Blood Reactor Positive Culture

Proof of Calfhood Vaccination:

7 3/4 Mo. on 5/16 Yes No
8 Mo. on 5/27 Yes Yes
7 1/2 Mo. on 9/4 Yes Yes

No Proof of Calfhood Vaccination:

5 1/2 Mo. on 5/25 Yes No
8 1/4 Mo. Twins on 9/5 Yes Yes
7 3/4 Mo. on 10/6 Yes Yes

BACKGROUND

New York State furnishes Strain 19 vaccine, ear tags, tattoo equipment and report forms to veterinarians who vaccinate calves against Brucellosis. They are required to report all such vaccinations to us. Fees for their services are paid by the livestock owner. We want calves vaccinated at two to three months and always under six months.

** Differences not statistically significant, as determined by Dr. Henry Dunn, Sr. Research Associate and Statistician at the N.Y.S. College of Veterinary Medicine.
The decision of whether or not to calfhood vaccinate rests with the livestock owner and advice given to him by his practitioner.

New York State has always believed in the total eradication of Brucellosis. This is based on blood test findings and culture of the Brucella organism. Once we establish the existence of field strain Brucella, we blood test the entire herd every two weeks and process all reactors for removal to slaughter, immediately.

The attached “Recommendations to Herd Owners for the Control of Brucellosis” is reviewed with the livestock owner at the time of initial detection of Brucellosis. The owners of the herd in this study told us that these recommendations were too stringent and it would be impossible to implement them. They continued to lose animals as Brucella reactors. Abortions occurred in the barn and at pasture. Spread of infection throughout the herd continued unabated. Three months later, they enacted all of our recommendations. Unfortunately, it takes at least a year to clean up a herd after all spread has ceased.

RECOMMENDATIONS TO HERD OWNERS FOR THE CONTROL OF BRUCELLOSIS

I. Pregnant animals should be closely observed for impending abortion or calving, morning and night on a daily basis.

A) Pregnancy exams should be made on every animal of questionable status.

1. Most Brucella-caused abortions occur during the last trimester of pregnancy (6 to 9 months).

2. Brucella abortions may occur as early as 3 to 6 months of pregnancy.

3. A cow can calve at full term (or beyond), with an apparent normal calf, expel her placenta, milk well, yet be infected with Brucellosis.

B) A cow will generally give a 24 hour warning prior to aborting—sudden bagging and “setting or dropping of cords” followed by discharge and some placenta showing.

C) All animals that show signs of aborting or calving should be segregated immediately by being tied individually or placed in separate pens.

1. Areas should be easy to clean and disinfect.

2. One or two designated (reliable) people should handle all calvings and abortions. They should wear rubber footwear and (if possible) rubber or plastic apron or overalls and disinfect. Otherwise, they should change their clothes and have same laundered prior to reuse.

a) Aborted fetuses should be placed in a plastic bag and buried immediately, also all placentas from calvings or abortions.
b) Newborn calves should be removed to an isolated area. They should be carried, but not through stable areas. Preferable not to raise any calves until several months of clean tests.

c) Calving and aborting areas should be thoroughly cleaned and disinfected regularly.

d) Dogs and cats must be excluded from all barns, effective rodent program essential.

e) Fresh cows should remain in isolation until they have passed a negative blood test two weeks following calving.

f) Aborted animals that do not show signs of Brucellosis at time of abortion should remain in isolation until after they have been retested at least two weeks later, and if still negative, remain in isolation another two weeks and again tested.

g) Animals that retain their placenta and/or have a discharge following calving should be handled in the same manner as aborted animals (above) until their status is determined.

II. Purchased additions must be blood tested and found to be negative prior to delivery to the farm. They must originate from a negative herd. They must be housed and milked as a separate unit.

III. Disinfectants should be placed in areas of entry to mangers and segregation areas. Fresh disinfectant solutions should be made frequently.
BRUCELLOSIS ERADICATION IN CANADA

Dr. A. E. Lewis, Director General, Animal Health Directorate
Health of Animals Branch Agriculture Canada, Ottawa, Ontario

The eradication of brucellosis in Canada with its large land mass and wide distribution of 13,156,000 cattle presents many complex problems. In an effort to resolve some of these problems, the entire Brucellosis Eradication Program was comprehensively reviewed in 1977 in consultation with the livestock industry.

Agriculture Canada's Health of Animals Branch has directed the program in three key result areas—rapid detection, elimination, and prevention of spread. Recognizing that cattle movement is one of the primary contributory factors in the spread of the disease, emphasis has been placed on movement controls.

Effective as of April 1978, the Canadian provinces were classified into Brucellosis Free, Low and Non-Designated depending upon their brucellosis status. A “Brucellosis Free Region” applies to the provinces of Newfoundland, Prince Edward Island, Nova Scotia and New Brunswick, which are free of field strain infection. The second classification “Low Incidence Regions” includes Quebec, Manitoba, Saskatchewan, Alberta and British Columbia, where the current number of infected herds under quarantine does not exceed 0.3 percent. Ontario is classified as “Non-Designated” because it does not qualify as Free or Low.

The campaign to eradicate brucellosis in now strengthened by a concentrated effort in higher incidence areas, as well as preventing the spread of infection through controls between regions. Emphasis is placed on negative tests before leaving higher brucellosis incidence regions and negative tests within a prescribed period of time following arrival in lesser incidence regions. In addition, regulations control the movement of cattle within the Non-Designated Region, Ontario.

Within Free and Low Incidence Regions, all eligible cattle passing through terminal stockyards and major auction markets are blood tested.

In all regions, mandatory certification or a brucellosis test is required within 60 days prior to entering fairs, shows or exhibitions.

The enacted movement controls have generated an interest among cattle owners in certifying their herds as a Brucellosis Free Listed Herd to ensure a “Free” movement and preferred status for export purposes. In Ontario, approximately 5,000 herds are in the process of obtaining or are maintaining this status. For eligibility as a Brucellosis Free Listed Herd, an owner must have maintained a herd unit for at least 2 years. Certification may then be granted if all test-eligible animals prove negative to two tests for brucellosis at intervals of not less than 6 months or more than 12 months. Additions to Brucellosis Free Listed Herds are also controlled.
Brucellosis is usually introduced into a herd when an owner unknowingly buys an infected animal. As a further step to control the spread of the disease, the Animal Disease and Protection Regulations provide for the registration of livestock dealers premises. Under this legislation, all test-eligible cattle require a negative test for brucellosis within 30 days prior to being brought to a dealer's registered premises. In addition, the dealer is required to keep and make available to Health of Animals Branch inspectors a record of cattle moved onto and off his premises.

For the period April 1, 1977, to March 31, 1978, blood samples were collected and tested from over 3 million cattle. This amount of testing is good coverage of Canada's current cattle population of about 13 million cattle.

Where suspected brucellosis exists in a herd, intensive epidemiology is conducted. Herd depopulation is an integral part of the brucellosis eradication program where it is not possible to eliminate the disease by frequent testing and other control procedures. (66 herds have been depopulated in Canada from April to August of this year).

The decrease in the number of quarantined herds in Canada anticipated pursuant to the changes in the eradication program has commenced. From January to September of this year, the number of quarantined herds has decreased from 1,000 to 480 (Newfoundland and New Brunswick 0, Prince Edward Island, 1, Nova Scotia 4, Quebec 91, Ontario 289, Manitoba 30, Saskatchewan 31, Alberta 31, British Columbia 3).

Greater emphasis is now in progress on research into the disease, particularly in assessing the sensitivity and specificity of various brucellosis tests under Canadian conditions.

While rapid gains are being made in the Eradication of Brucellosis in Canada, the industry's role is becoming one of increased personal vigilance. Complacency can be avoided by communicating with the livestock industry, and the veterinary sector through meetings, news media and correspondence.

Agriculture Canada, Health of Animals Branch has made the elimination of brucellosis from all Canadian cattle herds its number one priority, and eventually this disease will be eradicated.
BOVINE BRUCELLOSIS ERADICATION IN AUSTRALIA

J. H. Whittem
Embassy of Australia, Washington, D. C.

Australia is a southern hemisphere land mass of about 780 million hectares with climate varying from temperate in the south through semi-arid and arid in the inland to wet tropical on the north and northeast littoral. Water is the scarce resource through most of the continent, rainfall is unreliable and the greater part of the land mass is therefore devoted to the extensive grazing (ranching) of ruminant animals, with the greatest cattle populations to be found in the south and in Queensland. It is a federation of 5 mainland states, an island state and a federal territory now achieving statehood. Field veterinary services are the responsibility of state and territorial governments. FIGURE 1 depicts state boundaries, sheep and cattle populations and major centers of veterinary services.

In 1968, following the successful eradication campaign for bovine pleuropneumonia, the Australian Government agreed that bovine tuberculosis and brucellosis should be eradicated from the national herd which numbers 30 - 35 million head predominantly of beef cattle. FIGURE 2 shows the extent of federal funding provided and proposed since that date, while FIGURE 3 shows usage of these funds in the several states. Both eradication programs are regarded as parts of a single campaign.

The Australian campaign resembles the U.S. campaign in the sense of being a joint Federal-State effort; however, state veterinary services carry out most of the field and diagnostic activity whilst the Federal Government provides funds, policy coordination, research, and some monitoring - e.g., of vaccine safety and potency, and standard diagnostic reagents.

Following the U.S. example, the policy guidelines for Chief Veterinary Officers and the day-to-day parameters of regulatory activities are enshrined in a document entitled "Standard Definitions and Rules," now undergoing its first revision. Most of the following data is drawn from this source, plus progress reports published by the Australian Bureau of Animal Health.

For example, TABLE 1 sets out definitions of official types of herd or group tests which apply to both tuberculosis and brucellosis.

The Australian brucellosis campaign makes use of both Strain 19 and 45/20 vaccines according to policies determined by the Chief Veterinary Officer of each state or territory. In general, Strain 19 vaccine is used in those states where disease prevalence still exceeds 2% and in the pre-test and slaughter phase, while 45/20 vaccine has been used to protect herds at risk in areas undergoing eradication by test and slaughter.

In more detail, as the proceedings of the 1978 Annual General Meeting of the Australian Veterinary Association reveal:
Heifer vaccination is compulsory in Victoria, in the coastal regions of N.S.W., and in two special problem areas in N.S.W. In these areas Strain 19 is used and generally the use of 45/20 vaccine is discouraged. Vaccination is prohibited in Tasmania and the Kimberleys. In the rest of Western Australia and the Northern Territory Strain 19 vaccine is not used and 45/20 vaccine is used only in heifers “at risk.” Small quantities of 45/20 vaccine are used in New South Wales and in South Australia. Queensland is the largest user of 45/20 vaccine (30% to 50% of all cattle vaccinated). Most is used in connection with weaner segregation programs on extensive cattle producing properties. Strain 19 vaccination of dairy heifers is encouraged in Queensland but vaccination of beef cattle is restricted to heifers at risk. In those areas of N.S.W. outside the compulsory vaccination areas vaccination is restricted to heifers at risk. South Australia has an extensive Strain 19 vaccination programme.

This statement illustrates with particular clarity the fortuitous but probably valuable degree of flexibility built into the Australian program by the constitutional reality that the Chief Veterinary Officers of the several States and Territories possess a quasi-divine right to direct disease control measures in their own States.

One hopes that with their professional wisdom and knowledge of local environmental, industrial and political conditions, the best set of parameters for rapid progress in controlling the disease will be developed in each socio-geographic or regional entity. None of us believe that uniformity is an end in itself or that complete conformity will hasten progress of eradication over our three million square miles.

The official serological tests are shown in TABLE 2; of these the Rose Bengal test is commonly used for screening with a confirmatory complement fixation test on RBT positive sera. The other tests are used only in special circumstances.

TABLE 3 sets out the criteria for interpretation of these tests, and TABLE 4 lists the minimally acceptable tests for specific purposes. The program is based on an area concept and TABLE 5 sets out the principal parameters of the variously classified areas under the scheme.

During planning a great deal of attention has been paid to the need for monitoring disease prevalence and progress towards eradication; TABLE 6 lists these activities for each type of area.

TABLE 7 presents some selected campaign parameters for the two years 1976/77 and 1977/78, and the figures may be read to support the claim that much work is being carried out, and with good effect in reducing brucellosis prevalence in Australia.

FIGURE 4 shows the present classification of Australia in terms of brucellosis prevalence and campaign activity. It will be seen that Tasmania is free, much of northern Australia is free or provisionally-free and the great bulk of the remaining areas inhabited by significant
numbers of cattle are subject to active eradication procedures—namely test and slaughter.

As the test and slaughter phase of the operation has commenced only recently in some important states, it is not surprising that at the end of 1977/78 there was still an individual prevalence of brucellosis of 0.65% with some 10,000 known infected herds.

Australia may need to review its vaccination policy in order to maintain an adequate herd immunity at least in areas at risk, rather than to de-emphasize vaccination as the United States and Canada have done.

Other changes in vaccination policy may follow reassessment of the problem of post-vaccination serological reactions using more modern serological tests.

Finally, with the funds and other resources now available, the objective of achieving nation-wide provisionally-free brucellosis states by 1984 seems not unattainable.
Australia Livestock Population and Veterinary Services

Figure 1

Sheep - $136.5 \times 10^6$ (1977)

Cattle - $32.1 \times 10^6$ (1977)
Brucellosis and Tuberculosis Eradication Campaign
FY 77/78 Users of Funds

FIGURE 3

TOTAL $21,044,000
FIGURE 4

BRUCELLOSIS ERADICATION
CLASSIFICATION OF AREAS - 1978

FREE
Prevalence nil

PROVISIONALLY FREE
Prevalence < 0.2%

ERADICATION AREA
Prevalence < 2.0%

RESIDUAL AREA
Prevalence variable
BRUCELLOSIS AND TUBERCULOSIS ERADICATION IN AUSTRALIA

TYPES OF HERD/GROUP TESTS

Survey - Survey testing is testing in residual or control areas to determine prevalence.

Routine - Routine testing is testing undertaken in an area eradication program in herds not considered to be infected or 'at risk.'

Movement - Testing of individual breeding animals and spayed females within 30 days prior to movement as required in the rules for movement between areas.
BRUCELLOSIS AND TUBERCULOSIS ERADICATION IN AUSTRALIA

TYPES OF HERD/GROUP TESTS

(continued)

*Sample* - Survey or routine tests of sufficient extensively grazed breeding cattle from each discrete herd or group to reveal 0.5% prevalence with 99% probability.

*Eradication* - Testing of all eligible animals in a known infected herd at regular intervals.

*Eligible Animals* - For Brucellosis testing, comprise all entire males and all females (including spayed females) over 6 months of age except official Strain 19 vaccinates under 20 months of age and 45/20 vaccinates within 12 months of their last vaccination. (For TB - all animals.)
BRUCELLOSIS ERADICATION IN AUSTRALIA
SEROLOGICAL TESTING

- Rose Bengal Test (RBT)
- Complement Fixation Test (CFT)
- 45/20 Vaccine Anamnestic Test
- Serum Agglutination Test (SAT)
- Anti-Bovine Globulin or Coombs Test (ABGT)
- Milk Ring Test (MRT)
- Cream Ring Test (CRT)
BRUCELLOSIS ERADICATION IN AUSTRALIA

INTERPRETATION OF TESTS

*Rose Bengal Test (RBT)*
Negative - no agglutination.
Positive - any degree of agglutination.

*Complement Fixation Test (CFT)*
Negative - no fixation at a dilution of 4 or greater.
Inconclusive - fixation at a dilution of 4.
Positive - fixation at a dilution of 8 or greater.

*45/20 Vaccine Anamnestic Test*
See CFT.

*Serum Agglutination (Tube) Test (SAT)*
Negative - less than 33½ International Units (IU).
Inconclusive - 33½ to 100 IU.
Positive - 100 IU or greater.
BRUCELLOSIS ERADICATION IN AUSTRALIA
INTERPRETATION OF TESTS
(continued)

Anti-Bovine Globulin or Coombs Test (AGBT)
The AGBT is based on the SAT and a positive reaction is an extension of agglutination of two or more serial dilutions beyond the level of agglutination reached in the preliminary SAT.

Bulk Milk Ring Test (MRT)
Negative - no agglutination.
Positive - agglutination.

Bulk Cream Ring Test (CRT)
See MRT.
BRUCELLOSIS ERADICATION

Minimal Tests for Specific Purposes

*Survey* - Rose Bengal Test with confirmatory CFT on reactors; the latter not applied within 12 months of 45/20 vaccination.

*Routine, Movement, Sample* - See above.

*Eradication* - as above; further epidemiological testing may be required, using the 45/20 vaccine anamnestic test. In remote extensive herds, the CVO may approve the slaughter of cattle as reactors on the results of the RBT alone, provided RBT positive sera continue to be monitored by the CFT.
TABLE 5

BRUCELLOSIS AREA CLASSIFICATION

FREE AREA
- Nil Brucellosis

PROVISIONALLY FREE AREA
- < 0.2% Brucellosis
- Infected herds quarantined
- Compulsory eradication

ERADICATION AREA
- < 2% Brucellosis
- Infected herds quarantined
- Compulsory eradication

CONTROL AREA
- Variable prevalence
- Infected herds quarantined
- Voluntary eradication
- Vaccination

RESIDUAL AREA
- Variable prevalence
- Vaccination
BRUCELLOSIS ERADICATION IN AUSTRALIA
MONITORING FOR INFECTION
(continued)

Provisionally Free Area

- *Traceback* operates in the area.
- *Dairy herds* are subjected to three Milk Ring Tests per year at approximately equal intervals.
- *All herds* are routine or sample tested triennially.
- *Abortion* investigations are carried out.
BRUCELLOSIS ERADICATION IN AUSTRALIA
MONITORING FOR INFECTION

Free Area

- *Traceback* operates in the area.

- *Dairy herds* are subjected to three Milk Ring Tests per year at approximately equal intervals.

- *Beef herds* have at least 6% of breeding animals checked annually by trace-back, movement, survey testing.

- *Abortion* investigations are carried out.
BRUCELLOSIS ERADICATION IN AUSTRALIA
MONITORING FOR INFECTION

Eradication Area

- *Traceback* operates in the area.
- *Dairy herds* are subjected to three Milk Ring Tests per year at approximately equal intervals.
- *Beef herds* have at least 6% of breeding animals checked annually by trace-back, movement, survey testing.
- *Abortion* investigations are carried out.

Control Area

- *Traceback* operates in the area.
- *Herd milk ring tests* are carried out.
<table>
<thead>
<tr>
<th>BRUCELLOSIS CAMPAIGN - SELECTED STATISTICS 1976-78</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No of breeder cattle</strong></td>
</tr>
<tr>
<td><strong>No of herds</strong></td>
</tr>
<tr>
<td><strong>No of females slaughtered</strong></td>
</tr>
<tr>
<td><strong>No of blood samples from slaughtered cattle</strong></td>
</tr>
<tr>
<td><strong>Reactor Rate</strong></td>
</tr>
<tr>
<td><strong>No of blood tests carried out</strong></td>
</tr>
<tr>
<td><strong>No of blood samples tested</strong></td>
</tr>
<tr>
<td><strong>No of reactors detected</strong></td>
</tr>
<tr>
<td><strong>No of reactors slaughtered</strong></td>
</tr>
<tr>
<td><strong>Total No of blood tests carried out</strong></td>
</tr>
<tr>
<td><strong>No of known infected herds</strong></td>
</tr>
<tr>
<td><strong>Herd Prevalence</strong></td>
</tr>
<tr>
<td><strong>Individual Prevalence</strong></td>
</tr>
</tbody>
</table>

Table 7
The brucellosis incidence rate, after having declined during the 1960's, began to increase in FY 1972. The disease spread probably began to occur several years prior to that time. A number of program changes were made to check that spread. The Uniform Methods and Rules (UMR) were amended to again require testing of cattle in modified certified areas before movement; and in FY 1975, the Code of Federal Regulations (CFR) was amended requiring similar testing for animals moving interstate. In FY 1974 and FY 1975, the UMR and CFR were amended to require "S" branding of exposed animals.

Associated with these changes, both Federal and State appropriations for brucellosis eradication were increasing. The Federal appropriation increased from $24 million in FY 1974 to over $55 million in FY 1978, while State expenditures went from $29 million to over $45 million. The need to change the direction of the program so that eradication could be reached as quickly as possible again became foremost in the minds of much of the industry. Outbreaks in at least three certified free States resulted from imports from Canada. Regulation changes were made to stop this introduction of disease.

Georgia and Tennessee have made significant progress toward lowering their incidence of brucellosis during the past 2 years through intensified programs. The MCI reactor rates have been cut in half in both States. Alabama and Kentucky both increased activities for locating infection during FY 1978. During FY 1978, there were 41 percent fewer infected herds found than in FY 1975. There are 26 States with 10 or fewer quarantined herds as of September 30, 1978. These are positive steps and reflect the interest of many in again turning the program toward eradication.

However, in many areas, this progress was accomplished because many States were willing to impose standards that go beyond the minimum standards in the UMR. Approximately 2 years ago, there was a request that a Brucellosis Technical Commission be appointed to do a thorough review of the program. At the same time, there was a request that no changes in the UMR be made that would impose added restrictions. This was honored.

Of the 11 States that had over 90 percent of all infected herds at the time the Brucellosis Technical Commission was formed, few changes have been made in 6, although Arkansas is intensifying their program in FY 1979. The infection levels in these States have stabilized or actually increased in some. Fortunately, during this period there have been relatively low numbers of animals moving to other farms; but even at this
low rate of movement, many free and low-incidence States are finding outbreaks that were the results of interstate spread from high-incidence States. During one 3-month period this spring, half of all newly infected herds in one Midwest State were found through quarantine-and-retest procedures of cattle imported from high-incidence States. Most of the States bordering high-incidence States are experiencing this problem. Most projections show there will be increasing numbers of animals moving back to farms in the near future. Until this spread of infection is checked, it will be difficult to make additional progress in many areas of the country.

The statistical data for this year does not look encouraging when viewed from a national standpoint. However, there have been improvements in many areas, as can be seen by separating the data for these six high-incidence States from other States. This will be done in several instances for comparison purposes.

BLOOD TESTING CATTLE

Figure 1

The total number of cattle tested in all areas of the program remained at last year's level. There was a decrease in the number of cattle tested on farms. The number of reactors disclosed was also up by 5,000 head. The total reactor rate of all cattle tested was 1.16 compared to 1.14 in FY 1978 (1.29 in FY 1976, 1.46 in FY 1975, 1.34 in FY 1974, and 1.16 in FY 1973). Area testing accounted for approximately 568,700 of the total on-farm tests.

MARKET CATTLE TESTING PROGRAM

Figure 2

The number of cattle sampled under the MCT program increased by 300,000 to 13.8 million this year. Most of this increase was due to a higher than normal sell off in Texas. The percent of the total sampled at locations other than slaughter increased from 32.5 per cent of the total last year to 37.8 percent this year. Most of this increase occurred at livestock markets. The MCI reactor rate, which had declined since FY 1975, showed a slight increase from 0.53 in FY 1977 to 0.54 in FY 1978 (0.66 in FY 1976, 0.71 in FY 1975, and 0.70 in FY 1974). MCI reactors were traced to 18,819 herds of origin, 7,023 which were found infected, with an animal infection rate of 16.97 percent. Since over 70 percent of all MCI reactors are located in the six high-incidence States which were not intensified, it is not expected there will be any additional significant reduction in this rate until improvements are made in the programs in those States or controls are placed on animal movements from those States.
MILK RING TEST

There were 843,000 ring test samples collected during this year—an increase of over 100,000 from last year. The number of herds found suspicious was 2,586, representing 0.30 percent of the total. Of those suspicious to the test, 2,276 were blood tested with infection disclosed in 435. This is a reduction from 601 infected herds disclosed in FY 1977. Emphasis has been placed on improving efficiency of ring test procedures so that infection in dairies is detected early before extensive spread occurs in the herd. This includes collecting fresh milk samples, properly preserved samples, proper adjusting of sample size according to herd size, proper laboratory procedures, and effective followup testing of suspicious herds. The fact that more ring test samples were collected this year, a greater number of herds were tested, and less infected herds were found is a good indication that improvements were made in this program.

BRUCELLOSIS INFECTED HERDS

The number of infected herds in the 50 States is up over 400 from last year. The number in certified free States is 364 compared to 414 last year. The number of infected herds is up considerably in high-incidence States that have not intensified their programs. The number of newly infected herds in these six States is up 9.4 percent from last year while the remainder of the country is down 5.4 percent. Included in the number of newly infected herds are those found by quarantine-and-retest procedures of cattle imported from high-incidence States. As noted earlier, a significant number of newly infected herds in a number of low-incidence States was found by this method. This again points out the need to control movements of negative-exposed cattle from high-incidence areas. The number of quarantined herds at the end of the year is down considerably because of increased herd depopulations. There were over 1,600 chronically or badly infected herds depopulated with Federal funds this year; this is up by 700 herds over last year. (Additional herds were depopulated strictly with State funds.) Two years ago, 12 States had over 90 percent of all infected herds. This year, 91.6 percent of all infected herds were found in 10 States. Ten States had between 30 and 300 infected herds and 30 had fewer than 30. Texas accounted for 33.4 percent of the total.

Ten States and the Virgin Islands had no infected herds at the end of this fiscal year. Six States and the Virgin Islands have gone at least 12 months without a reactor herd. Several States with large cattle populations including Wisconsin and Minnesota are nearing zero infection levels.
The number of certified free States dropped from 28 to 27 while the number of certified free counties increased from 1,956 in FY 1979 to 2,016 as of June 30, 1978. The number of modified certified counties decreased from 1,196 to 1,136. There is now one county and Yellowstone National Park listed as noncertified.

VACCINATION

For the first time since FY 1973, there was an increase in the number of calves vaccinated from 3.75 million in FY 1977 to over 4.1 million in FY 1978. Federal funds were provided on a matching basis with State funds to implement fee-basis calfhood vaccination in Arkansas, Kentucky, Oklahoma, and Texas during the year. These States, as well as Florida, increased the number of calves vaccinated. Four certified free States, New York, Pennsylvania, Vermont, and Washington, which have experienced outbreaks, also increased the number of calves vaccinated in FY 1978 over the previous year. Wisconsin, an exporting State, vaccinated 308,727 calves in FY 1978, an increase of 46,171 over last year.

Over 400 dairy and beef herds have been adult vaccinated since this program was approved in FY 1977. Preliminary results on 242 of these herds vaccinated with a reduced dose (1 - 3 x 10^9 cells) of viable Brucella abortus, Strain 19 vaccine, controlled the disease and greatly reduced the number of reactors disclosed on subsequent herd tests. The rivanol and complement-fixation tests can be successfully used to diagnose infected cattle 4 to 6 months after vaccination when using the reduced dose of vaccine. However, persistent infection occurs in many herds in spite of these measures. Also, many dairy herds that no longer are revealing reactors to the blood tests are remaining positive to the ring test.

SWINE BRUCELLOSIS

FY 1978

Perhaps the most important event in the swine brucellosis program this fiscal year occurred on December 23, 1977, when amendments to Parts 78 and 51 of the CFR were published as final rules in the Federal Register. The Part 51 amendment provided for the payment of indemnity on swine destroyed because of brucellosis ($10 for grade and $25 for registered animals); while the amendment to Part 78 required the identification of sows and boars moving interstate for slaughter, the testing of breeding animals moving interstate for purposes other than slaughter, and the identification of reactors as such and their movement only for immediate slaughter.

The latter amendment was scheduled to go into effect on March 23, 1978, but was delayed until May 22, 1978, to permit the affected industry additional time to prepare to carry out its provisions.

This delay minimized the identification regulation's effect on FY 1978
program activity, but it will be a key element in developing the long
needed nationwide surveillance system that is essential for the swine
program to succeed.

Figure 7

There was an increase in the total number of swine tested during the
year from 1.75 million in FY 1977, to 1.94 million in FY 1978. This total
includes 1.5 million sows and boars tested under the market swine
testing (MST) program and 445,000 eligible swine tested on farms.

Figure 8

The MST reactor rate in FY 1978 was 0.03, compared to the 0.028 rate
of the previous year. It should be emphasized that this low rate is largely
due to the fact that 80 percent of the MST samples were collected in
States that have already attained Validated Brucellosis-Free status. This
rate can be expected to increase as surveillance expands to include
States which have carried on only limited eradication activities in the
past.

The reactor rate on farm tests in FY 1978 was 0.19 compared with 0.39
in FY 1978, with the rate on all tests 0.07 in FY 1978, down from 0.1
percent a year ago.

Figure 9

Two States, Iowa and New Hampshire, attained Validated Brucellosis-

The number of Validated Brucellosis-Free counties increased from 609
in FY 1977 to 711 at the present time. In addition to all counties in the 14
validated States, there were free counties in California—53; Connecticut—6; Hawaii—3; Massachusetts—7; and Michigan—13.

Figure 10

There were 5,262 Validated Brucellosis-Free herds at the end of FY
1978, up slightly from the 5,228 herds holding such status a year ago.
Experience in the validated States has shown that recommended
eradication methods are highly effective against swine brucellosis, and
that the disease can be eradicated relatively quickly when these methods
are conscientiously applied. MST is the primary method of locating in-
fected herds under the program; and, at the present time, approximately
30 percent of the sows and boars slaughtered annually are tested under
the MST program.
During the coming year, a major effort will be made to increase the number of eligible swine blood tested for brucellosis at slaughter, with the initial emphasis directed toward the 72 largest plants which combined handle 90 percent of the 4.8 million sows and boars slaughtered annually in the United States.

This increased surveillance and the improved traceability made possible by the identification regulation will help assure that the past gains of the swine program can be maintained and progress toward eradication accelerated.
Figure 1

Blood Testing: Cattle

Thousands Reactors Found

Fiscal Year

1970 72 73 74 75 76 77 78

Brucellosis Eradication

Millions Cattle Tested

30 20 10 0

Farm or Ranch

MCT

283 228 283 196

119 124 158 158

22.0 20.8 20.8 17.7
Market Cattle Testing Program

Brucellosis Eradication

Fiscal Year

- At Packing Plants
- Other

<table>
<thead>
<tr>
<th>Year</th>
<th>At Packing Plants</th>
<th>Other</th>
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<tbody>
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<td>62.2%</td>
<td>41.9%</td>
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<tr>
<td>1972</td>
<td>63.3%</td>
<td>37.9%</td>
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<td>1973</td>
<td>63.7%</td>
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<td>60.6%</td>
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<td>70.0%</td>
<td>30.0%</td>
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<tr>
<td>1976</td>
<td>69.6%</td>
<td>30.4%</td>
</tr>
<tr>
<td>1977</td>
<td>67.5%</td>
<td>32.5%</td>
</tr>
<tr>
<td>1978</td>
<td>62.2%</td>
<td>37.8%</td>
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</tbody>
</table>

Million Cows Blood Tested

Figure 2
Brucellosis Eradication

Milk Ring Test Results (BRT)

- Total Suspicious BRT Tests
- Follow-up Herd Blood Tests
- Infected Herds Found

<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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<tr>
<td>1967</td>
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<tr>
<td>1978</td>
<td>2,566</td>
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<td>435</td>
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</table>
Brucellosis Infected Herds Found
In Noncertified, Modified Certified, and Certified-Free States

States Where Infected Herds Found

Certified-Free  Modified Certified  Noncertified

Number Infected Herds (Thous.)

25

Figure 4

Fiscal Year

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Non-Certified</th>
<th>Modified Certified</th>
<th>Certified Free</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>4</td>
<td>27</td>
<td>19</td>
</tr>
<tr>
<td>1971</td>
<td>1</td>
<td>27</td>
<td>22</td>
</tr>
<tr>
<td>1972</td>
<td>1</td>
<td>22</td>
<td>27</td>
</tr>
<tr>
<td>1973</td>
<td>0</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>1974</td>
<td>0</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>1975</td>
<td>0</td>
<td>21</td>
<td>29</td>
</tr>
<tr>
<td>1976</td>
<td>0</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>1977</td>
<td>0</td>
<td>22</td>
<td>28</td>
</tr>
<tr>
<td>1978</td>
<td>0</td>
<td>23</td>
<td>27</td>
</tr>
</tbody>
</table>
Figure 5

Distribution of Brucellosis Reactor Herds
Percent of Total Reactor Herds Found

- 30 States, < 30 Herds: 1.7%
- 10 States, 30 < 300 Herds: 6.6%
- 5 States, 300 < 1,000 Herds: 25.5%
- 4 States, 1,000 < 3,000 Herds: 32.7%
- 1 State, > 3,000 Herds: 33.4%

Fiscal Year 1978
(TOTAL OF 15,081 HERDS)
Brucellosis Eradication

Calves Vaccinated

Million Calves Vaccinated

Fiscal Year

1954 '58 '62 '66 '70 '74 '78

0 2 4 6 8
Swine Brucellosis
Animals Blood Tested

Thous. Animals
2,500
2,000
1,500
1,000
500
0


Fiscal Year

- Total Tests
- On Farm
- MST

Figure 7
Infection Rate
Swine Brucellosis

Percent
0.5

0.4

0.3

0.2

0.1

0

Fiscal Year

Total Tests
On Farm
MST

Figure 8
Validated Areas

September 30, 1978

- Validated Areas
- Total 711

Map showing validated areas in various states.
REPORT OF THE COMMITTEE ON BRUCELLOSIS

Chairman: Mr. Bert W. Hawkins

Co-Chairman: Dr. A. J. Roth

Dr. J. A. Acree, John Armstrong, Ralph Bishop, J. D. Branscome, Jack Dahl, Burton Eller, Dr. D. E. Flagg, Jerry Houck, Bill Gallagher, Dr. John W. Holcombe, Dr. A. E. Janawicz, Dr. Billy Johnson, Alfred Keating, T. A. Kincaid, Jr., W. D. Knox, Dr. Harvey McCrory, Dr. W. C. Ray, Larry Schaffer, Walter Stemler, K. E. "Skip" Thayer, Dr. John Hudelson, J. O. Pearce, Jr., Dr. Paul Doby, Dr. Frank Drazek, Dr. John Cobb, Dr. L. C. Vanderwagon, Dr. R. L. Hartin, Dr. John Quinn, Dr. Ben Hopson, Dr. A. E. Lewis, Robert Gadd

There were 29 members in attendance. The committee met on Sunday afternoon in general section; Monday, Tuesday afternoon and Wednesday morning in executive section.

The Brucellosis Committee was called to order at 2:00 p.m. Sunday, October 29, 1978, by Chairman Bert Hawkins. Approximately 200 people, including committee members, were in attendance. Chairman Hawkins complimented the Brucellosis Technical Commission for the outstanding objectivity of their long-awaited report and expressed his desire for a fruitful discussion and meaningful action by the Brucellosis Committee on the recommendations of the Brucellosis Technical Commission.

Dr. Berman, Chairman of the Brucellosis Technical Commission, briefly outlined a few of the significant findings of their report. He emphasized that the report had to be looked at in its totality because of interdependence of many of their recommendations.

Dr. Bert Lewis, Health of Animals Branch, Ministry of Agriculture, Canada, presented a report on the current brucellosis status in Canada. Ontario is the only Province in the nondesignated area status group and has a herd infection rate of 0.43%. Throughout all Provinces the number of herds under quarantine was reduced from 1,441 in August, 1977, to 480 in September, 1978. They are concentrating on improving the public awareness and knowledge of the disease and the eradication program procedures by markedly increasing attendance at various industry and professional meetings.

Dr. John Wittem, Scientific Attaché, Australian Embassy, presented a report on the current brucellosis program procedure and eradication program progress in Australia. Their goal is to be provisionally brucellosis free in all states by 1984. Dr. Wittem stated that a few slaughter plants were refusing to slaughter brucellosis reactors because of the health hazard. He believed these problems were being resolved. Vaccination policies vary from State to State with some using 45/20, some using ST19, others (e.g. Tasmania) not using either. It was reported that there is some disquiet among regulatory personnel regarding the efficacy of 45/20 vaccination in controlling Brucella infections.
Dr. F. J. Drazek, Ithaca, New York, presented a Report on "A Comparison of the Susceptibility of Strain 19 Calfhood Vaccinated Animals versus Non-vaccinates in a Brucellosis Outbreak." This report was based on results in a 233-cow freestall dairy herd infected with *Brucella abortus*, type 1. On the initial herd test with reactors, it was established that 41% of the cows had proof of calfhood vaccination. In five months, 120 animals were removed as reactors. Forty-four of these (36.6%) were calfhood vaccinates, indicating that the vaccination had not provided significant protection against infection in this herd. Attempts to culture *Brucella* from specimens collected from 50 of the reactors resulted in 35 isolates. Eighteen of these (51%) were obtained from calfhood vaccinated cattle. Recommendations on herd management practices to facilitate disease control were not adopted by the livestock owner for three months, allowing abortions to occur unchecked in the barn and at pasture and resulting in continued spread of infection.

Dr. T. Kramer, Auburn University, Auburn, Alabama, reported on the indirect hemolytic test developed by Dr. Plackett, of Australia. This test has advantages of simplicity, absence of complicated controls, and easy training of personnel compared with the complement-fixation test. The test in Dr. Kramer's investigations does not yield very high titers, but is easy to read. He has found variation in results between batches of antigen. In comparative testing of serums from adult vaccinated cattle using the indirect hemolytic test, the CF test, and the rivanol plate agglutination test, he found that many samples were negative on the IHT but positive to the CF test. Most of these samples (75% or 27 out of 36) were negative to the rivanol test. In calculations on specificity and sensitivity he reported that the CF test had a sensitivity of 93.5% and a specificity of 72.5% while the IHT was 73.8% and 99.0% respectively. The distribution of IHT titers on serums from culture-positive cattle showed that 21 of 27 cattle had reactions exceeding 1+20. Of the remaining six cattle, three animals had reactions of 1+10, and three animals had reactions of 2+10.

Dr. Huber, Veterinary Services, APHIS, Florida, reported on detection of antibodies in milk following adult vaccination with reduced doses \((3 \times 10^9\) organisms). Work was summarized on milk samples collected from 48 lactating cows vaccinated as adults at time of vaccination and at 30, 57 and 128 days postvaccination.

He concluded that:

1. the reduced dose of strain 19 vaccine does not frequently result in persistent strain 19 infection,
2. antibody persisted longer in blood serum than in milk, and
3. antibody disappearance occurred within 60 days from milk (from normal udders) following reduced-dose vaccination.
Dr. Meyer, Univ. of California, Davis, reported on the controlled experiment using *Brucella melitensis* strain H38 killed vaccine in adjuvant. This paper summarizing the therapeutic and immunogenic evaluation of H38 vaccine use in cattle is reported separately in the Proceedings of the general meeting.

Dr. Gilsdorf, Veterinary Services, APHIS, Ames, Iowa, reported on the controlled experimental investigation on various reduced dosages of strain 19 in cattle. He concluded that the serologic response was dose related. The exposure of the vaccinated cattle, however, was inadequate and it was not possible to evaluate the protective value of the various dose levels employed. A complete report is contained in the Proceedings of the general meeting.

Dr. Deyoe, Federal Research, SEA, Ames Iowa, briefly reviewed the number of research projects being supported in whole or in part by USDA (SEA & APHIS).

Dr. Lane, representing Dairy Farmers, Inc. and other dairy organizations in Florida, read a position statement and petition on behalf of the Florida Dairymen. He petitioned that appropriate changes be made in the UM&R for whole herd vaccination in high-incidence states and that allowance be made for unrestricted movement of AV animals after the herd is released from quarantine.

Meeting was adjourned at 5:20 p.m., to be reconvened at 1:30 p.m. Monday.

The Brucellosis Committee met in executive section on Monday, October 30, 1978. There were 29 members of the Committee in attendance.

Dr. Clarence Campbell asked for consideration by the Committee on five motions relative to the State of Florida's brucellosis program.

Dr. Paul Nicoletti gave a brief summation of "The Effects of Adult Cattle Vaccination with Strain 19 on the Incidence of Brucellosis in Dairy Herds in Florida and Puerto Rico."

The Committee then took into consideration motions relative to recommendations of the Brucellosis Technical Commission. These motions that were passed by the Committee are as follows:

**Motion 1A**

The National Brucellosis Technical Commission reported that effective control leading to local eradication of bovine brucellosis is biologically feasible. Cognizance is taken of the probability that if no cooperative state-federal program existed, uncoordinated state and individual programs would be initiated that would prove more costly and interfere with commerce more than the existing program, resulting in significant increases in the prevalence of both bovine and human brucellosis. The Commission's study revealed that achievement of the goal of eradication is contingent upon the assumption of responsibility for their actions by individuals involved in the program.
In consideration of the foregoing, it is moved that the Brucellosis Committee of the United States Animal Health Association strongly urges that each state animal-health agency and the Animal and Plant Health Inspection Service, United States Department of Agriculture, enact and that the cattle industry of each state support a cooperative program of control that will lead to the eradication of bovine brucellosis on a local, regional, and national basis.

Motion 1B

The National Brucellosis Technical Commission reported that biologic knowledge essential to accomplish control which leads to the eradication of brucellosis is available and has been used in many areas. However, the levels of understanding and current knowledge of brucellosis are inadequate in numerous parts of the country, even to an extent which constitutes a major barrier to the achievement of control leading to local eradication.

It is therefore moved that the Brucellosis Committee of the United States Animal Health Association recommends that there be increased support given to ongoing cooperative state-federal-industry programs of education and training to raise the levels of understanding of the biologic basis essential to accomplish brucellosis control and eradication for producers, marketing segments of the industry, and professionals. This informational education should be of such quality as to promote actions from a base of enlightened self-interest and also increase general public awareness of all the implications of the disease and the programs designed to achieve its eradication locally.

Motion 2

Education Advisory Subcommittee

It is moved that a permanent subcommittee of the Brucellosis Committee be appointed and that this unit be known as the Education Advisory Subcommittee.

It will be the role of this subcommittee to coordinate the development of factual information and data for use in keeping the livestock industry and related interests abreast of developments and new information relative to brucellosis and the National Brucellosis Eradication Program.

The Subcommittee will also coordinate the preparation of informational material outlining the responsibilities and accountability of accredited practicing veterinarians with respect to the National Brucellosis Eradication Program, which, together with the data described in the foregoing paragraph, may be used in accreditation seminars and by State-Federal regulatory veterinarians in their efforts to provide practitioners with the facts necessary for the proper discharge of their responsibilities.
The Subcommittee would supervise the development of educational material—kits or visual aids that could be used in State-Federal Industry Programs of continuing education for those who have a need to know such as industry groups, livestock owners, practicing veterinarians, bankers, State and Federal personnel, etc.

The Brucellosis Committee further recommends that the Education Advisory Subcommittee shall advise the Chairman of the Brucellosis Committee on February 1st and July 1st, their recommendations, suggested protocol and means of implementing continuing education programs, etc., which would assist in accomplishing the goal of improving the level of knowledge about Brucellosis for those who have a need to know.

Move that the U.S.A.H.A. lend its support and endorsement for such publications as may be developed from time to time through the Education Subcommittee (after review by the Science Advisory Committee). These publications would be designed to fulfill the charge of the Education Subcommittee.

Motion 3
Indemnity

It is moved that the Brucellosis Committee recommend that the Animal and Plant Health Inspection Service, United States Department of Agriculture, evaluate the possibility of adopting an indemnity system keyed to replacement value which moves with the market.

The Committee is further moved to recommend that the Brucellosis Indemnity Claims System (Minicomputer) be utilized in all states where it would be applicable.

Thirdly, the Committee is urged to suggest that the Animal and Plant Health Inspection Service re-examine the policy of making federal indemnity payments in states where program components are of relatively low quality.

Motion 4
Research

It is moved that the Brucellosis Committee recommend that the United States Department of Agriculture provide adequate level of brucellosis research funding for sufficient time to assure an adequate flow of new information, both for presently perceived needs and for unanticipated problems which may arise as the program advances.

Motion 4A
Economic and Epidemiologic Research

The Brucellosis Committee is moved to recommend that the United States Department of Agriculture sponsor ongoing research on the cyclic, geographic, movement, marketing, and other economic and epidemiologic factors which influence animal-disease control, and that
this research-generated data be used in the systematic review of brucellosis program policy, its implementation and evaluation.

Motion 6
Health Concerns

Motion is made that the Brucellosis Committee recommend that the Animal and Plant Health Inspection Service, United States Department of Agriculture, and the Brucellosis Industry Advisory Committee give serious consideration to and study the probable effects of implementing consumer-protection standards in the processing of brucellosis reactor cattle and swine comparable to the standards presently in force requiring the cooking of branded tuberculin reactor cattle. or cattle or swine with lesions of tuberculosis.

It is further moved that the findings resulting from this study be reported to the Chairman of the Brucellosis Committee by July 1, 1979.

Motion 7
Identification

It is moved that the Brucellosis Committee Chairman appoint a subcommittee to study in-depth the concept of a permanent, non-duplicative, individual identification system. This study will consider the cost-benefit impact and practicability to the cattle industry. This study will also define such a system and recommend the methods and materials to be used. Prior to the adoption of a new system, the present identification systems compatible to states of origin should be employed. It is the sense of this motion that whatever identification system is used, it is imperative that animals found infected with brucellosis be traceable to herds of origin and previous owners. The following identification systems are available at this time: official metal eartag, Freezebrand, Hot brand and plastic eartags. The Chief Animal Health official in each State shall require accountability of official eartags by each Veterinary practitioner and State-Federal regulatory personnel applying such identification to livestock.

Motion 7B
Dealer Registration

Dr. J. A. Acree reported to the Committee about the development of addition to the U.M. &R. concerning dealer registration and record keeping which will be sent out to each state as a proposed model law.

Motion 7C
Educational Warranties

It is moved that the Chairman of the Brucellosis Committee appoint a study subcommittee, to be comprised of members of the Brucellosis Committee, the Industry Advisory Committee, and the Scientific Advisory Committee to develop proposed program procedures and educational information relative to warranties.

It is further moved that the study subcommittee report its findings and results to the Brucellosis Committee Chairman by July 1, 1979.
Motion 7D
Memorandum of Agreement

It is moved that the Brucellosis Committee recommends that Uniform Methods and Rules be changed to require that an individual herd plan be developed with each owner of a brucellosis-infected herd (with or without his veterinarian) by a veterinarian of the state animal-health agency, such plan to be formalized as a memorandum of agreement between the owner and state-federal animal-health officials and to set forth criteria to be followed in eradicating brucellosis from the owner's herd. It would be the responsibility of all parties concerned to adhere to the provisions of the memorandum of agreement. However, the document would provide for reevaluation and amendment of the plan as agreed to if changes were indicated as the operation advanced.

Motion 7E
Community Notification

The Brucellosis Committee is moved to urge that Uniform Methods and Rules (1977), Part II—Recommended Procedures, Section D—Quarantines, be amended to include the recommendation that the status of any herd placed under quarantine for brucellosis be made known to herd owners in the immediate community. Notification of such herd owners may be achieved by means of an educational letter or through personal contact, and should be accomplished within 30 days of the issuance of the quarantine. The purpose of this notification is to emphasize to owners the importance of taking appropriate action to protect their cattle against the disease threat posed to them by the presence of an infected herd in their community. Similar notification should be made when the herd quarantine is released.

The Committee is further moved to recommend that adjacent herds, herds sharing common pasture or having other direct or indirect contact with the infected herd, and herds containing previous purchases from or exchanges with the infected herd be tested within 30 days of disclosure of the infected herd or be placed under quarantine until tested.

If the above-described herds are negative, the State Brucellosis Epidemiologist may determine if further testing of such herds is necessary when the quarantine is released on the infected herd.

Motion 7F
Branding

It is moved that the Brucellosis Committee recommend that each state adopt regulations requiring the “S” branding of cattle as follows:

1. Cattle, except steers and spayed heifers, that have been exposed to brucellosis reactors, unless they are returned directly to the herd of origin for quarantine until appropriate release.

2. Test-eligible, cattle of unknown status which are being moved or sold without appropriate serologic testing as required by the classification of their state or origin.
It is the sense of this motion that "S" branded cattle should be restricted in their movements, and should be moved only from the farm of origin or a point of concentration or sale to a quarantined feedlot or quarantined pasture, and be permitted to move to one other market under permit or to immediate slaughter.

_Motion 7F-2_  
**Definition of Exposed Animals**

The Brucellosis Committee is moved to recommend that Uniform Methods and Rules (1977), Part I—Definitions, Section M—Exposed Animals, be amended to read as follows:

Animals that are part of a known infected herd or that have been in contact with brucellosis reactors in marketing channels are considered to be exposed, regardless of the blood-test results. Such animals must be placed under quarantine and restricted pending slaughter or testing after return to herd of origin.

_Motion 7G_  
**Classification of States**

It is moved that the Brucellosis Committee recommend that the Animal and Plant Health Inspection Service, United States Department of Agriculture, develop educational material to instruct the industry concerning the new brucellosis classification of states: Class A States—Brucellosis-Free; Class B States—Intermediate Risk of Brucellosis; Class C States—Higher Risk of Brucellosis.

The Committee is further moved to suggest that APHIS notify the chief animal-health official of each state on a yearly basis as to the classification of his particular state. In the case of Class B and Class C states, this notification should be accompanied by an outline of the deficiencies that must be corrected in order to qualify the state for advancement to a higher classification.

The Committee is also moved to recommend that Uniform Methods and Rules (1977) be amended to include the foregoing proposals, and that the classification of states under this proposal be placed in effect prior to or by December 31, 1981.

In addition, it is moved that the Brucellosis Committee recommend to the Animal and Plant Health Inspection Service, United States Department of Agriculture, that the criteria for classification of states be amended to provide that individual states may request establishment of not more than two special State and Federal Quarantine areas within a state:

1. To permit maintenance of status in an A classification for a temporary period while effective measures are being taken to eliminate a limited reintroduction of field-strain infection in cattle at rates exceeding the criteria for maintaining Class A status.
2. To permit improvement of status, to an A or B classification, of states which have one or two relatively circumscribed but persistent foci of infection where field-strain infection is maintained at rates exceeding the criteria for improvement in status to a Class A or B state.

It is recommended that such requests be reviewed by a committee composed of persons knowledgeable about brucellosis, from the cattle industry, universities, and state and federal agencies outside the requesting state. It is suggested that states making requests submit a plan in the form of a cooperative state-federal agreement which includes epidemiologically sound procedures to prevent spread of infection from the Special Quarantine Area, a legal geographic description of the proposed quarantine area, proposed measures for effective control and surveillance, and a specified time frame appropriate for resolution of the problem and elimination of the Special Quarantine Area.

Following careful review, the committee should make recommendations to the Animal and Plant Health Inspection Service for approval or disapproval of the proposed State and Federal Quarantine Area as provided in Uniform Methods and Rules to maintain or improve brucellosis classification of the state as outlined in this section. Implementation and progress of the plan for the State and Federal Quarantine Area for brucellosis should be continuously monitored by state and federal employees and by adjacent cattle owners. Revocation of the privilege of the Special Quarantine Area and subsequent loss of classification should be considered at any time the plan is not being effectively followed and when defects in control may result in the spread of brucellosis from Special Quarantine area cattle to cattle not from the Special Quarantine Area.

It is further moved that the Brucellosis Committee establish a subcommittee to develop guidelines and standards for implementing and monitoring State and Federal Quarantine Areas.

Motion 7H
Vaccination Recommendations

The Brucellosis Committee is moved to propose to the Animal and Plant Health Inspection Service, United States Department of Agriculture, adoption of the recommendations of the National Brucellosis Technical Commission as set forth in Table I of the Commission's report under "Vaccination Recommendations for Present Changes in 1978-79," and that Uniform Methods and Rules (1977) be amended to incorporate these recommendations and proposed changes.

It is further moved that the Committee urge that the proposed changes be placed in effect as soon as possible, but no later than December 3, 1981.
<table>
<thead>
<tr>
<th>Vaccination Recommendations for Present Changes in 1978-79</th>
<th>Recommendations for Future Changes When Research Results Provide Additional Data on Reduced Doses and Alternate Route for Vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLASS “A” STATES</strong></td>
<td><strong>Class “A” future</strong></td>
</tr>
<tr>
<td>Brucellosis-Free</td>
<td>1. Extend age for official calf vaccination to 12 months and encourage vaccination for calves that may be sold or exposed in the future.</td>
</tr>
<tr>
<td></td>
<td>2. Change test-eligible age to 16 months of age for both beef and dairy heifers with official calf vaccination “OCV”.</td>
</tr>
<tr>
<td><strong>CLASS “B” STATES</strong></td>
<td><strong>Class “B” and Class “C” Future</strong></td>
</tr>
<tr>
<td>Intermediate Risk of Brucellosis</td>
<td>1. Change test-eligible age — same as Class A Future</td>
</tr>
<tr>
<td>AND</td>
<td>3. Whole herd vaccination — same as Class B &amp; C ’78-79</td>
</tr>
<tr>
<td><strong>CLASS “C” STATES</strong></td>
<td>4. Adult vaccination — same as Class B &amp; C ’78-79</td>
</tr>
<tr>
<td>Higher Risk of Brucellosis</td>
<td>a. Include herds of unknown status which are determined to be at high risk of infection — handle same as infected herds.</td>
</tr>
<tr>
<td>b. Provide for quarantine release of previously infected herds, including adult vaccinates, under appropriate conditions of time and negative serologic tests (see suggestions in the text).</td>
<td></td>
</tr>
</tbody>
</table>
Motion 7H-1
Serologic Tests Option

It was moved that the Brucellosis Committee recommend to APHIS, USDA:

(a) that effective immediately, the U.M. & R. be amended to require quarantine and retest, at not less than 30 days or more than 120 days post-movement of all test-eligible cattle moving interstate from modified certified states and that they move under permit issued by state of destination.

(b) that Option #2 of “Alternative Options for Serologic Test Requirements” as set forth in the report of the National Brucellosis Technical Commission be made a part of the U.M. & R. and be implemented by or before December 31, 1980.

(c) that Option #1 of “Alternative Options for Serologic Test Requirements” as set forth in the report the National Brucellosis Technical Commission be made a part of the U.M. & R. and be implemented by December 31, 1982.

Motion J-1
Check Test

It is moved that the Brucellosis Committee make the following suggestion to the Animal and Plant Health Inspection Service, United States Department of Agriculture, with respect to Uniform Methods and Rules (1977), Part II—Recommended Procedures, Page 4:

That the last sentence of Paragraph 1—Quarantines be changed to read, “In all Brucellosis Areas, a herd check test is recommended not less than six months after quarantine release.”

Motion J-2A
Card Test

It is moved that the Brucellosis Committee recommend to the Animal and Plant Health Inspection Service, United States Department of Agriculture, that Uniform Methods and Rules (1977), Part II—Recommended Procedures, Section G—Classification of Cattle, be amended to provide as follows: That the Card test be used as an official test to classify cattle as reactors only (1) when conditions and time are such that no other test is available, or (2) on request of the owner and/or his agent because of time or situation constraints.

Card tests may be used to classify animals negative on surveillance samples collected at slaughter or at livestock markets, on routine samples collected on farms, and on tests of suspicious and infected herds. Results of the card tests may be used in conjunction with other test results to aid in classification of cattle as reactors.
TABLE II
FOR BRUCELLOSIS-TEST-ELIGIBLE CATTLE
ALTERNATIVE SEROLOGIC TEST OPTIONS FOR CHANGE-OF-OWNERSHIP OR MOVEMENT

<table>
<thead>
<tr>
<th>SEROLOGIC TESTS OPTION #1</th>
<th>SEROLOGIC TEST OPTION #2</th>
<th>SEROLOGIC TESTS FUTURE OPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>More Protection</strong> — All States</td>
<td><strong>Less Protection</strong> — All States</td>
<td><strong>When Prevalence is Reduced to 1/2</strong> Present Class B Requirements No Class C States</td>
</tr>
<tr>
<td><strong>More Restrictions</strong> — Class B &amp; C States</td>
<td><strong>Less Restrictions</strong> — Class B &amp; C States</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASS “A” STATES</th>
<th>No serologic tests required for movement or sale.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brucellosis-Free</strong></td>
<td><strong>Within Class A States</strong> To Class A or B or C States</td>
</tr>
<tr>
<td><strong>Recommend voluntary test 30-150 days post-purchase or post-movement.</strong></td>
<td><strong>SAME AS OPTION 1-A</strong></td>
</tr>
<tr>
<td><strong>SAME AS OPTION 1-A</strong></td>
<td><strong>SAME AS OPTION 1-A</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CLASS “B” STATES</strong></th>
<th><strong>Two negative tests at intervals of not less than 60 days</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intermediate Risk of Brucellosis</strong></td>
<td><strong>Quarantine at destination and test 30-150 days post-movement</strong></td>
</tr>
<tr>
<td><strong>Within Class B States</strong></td>
<td><strong>Within Class B States</strong></td>
</tr>
<tr>
<td><strong>To Class A or B or C States</strong></td>
<td><strong>To Class A or B or C States</strong></td>
</tr>
<tr>
<td><strong>Quarantine at destination and test</strong></td>
<td><strong>SAME AS OPTION 1-B</strong></td>
</tr>
<tr>
<td><strong>Within Class B States</strong></td>
<td><strong>Within Class B States</strong></td>
</tr>
<tr>
<td><strong>To Class A or B or C States</strong></td>
<td><strong>To Class A or B or C States</strong></td>
</tr>
<tr>
<td><strong>CLASS “C” STATES</strong></td>
<td><strong>Three negative tests at intervals of not less than 90 days</strong></td>
</tr>
<tr>
<td><strong>Higher Risk of Brucellosis</strong></td>
<td><strong>Quarantine at destination and test</strong></td>
</tr>
<tr>
<td><strong>Qualified herd — Same as Option 1-B</strong></td>
<td><strong>SAME AS OPTION 1-B</strong></td>
</tr>
<tr>
<td><strong>Within Class C States</strong></td>
<td><strong>Within Class C States</strong></td>
</tr>
<tr>
<td><strong>To Class A or B or C States</strong></td>
<td><strong>To Class A or B or C States</strong></td>
</tr>
<tr>
<td><strong>Quarantine at destination and test</strong></td>
<td><strong>SAME AS OPTION 1-B</strong></td>
</tr>
<tr>
<td><strong>Within Class C States</strong></td>
<td><strong>Within Class C States</strong></td>
</tr>
<tr>
<td><strong>To Class A or B or C States</strong></td>
<td><strong>To Class A or B or C States</strong></td>
</tr>
<tr>
<td><strong>No Class C States</strong></td>
<td></td>
</tr>
</tbody>
</table>

**REPORT OF THE COMMITTEE**

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184
Motion J-3  
Laboratory Review  
The Brucellosis Committee is moved to suggest to the Animal and Plant Health Inspection Service, United States Department of Agriculture, that Uniform Methods and Rules (1977) be amended in Part II—Recommended Procedures, Section A—Laboratories, to provide that each state or region have the laboratory capability of running the complement-fixation and Rivanol test and of bacteriological culturing services for the isolation of \textit{B. abortus} from milk and tissues.

The Committee is further moved to recommend to the Animal and Plant Health Inspection Service that the latter develop a cooperative system with states, universities, and industry for regular review of the training and performance of laboratory personnel and for assisting laboratories in the development of systems of continuous quality control for all laboratory tests and culturing procedures.

It is also moved that the Committee recommend that Uniform Methods and Rules (1977), be amended in Part II—Recommended Procedures, Section A—Laboratories, to include the provision that such laboratories be evaluated by a review committee as needed, but at least once in each three year period.

Motion J-4  
Epidemiologic Services  
The Brucellosis Committee is moved to recommend that a Section Q be added to Part II—Recommended Procedures, Uniform Methods and Rules (1977), to provide that each state brucellosis-eradication program furnish quality epidemiologic services to aid veterinarians and herd owners in brucellosis prevention and control leading toward local eradication.

The Committee recommends that each state implement the following components related to epidemiologic services in its brucellosis-eradication program:

(a) That State-employed veterinarians having brucellosis program responsibilities attend an APHIS Brucellosis Epidemiology Short Course or its equivalent within the first year of their assignment.

(b) That State livestock inspectors and APHIS animal-health technicians have in their job descriptions a requirement for a structured program of continuing education on program elements.

(c) That each State brucellosis program supervisor notify the State public health agency at the time or within 15 days of the inspection of each quarantine for brucellosis, so that the public health agency may take appropriate educational steps.
Motion J-5
Program Review

It is moved that the Brucellosis Committee recommend that the Animal and Plant Health Inspection Service, United States Department of Agriculture, develop a cooperative system with states, universities, and industry for regular review of the federal program and each state brucellosis program with respect to the qualifications and performance of personnel and to the implementation of Uniform Methods and Rules (1977), with evaluation by a review committee as needed, but at least once in each three-year period. The summary of the findings of the review committee shall be distributed to all other States by APHIS.

Motion K
Surveillance Procedures

The Brucellosis Committee is moved to recommend that the chief animal-health official of each state and his federal counterpart review the state's surveillance procedures, noting the total surveillance programs available in the state and revealing their findings in a letter to the Brucellosis Staff of the Animal and Plant Health Inspection Service, the information be used by APHIS in state program evaluations.

Motion 11
Definition of Reactor

It is moved that Part I—Definitions U.M. & R. 1977 be amended to provide for the use of the Complement Fixation and Rivanol tests to define reactors by addition of the following for both official calfhood vaccinated cattle and for all other (non-vaccinated) cattle: to the card test where it has been used as the sole test as specified; or disclose titers of 50% fixation in a dilution of 1:20 or higher on the complement fixation test; or a titer of +25 or higher on the Rivanol test; or are found infected by other diagnostic procedures such as isolation of field strain B. abortus.

Where approved, whole herd vaccination (including infected; qualified or unknown status herds at high risk) with reduced doses of strain 19 has been carried out, AV tattooed or branded animals should be considered reactors if the CF titer from two up to five months post vaccination is 50% fixation at a dilution of 1:40 or higher. A first test is recommended at two months or as early as possible following whole herd vaccination in order to facilitate elimination of field strain infection. At five or more months post vaccination, animals should be considered reactors if the CF titer is 50% fixation at a dilution of 1:20 or higher, or the titer is +25 or higher on the Rivanol test.

The evaluation of titer responses for all herds shall be the responsibility of a trained, experienced epidemiologist(s) who has been designated to perform this function in each of the states in light of herd and individual animal history and other epidemiologic considerations. The qualifications and selection of the designated epidemiologist shall be determined by the Brucellosis Staff Veterinary Services Regional Epidemiologist and State and Federal Animal Health Officials.
Evaluation of Complement Fixation Test Methods

The Science Advisory Committee recognizes that there is variation among the complement fixation tests being conducted in different official laboratories at this time. The tests are all based on Kolmer methods, with overnight fixation at ca. 4°C, but they may differ from the method originally described by Jones, Hendricks and Berman, A. J. Vet. Res., 24, 1143, 1953, in various respects, such as: total volume in tubes or microtiter system, dilution series, RBC suspension density, unitage of complement, etc. Despite this amount of variation in each of the laboratories in states using cold fixation complement fixation procedures, these procedures have been effectively within the titer recommendations as proposed herein.

It is proposed that collaborative work on cross comparisons among test procedures which is in progress, be completed during the next year and reported to APHIS and to the Brucellosis Committee with a view to recommendations on adoption of a single standard method and guidelines on interpretation.

Motion 12
Definition of Test Eligible Cattle

It was moved that a definition of Test Eligible Cattle be added to the U.M. & R. Such definition is to read:

Test Eligible Cattle includes all cattle over 12 months of age except steers, spayed heifers, official vaccinates of dairy herds under 20 months of age and official vaccinates of beef breeds under 24 months of age as evidenced by the presence of the first pair of permanent incisor teeth which are not parturient (springer) or post parturient.

Motion 13
Herd Definition

It was moved that the following definition be accepted for change in U.M. & R.: A herd is all cattle (genus Bos) under common ownership or supervision, that are grouped on one or more parts of any single premises (lot, farm, or ranch) or on two or more premises geographically separated but which have had an interchange movement, or contact at any time. Such contact shall be accepted as fact unless otherwise established by the owner and consistent with the findings of the epidemiologic investigation.

Groups of cattle under multiple ownership on common premises, such as community pastures, grazing association allotments, etc., shall also be considered as a herd. For brucellosis eradication purposes, such herds shall include all other groups of cattle owned by those persons unless the epidemiologic investigation establishes that association has not occurred.
Motion 14
Traceback of Reactors

It was moved that the U.M. & R. be changed as follows:

1. Successful Traceback of Reactors: a successful traceback occurs when the premises or herd of origin of a market test reactor is located and the herd (as defined in Part 1, D) is tested as deemed necessary. Tracebacks to dealers, feedlots, commission firms and such are not considered successful tracebacks of reactors if the investigation ceases at that point and all possible herds of origin are not tested. “Sold out” herds shall be confirmed by documentation of slaughter and shall have no cattle remaining on the premises.

2. Epidemiologic Investigation of Reactors: every traceback requires a comprehensive epidemiologic investigation and follow-up (including traces to “sold out” herds) to effectively locate and control the disease. This investigation must include the following:

   (a) Market cattle reactors with positive (CF, RIV, or ME) supplemental test titers

      (1) Contact and/or adjacent herds shall be identified, reported, investigated, and tested.

      (2) All sales following the estimated date of onset of infection shall be traced and herds of destinations investigated for evidence of infection by testing purchased animal(s) as a minimum.

      (3) If herd is negative, the herd will be tested 30-90 days later if deemed necessary by epidemiologist.

   (b) Market reactors with negative (CF, ME, or RIV) supplemental test results shall be investigated for evidence of brucellosis in the herd of origin and for a probable explanation of the testing results. The herd shall be tested if reasonable doubt exists as to the reason for the serologic response or if evidence of brucella infection is present or if the status of neighboring or other contact herds is questionable.

Motion 15
Identification of Official Vaccinates

The Brucellosis Committee recommends that there be uniformity of identification in all States of official calfhood vaccinated calves by official vaccination tattoos and official calfhood vaccination tag.

Motion 16
Swine Brucellosis

It was moved that activities relative to swine brucellosis be moved from this committee to another appropriate committee, but not a new committee.

This motion is proposed with the provision that the other committee is receptive to accept the responsibility of swine brucellosis activity.
Motion 17
Definitions for Tested & Qualified Herds

It is moved that a new definition for tested herds be added to the U.M. & R. and to take effect immediately. This classification of herds will be discontinued on December 31, 1980 with the implementation of Serologic Tests Option #2. The definition will apply to herds located in non-certified areas.

A tested herd is a herd of cattle for which the State has records showing that the herd has been subjected to official testing for brucellosis in accordance with the procedures for herd tests for initial modified area certification specified in part V of these Brucellosis Eradication Uniform Methods and Rules within 12 months prior to movement and that the herd is not to be affected with brucellosis.

The Qualified herd will refer to herds located in any area that meets the requirements of the present Certified Brucellosis Free herd. The present terminology Certified Brucellosis Free Herd will be discontinued immediately.

A Qualified Herd, formerly Certified Brucellosis Free Herd, must have at least two consecutive negative tests not less than 10 months nor more than 14 months apart. Additional herd tests may be conducted if the owner so desires or if the certifying agencies deem it necessary. Commercial dairy herds require a minimum of three consecutive negative milk ring tests conducted at not less than 90-day intervals, followed by a negative herd blood test conducted within 90 days after the last negative milk ring test. Herd additions must be made in accordance with procedures outlined in the U.M. & R.

Motion 18
Adult Vaccination Procedures

It was moved that U.M. & R. be revised to allow the use of the tailhead as an alternate site for the hot AV brand on adult vaccinated cattle.

It was further moved that a subcommittee be appointed to review the permanent identification methods for identifying adult vaccinated cattle with the report to be presented by July 1, 1979.

It was further moved that the present two year limit for adult vaccinating of replacement cattle added to adult vaccinated herds be extended by one year.

Motion 19
Mid-Year Brucellosis Committee Meeting

It was moved that the Brucellosis Committee and its Advisory Committees meet in midyear 1979 to review Committee reports and discuss progress of programs.
**Motion 20**

*Brucellosis Training*

The Brucellosis Committee recommends that APHIS conduct work conferences on the changes to be made in the Brucellosis Eradication Program. These work conferences should provide for the following:

1. Training for brucellosis administrative staffs of all states.
2. Training in these locations:
   a. South
   b. West
   c. Northcentral—East

The conferences should be held after USDA accepts the Brucellosis Committee Reports but before the Brucellosis Committee Meeting in midyear, 1979. It is requested that the Brucellosis Technical Commission be authorized to attend with expenses paid by APHIS.
STANDARDIZATION OF LEPTOSPIRAL TESTING

Albert L. Brown, Ph. D.

The veterinary profession in the United States has now had about 20 years experience with leptospiral bacterins in cattle. In 1954, Brown, Creamer and Scheidy reported on an improved leptospiral bacterin at the 58th annual meeting of the U.S. Livestock Sanitary Association. This was not the first commercial vaccine to be introduced but the first produced in culture medium. The bacterin described contained only the *Leptospira pomona* antigen. It was prepared in modified Stuart's medium supplemented with 10% rabbit serum and was inactivated with thimerosol. At the time, we had completed short-term protection studies in cattle. Shortly thereafter, we completed a 6 month duration of immunity study and eventually a 14 month duration of immunity study. All of these studies demonstrated satisfactory protection against challenge. The original potency test was conducted in guinea pigs and was evaluated by measuring rectal temperatures for ten consecutive days. A few years later, a hamster test was developed and correlated with protection in cattle. As a result, regulations were written mandating that all licensed bacterins must be tested in hamsters at 1/1000th of a bovine dose. This requirement has since been increased to 1/100th of a bovine dose. During the past few years, new methods have been developed to grow leptospira in essentially synthetic media. The yields obtained in these media are about ten-fold greater than in modified Stuart's medium, and this development has provided bacterin producers with a virtually unlimited source of antigens. Along with these developments, other serotypes of leptospira have been found to be of importance in the total disease picture and combined vaccines containing as many as five different antigens are now available.

With all of this success, it might seem we would be pleased. However, based on numerous inquiries received during the past year about the interpretation of serological results with regard to diagnosis and to what may be expected following vaccination, it is apparent considerable confusion exists about the subject of measuring antibody titers and their interpretation.

There are scientists who believe that if a vaccinated animal is protected, it must necessarily have some antibody titer. Following this line of thought, when this titer becomes unmeasurably low (as it does in many animals), the animal again becomes susceptible. Although this seems reasonable, it is not entirely in accordance with experimental results; however, vaccine producers attempt to satisfy this viewpoint by making bacterins which produce high antibody titers. On the other hand, there are those who feel if a vaccinated animal has a high antibody titer, it must necessarily be interpreted as an indication of infection rather than protection. A titer of 1:100 is usually considered as a significant
indication of previous infection, but vaccination may produce much higher titers. In both instances, strict interpretation without regard to vaccination history may be misleading and is creating problems with disease diagnosis and with the shipment of cattle abroad. Some countries, for example, reject animals with titers well within the range of vaccinated animals. The purpose of this paper is to discuss the levels of antibody we are finding following vaccination and the problems associated with testing.

During the past several years, our laboratory has tested perhaps 5,000 serum samples using a uniform test procedure based on the microtechnique microscopic agglutination test developed at the CDC by Cole, Sulzer and Pursell. Most of our field research has been carried out in the area around North Platte, Nebraska in cooperation with Dr. Robert Bohlender who has a specialized practice in beef cattle management. The work reported here is part of a continuing study to learn what happens when cows are repeatedly vaccinated on a routine basis. The data presented in Tables 1 and 2 have been selected from these studies.

Table 1 shows the results from vaccinating one small herd of 82 cows with two doses of bacterin four weeks apart. The bacterin contained five serotypes of leptospira. Blood samples were taken before vaccination, at the time of the second vaccination and four weeks following the second vaccination. Although many cows had some low level antibody titers prior to vaccination, the only history of leptospiral vaccination was with *L. pomona* bacterin. It is believed many of the low values found in every herd are non-specific and not indicative of previous exposure. The fact that we have three blood samples rules out acute infection. There was a range of responses between individual animals. Following the second dose of bacterin, there was a strong anamnestic response and again a wide range of values.

Table 2 shows the serological results of some cows selected at random from the same herd 6 months following administration of the second dose. The results are compared with those from a similar herd which had received only one dose of bacterin. After six months, some of the cows that received one dose became negative; however, on the average, the herd had a respectable titer. In the cows that had received two doses, high titers remained. Some of these animals had titers sufficiently high that they might have been considered to have been infected if the vaccination and disease history on the herd was unavailable.

With any antibody reaction there is an optimum combination of antibody and antigen. The principle is illustrated in Figures 1 and 2. When there is too much specific antibody, it covers the leptospira completely providing little chance for agglutination. When there is too much antigen, the chance of more than one antibody molecule sticking to any leptospira is greatly reduced and agglutination is not observed. It is generally agreed that shortly after vaccination, the antibody produced is of the immune globulin type M (IgM). Production of this type of immune
globulin doesn’t continue for long and is eventually replaced by immune globulin type G (IgG). Although IgM is more efficient in producing the agglutination reaction because it has five receptors instead of two, both types produce the same apparent reaction.

The agglutination reaction has been used extensively in many different test procedures to measure leptospira antibodies. Dilutions of sera may be made in test tubes or by automatic equipment. Many laboratories employ a plate test. There is no standard dilution procedure. Both live and killed antigens are used. For any individual serotype, there is no standardization of the strain to be used. Some laboratories use serotypes other than those actually being tested for, because they have been found to be more sensitive. Different incubation times and methods of examination are used. With such a diversity of procedures, a difference in results might be anticipated.

To find out how great this difference might be, blood samples collected from ten calves inoculated in accordance without routine potency test procedure for *L. hardjo* were submitted to four laboratories using the same microtechnique microscopic agglutination test used in our laboratory. Prior to use, the calves were checked to determine their serological status to *L. canicola, L. grippotyphosa, L. hardjo, L. icterohaemorrhagiae* and *L. pomona*. For the purpose of this test, it was only required they be serologically negative to *L. hardjo*. A single dose of commercial bacterin containing the five serotypes was injected intramuscularly. Twenty-eight days later, generous blood samples were collected from each calf and serum was prepared. The serum was inactivated, sterilized by filtration and then kept frozen until it could be submitted for testing. The laboratories cooperating in this study were state and federal diagnostic laboratories in widely separated locations and were aware of the purpose of the test.

Tables 3 through 7 compare the test reports from the five laboratories. It should be pointed out that in our laboratory, we are primarily concerned with measuring the response to vaccination. For this reason, we use two-fold dilutions from 1:4 to 1:8192. Because the other laboratories are primarily concerned with diagnosis of disease, they screen their samples at a higher level. Three laboratories used some version of a two-fold dilution scheme while one laboratory used a ten-fold dilution method. Ignoring the negative values which merely mean the first dilution didn’t show agglutination, there doesn’t seem to be any consistent pattern between laboratories for samples testing high and samples testing low.

Regardless of how values are obtained, most diagnostic laboratories consider a positive agglutination value of 1:100 as evidence of prior infection. Based on a strict interpretation, one or more of the outside laboratories would have reported nine of these ten calves as having either an active or recent infection with *L. canicola*. Four calves would have been found positive for *L. grippotyphosa*, three for *L. hardjo*, five for *L. icterohaemorrhagiae* and two for *L. pomona*. In total, only calf
number 8 would have satisfactorily passed all of the testing.

As was mentioned earlier, our test procedure is patterned after that developed at the CDC. Since this test is automated and automatic equipment can malfunction, we conducted a small experiment to see how much variation might be expected if a sample of serum was tested repeatedly. Each of the ten samples previously described was tested ten times against a single antigen. The antigen was a four day old culture of *L. icterohaemorrhagiae* diluted to contain $1.5 \times 10^8$ leptospira per ml based on a Petroff-Hauser count. It was anticipated that if everything was done accurately, the results would be consistent. If a two-fold variation is considered negligible, the results were consistent. The variation was never more than two-fold from the modal number. With one exception, 80 percent of the time the same value was obtained and 20 percent of the time there was a two-fold difference. One sample had endpoints of $1:256$ 60 percent of the time and $1:128$ 40 percent of the time.

Of perhaps more importance than the mechanical reliability of the automatic testing equipment is the problem of standardizing the antigen. Live leptospiral antigens are particularly difficult to standardize. Cultures must be standardized with respect to growth medium and cultural conditions. In our laboratory, cultures are grown in Johnson and Harris’s modification of Ellinghausen’s medium (EMJH) on a shaker at $31^\circ C$ for between four and six days. Cultures eight days of age or older are no longer reliable. For convenience, many laboratories would prefer to transfer cultures on a weekly schedule. This can undoubtedly be accomplished by adjusting the inoculum size. We depend on a Petroff-Hauser counting procedure to standardize antigen. Ordinarily, we use $1.5 \times 10^8$ leptospira per ml except for the *L. pomona* antigen for which we prefer $2.0 \times 10^9$ leptospira per ml.

If the same antigen is used at different concentrations, the endpoints change. In one experiment, the amount of antigen was varied by increases or decreases of 100 million leptospira per ml. These are relatively drastic variations and, of course, on a percentage basis, the decrease would be expected to produce a more dramatic change than an increase. Each serum sample was tested 5 times. The results are summarized in Table 8. An increase in antigen generally resulted in a decrease in the apparent antibody titer, while a decrease in antigen generally resulted in a slight increase in the apparent titer. Properly speaking, every series of tests should be standardized by including appropriate positive and negative control sera.

The ability of technicians to perform the test may vary enough to produce different results. On cooperating laboratory submitted results of an experiment they had run to determine the variation in results obtained by two technicians. As might be suspected, the results were remarkably different. The microtechnique microscopic agglutination test procedure calls for the results to be read on the basis of a 50% agglutination endpoint. It is believed that much of the individual
variation may result from the lack of agreement about what constitutes a 50% endpoint. Standard control sera should help resolve this problem.

Finally, totally unexpected problems may occur. A story has been related of a laboratory obtaining all negative results. When the culture being used for antigen was checked by another laboratory, it was found that it had been completely replaced by a saprophytic leptospira apparently introduced through using filtered water for preparing medium.

REFERENCES


Fig. 1
Agglutination Reaction Between Leptospira and Antibody—Formation of Antigen-Antibody Lattice.

Fig. 2
Agglutination Reaction Between Leptospira and Antibody—Dependence of Agglutination Reaction on Antibody Concentration with Constant Amount of Antigen.
Table 1 – Four Weeks Post-Vaccination Antibody Titers

<table>
<thead>
<tr>
<th>Serotype</th>
<th>Agglutination Titers</th>
<th>Pre-Vac.</th>
<th>Post 1st Vac.</th>
<th>Post 2nd Vac.</th>
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<tr>
<td>L. canicola</td>
<td>6.9*</td>
<td>244</td>
<td>1106</td>
<td></td>
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<tr>
<td></td>
<td>Neg. - 64</td>
<td>32 - 1024</td>
<td>128 - 8192</td>
<td></td>
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<td>L. grippotyphosa</td>
<td>1.1</td>
<td>60</td>
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<td></td>
<td>Neg. - 16</td>
<td>8 - 256</td>
<td>64 - 2048</td>
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<td>90</td>
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<td>Neg. - 256</td>
<td>4 - 1024</td>
<td>8 - 2048</td>
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*Reciprocal of geometric mean antibody titers and range of values.
Table 2 - Six Months Post-Vaccination Antibody Titers

<table>
<thead>
<tr>
<th>Serotype</th>
<th>Agglutination Titers</th>
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<th>Two Doses</th>
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<td>L. canicola</td>
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<td>L. hardjo</td>
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<td>Neg. - 128</td>
<td>16 - 512</td>
</tr>
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<td>8 - 128</td>
<td>16 - 1024</td>
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<td>L. pomona</td>
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<td>Neg. - 1024</td>
<td>4 - 1024</td>
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</table>

*Reciprocal of geometric mean antibody titers and range of values.
Table 3 - Comparison of Leptospira Canicola Agglutination Titers as Measured by Five Laboratories.

<table>
<thead>
<tr>
<th>Animal No.</th>
<th>Results from Laboratory A</th>
<th></th>
<th>Results from Laboratory B</th>
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<th>Results from Laboratory C</th>
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<th>Results from Laboratory D</th>
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<td>200</td>
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<td>Neg.*</td>
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<td>Neg.*</td>
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*Reciprocal of antibody titer.
Table 4 - Comparison of Leptospira Grippotyphosa Agglutination Titers as Measured by Five Laboratories.

<table>
<thead>
<tr>
<th>Animal No.</th>
<th>Results from Laboratory</th>
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*Reciprocal of antibody titer.
Table 5 - Comparison of Leptospira Hardjo Agglutination Titers as Measured by Five Laboratories.

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*Reciprocal of antibody titer.
Table 6 - Comparison of *Leptospira Icterohaemorrhagiae* Agglutination Titers as Measured by Five Laboratories.

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<tr>
<td>10</td>
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</table>

*Reciprocal of antibody titer.*
Table 7 - Leptospira Pomona Agglutination Titers as Measured by Five Laboratories.

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<td>10</td>
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</table>

*Reciprocal of antibody titer.
Table 8 - Effect of Varying Antigen Concentrations on Antibody Titer.

<table>
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<tr>
<th>Serum Sample</th>
<th>Concentration of Antigen</th>
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<td>9</td>
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<td>10</td>
<td>388</td>
</tr>
<tr>
<td>Standard</td>
<td>5571</td>
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</table>

*Reciprocal of geometric mean antibody titer.
The committee was advised that the Congress has approved the establishment of a National Leptospiral Reference Laboratory at the National Animal Disease Center at Ames, Iowa.

The laboratory subcommittee reported its plans and its timetable to prepare a publication on the Laboratory Diagnosis of Leptospirosis. The publication will be prepared in three separate parts which will be entitled:

1. Serologic Procedures;
2. Isolation Procedures;

Because of the critical need for the standardization of serologic testing, it is planned to have a final draft of the first part (Serologic Procedures) for review, discussion and approval by the committee at its next annual meeting. It is the intent of the committee to include these sections as part of the Committee’s report for adoption and publication in the 1979 USAHA Proceedings. The second and third sections will be prepared in subsequent years.

The need to revise and update the Agriculture Information Bulletin No. 394 "Leptospirosis of Domestic Animals" was discussed. The committee recommends that this publication receive broader distribution.

The committee was requested to review a letter originating from the office of the Chief Staff Veterinarian of the APHIS/Veterinary Services’ Organisms and Vectors Staff for technical accuracy. The letter implied that there is some question that serovar hardjo exists in this country. The committee seriously objects to this erroneous statement and is preparing a letter to the Administrator APHIS expressing its concerns and a request to correct this erroneous statement. More than five separate US isolations of L. hardjo have been reported in scientific literature.

The committee reviewed the diagnostic problem related to the development of serological titers resulting from the use of leptospiral bacterins. After reviewing available data, the committee felt that the few 3-4 month post vaccinal titers that may be encountered in serologic testing generally were not a significant problem.

The committee wishes to point out the paucity of information concerning the pathogenesis of acute and chronic leptospiral infection in domestic animals; the mechanism of leptospirosis in the production of abnormal milk and agalactia and sterility. Moreover, in view of the high reactor rate of leptospiral infection in horses, the pathogenesis of acute and chronic infections warrant further investigation. Therefore, the committee urges that the USDA should provide funds to stimulate such research.
REPORT OF THE COMMITTEE ON MASTITIS

Chairman: R. B. Bushnell, Davis, Calif.

Co-Chairman: Kenneth M. Winland, Lafayette, Indiana

Members: Dr. Barbara Coles, Or.; Dr. Charles N. Dobbins, Ga.; Dr. N. Bruce Haynes, N.Y.; Dr. C. A. Jordan, Vt.; Dr. C. A. Kirkbride, S.D.; Dr. B. R. McCallon, Md.; Dr. J. S. McDonald, Ia.; Dr. Kermit J. Peterson, Or.; Dr. Donald S. Postle, N.Y.; Dr. Dan Basman, Wisc.; Dr. Douglas N. Stern, Mass.; Dr. G. H. Swenson, Mich.; Dr. R. F. Weidner, Ill.

The annual meeting of the Mastitis Committee of the U.S. Animal Health Association was convened at 1:30 p.m., October 31, 1978, by Chairman R. B. Bushnell. Six members and 12 guests attended.

Richard E. Miller, Food and Drug Administration, reviewed the historical sequence of legislation leading to present regulations on intramammary infusion products. He also explained FDA's legal responsibility to insure efficacy and safety to animals and the consuming public. Dr. Miller discussed proposed change in protocols for combination drug products as well as regional differences on the prevalence of various pathogens. His report stressed the lack of research information on minor pathogens. The committee, however, pointed out the prohibitive cost of developing research data on minor pathogens under current guidelines and in view of the limited market.

Committee members voiced concern that FDA's guidelines for approval of udder infusion products have not kept pace with changes in the standard practices of the dairy industry, such as three-time a day milking, higher production levels and realistic approaches to treatment routines.

As a result of these discussions, the committee appointed a subcommittee to survey the mastitis treatment practices of the dairy industry. This subcommittee will present their report at the 1979 annual meeting.

Dr. Clarence Jordan, Vermont, reported on the activities of the Cull Cow Antibiotic Residue Task Force. He indicated the new STOP (swab test on premises) test will strengthen USDA's surveillance of cull cow residues. He expects a progress report to be available at the 1979 annual meeting.

In conclusion the Committee recognized that the treatment of mastitis is only one facet of a control program and in addition to improved management for disease prevention, efforts must be made to prevent introduction of infection to herds by diseased replacements.
SUMMARY AND CONCLUSION

The inclusion of 50% dried urban sewage sludge in a normal swine starter ration for an 8 week period produced signs of toxicity including decreased weight gains, leucocytosis, lowered erythrocyte counts, and packed cell volume, along with increased serum transaminase levels. There was an increase in lead and cadmium levels in the liver and kidneys with a decrease in the copper and zinc levels.

INTRODUCTION

Municipal sewage sludge has been demonstrated to be a source of nitrogen for ruminants with the biological protein value rated 50%. Research with ruminants has indicated that the nitrogen retention from certain activated urban sludges was equal to that from soybean meal or urea. Two percent sludge has been found to provide a satisfactory source of vitamin B₁₂ for the pig.

Preliminary studies on feeding dried sewage sludge at 10 and 20 percent from the University of Florida, Gainesville, to swine produced no obvious toxic effects. However, at higher levels, toxicity may occur from a deficiency of available protein and other essential nutrients, or from the accumulation of hazardous chemical residues or be due to exposure to pathogenic micro-organisms or parasites.

This trial was planned to study the effect of feeding weanling pigs a starter ration containing 50% dry, activated, sewage sludge from the University of Florida sewage plant for 8 weeks.

MATERIALS AND METHODS

Ten 3-5 week old Hampshire Duroc weanling pigs weighing from 30 to 60 pounds were secured and randomized into 2 groups. One group, 8 pigs, was fed a starter ration *ad libitum* containing 50% dried sewage sludge with a moisture content of 10-15 percent. The other 2 pigs served as controls and were fed the starter ration. The starter ration contained a protein level of 17.2 percent while the sludge ration contained 9 percent protein. Four additional groups, 6 pigs each, of litter mates to the control group were maintained under similar conditions at the Live Oak, Florida Experiment Station to provide supporting control data.

Weight gains of all pigs in the trial were recorded weekly. Blood samples were collected weekly in suitable EDTA or oxalate tubes and examined for erythrocytes, leucocytes, including differential counts using standard procedures with a Coulter counter, prothrombin times
with a fibrometer, heavy metals,* including copper, Cu, molybdenum, Mo, lead, Pb, zinc, Zn, cadmium, Cd, nickel, Ni, and cobalt, Co, by wet ashing with an Atomic Absorption unit.** Serum enzyme determinations for serum alkaline phosphatase, SAP, lactic dehydrogenase, LDH, glutamic oxalacetic transaminase, SGOT, glutamic pyruvate transaminase, SGPT, gamma glutamic transpeptidase, γGT, and sorbitol dehydrogenase, SDH, were determined with a GEMSAEC autoanalyzer. Fecal samples from each animal were collected weekly and examined for parasite ova.

At the end of the 4th week, 4 animals of the 50% sludge treated group were slaughtered. Tissues from each animal, including liver, kidney and muscle, were collected for examination for heavy metal residues.** These tissues and a blood sample from each animal were wet-ashed with nitric acid for heavy metals. Similar studies were performed on tissues collected from another 2 sludge treated pigs slaughtered at the 6th week, as well as the last sludge treated pigs and the 2 control pigs at the 8th week. Table 2.

The starter ration and 50% sludge feed were sampled 6 times for the presence of aflatoxin B₁, as well as for pathogenic bacteria.

RESULTS

Growth—The average initial weights in the pigs of the control and sludge treated groups were 36.5 and 35.8 pounds respectively. The final average weights of the controls after 8 weeks was 133.7 pounds while the average weight for the sludge-treated pigs was 103 pounds. Thus, the average daily gain in the controls was 1.74 pounds while that of the sludge-treated groups was 1.20 (Fig. 1; Table 1).

Blood—The average blood cellular counts are presented in Figures 2-11 and Table 2. There was no apparent differences in prothrombin times, basophils, band neutrophils, eosinophils, and monocyte and erythrocyte counts. However, there were differences in:

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>50% Sludge Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV</td>
<td>37.6</td>
<td>30.4</td>
</tr>
<tr>
<td>Leucocytes %</td>
<td>19.0</td>
<td>24.4</td>
</tr>
<tr>
<td>Segmented Neutrophils %</td>
<td>21.8</td>
<td>27.6</td>
</tr>
</tbody>
</table>

Serum Enzymes—Serum samples from each pig in the 2 groups were analyzed weekly for enzyme levels. The averages for the two groups for the 8 week period are shown in Figures 12-15 and Table 3.

---

*IFAS Soils Department, University of Florida, Gainesville.

**Perkins-Elmer Atomic Absorption Unit.
Averages of Serum Enzyme Levels

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>50% Sludge Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP</td>
<td>609</td>
<td>446</td>
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<tr>
<td>LDH</td>
<td>690</td>
<td>651</td>
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<tr>
<td>SGOT</td>
<td>33.2</td>
<td>50.4</td>
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<td>SGPT</td>
<td>47.5</td>
<td>50.0</td>
</tr>
<tr>
<td>SDH</td>
<td>9.0</td>
<td>9.9</td>
</tr>
<tr>
<td>(\gamma) GT</td>
<td>12.1</td>
<td>13.0</td>
</tr>
</tbody>
</table>

These comparable levels suggest no periods of acute toxicity were present during the 8 week feeding trial. However, the differences in SGPT, SGOT, and \(\gamma\) GT toward the end of the trial between the 2 groups indicate possible toxic or cumulative effects in the sludge treated group.

Fecal samples from the 2 groups were examined for parasite ova prior to and during the trial. There were no apparent differences in the degrees of infection.

Aflatoxins—The starter and sludge-treated rations remained negative to aflatoxin B\(_1\) during the trial.

Necropsy Lesions—One of the control pigs had severe costochondrial enlargements suggestive of rickets; no other gross lesions were noted.

DISCUSSION:

Although one of the control pigs showed anorexia during the 7th week of the trial with the costochondrial lesions at necropsy, the control group gained significantly faster than the sludge-treated group (1.7 pounds vs. 1.20 pounds—average daily gain). Because of wastage of sludge-treated feed by that group, no feed conversion ration could be estimated.

The group receiving the 50% sludge starter ration had developed a higher average level of leucocytes and lower packed cell volume, suggesting toxicity which resulted in decrease in weight gains. Differences in serum enzyme levels of SAP, LDH, and SGOT, and prothrombin times between the 2 groups also suggest some interference with normal metabolic processes. The cadmium level in liver and kidney tissues was higher in the sludge-treated pigs while the copper and zinc levels were lower. Lead was found in the sludge-treated pigs at levels of 1 ppm in the kidneys, 0.4 ppm in the liver and 0.1 ppm in skeletal muscle.

Therefore, there were depressed growth rates, probably associated with the low protein level, as well as toxic effects from the presence of the heavy metals cadmium and lead, along with the depressed levels of copper and zinc, in the 50% sewage treated groups of pigs as compared to the pigs in the control group.
Table 1

Average Weight Gains in Control and 50% Sewage Sludge Fed Weanling Pigs

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<th>Wks.</th>
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<tr>
<td>Controls Average Weight (lbs)</td>
<td>36.5</td>
<td>44.5</td>
<td>56.0</td>
<td>67.8</td>
<td>80.5</td>
<td>91.3</td>
<td>107.3</td>
<td>114.5</td>
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<td>7.2</td>
<td>19.2</td>
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<tr>
<td>50% Sludge Average Weight (lbs)</td>
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<td>40.8</td>
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<td>54.6</td>
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<td>13.0</td>
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Table 2

Heavy Metal Residues at Slaughter (PPM)

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<th>Metals</th>
<th>Kidney Control</th>
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<th>Liver Control</th>
<th>Sludge</th>
<th>Muscle Control</th>
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<tr>
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<td>3.79</td>
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<td>Cobalt</td>
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<td>1.00</td>
<td>0.92</td>
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<td>0.92</td>
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<td>0.00</td>
<td>0.40</td>
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<td>Molybdenum</td>
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<td>0.80</td>
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<td>0.98</td>
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<tr>
<td>Zinc</td>
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<td>22.10</td>
<td>49.30</td>
<td>37.70</td>
<td>17.30</td>
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Table 3
Blood Chemistry of Control and 50% Sewage Sludge Treated Weanling Pigs

<table>
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<th>(IU/ml)</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAP</td>
<td>C</td>
<td>944</td>
<td>770</td>
<td>644</td>
<td>583</td>
<td>528</td>
<td>508</td>
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<td></td>
<td>S</td>
<td>696</td>
<td>363</td>
<td>318</td>
<td>413</td>
<td>384</td>
<td>412</td>
<td>432</td>
<td>543</td>
<td>450</td>
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<tr>
<td>LDH-L</td>
<td>C</td>
<td>747</td>
<td>644</td>
<td>514</td>
<td>531</td>
<td>585</td>
<td>1092</td>
<td>794</td>
<td>519</td>
<td>782</td>
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<tr>
<td></td>
<td>S</td>
<td>742</td>
<td>608</td>
<td>481</td>
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<td>685</td>
<td>408</td>
<td>551</td>
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<td>662</td>
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<td>SGOT</td>
<td>C</td>
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<td>41.6</td>
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<td>35.9</td>
<td>32.3</td>
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<td>28.6</td>
<td>32.1</td>
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<tr>
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<td>S</td>
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<td>73.7</td>
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<td>50.8</td>
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<tr>
<td>SGPT</td>
<td>C</td>
<td>40.8</td>
<td>56.4</td>
<td>56.2</td>
<td>48.0</td>
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<td>S</td>
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<td>47.9</td>
<td>46.0</td>
<td>47.3</td>
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<td>55.8</td>
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<tr>
<td>SDH</td>
<td>C</td>
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<td>-</td>
<td>10.5</td>
<td>11.0</td>
<td>-</td>
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<td>11.4</td>
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<td>12.6</td>
<td>10.1</td>
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<td>15.8</td>
</tr>
</tbody>
</table>

C = Control pig averages.
S = Sewage sludge fed pig averages.

FIGURE 1. Weight Gains in Control and 50% Sewage Sludge Treated Weanling Pigs
FIGURE 2. THE PCV LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS

FIGURE 3. WBC COUNTS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
FIGURE 4. ERYTHROCYTE AVERAGES IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS

FIGURE 5. PROTHROMBIN TIME AVERAGES IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
FIGURE 6. AVERAGE SEGMENTED NEUTROPHILS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS

FIGURE 7. AVERAGE LYMPHOCYTE LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
FIGURE 8. AVERAGE BAND NEUTROPHIL LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS.

FIGURE 9. AVERAGE EOSINOPHIL LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS.

FIGURE 10. AVERAGE BASOPHIL LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS.
FIGURE II. AVERAGE MONOCYTE LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS

FIGURE 12. AVERAGE SERUM GLUTAMATE PYRUVATE TRANSAMINASE LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
FIGURE 13. AVERAGE ALKALINE PHOSPHATASE LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS

FIGURE 14. AVERAGE SERUM GLUTAMATE OXALOACETIC TRANSAMINASE LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
FIGURE 15. AVERAGE GAMMA GLUTAMYL TRANSPEPTIDASE LEVELS IN CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS

FIGURE 16. AVERAGE COPPER LEVELS AT SLAUGHTER IN THE KIDNEY, LIVER, AND MUSCLE OF CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
FIGURE 17. AVERAGE ZINC LEVELS AT SLAUGHTER IN THE KIDNEY, LIVER, AND MUSCLE OF CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS

FIGURE 18. AVERAGE CADMIUM LEVELS AT SLAUGHTER IN THE KIDNEY, LIVER AND MUSCLE OF CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
FIGURE 19. AVERAGE LEAD LEVELS AT SLAUGHTER IN THE KIDNEY, LIVER AND MUSCLE OF CONTROL AND 50% SEWAGE SLUDGE TREATED WEANLING PIGS
AFLATOXINS AND OTHER MOLD TOXINS IN LIVESTOCK AND POULTRY FEEDS

G. T. Edds, D.V.M., Ph.D., Toxicologist and G. W. Meyerholz, D.V.M., and Bruce Abbitt, D.V.M., M.S., Extension Veterinarians, College of Veterinary Medicine, University of Florida

In most years, occasional lots of corn and other feeds (about 5 percent) have contained toxins produced by molds that are hazardous to animal health. The problem was generally associated with stored feeds. However, drought and insect damage in 1977 created favorable conditions for mold growth especially Aspergillus flavus which produces aflatoxin B₁. Corn harvested from the field during 1977 in the southeastern U.S. contained high amounts of aflatoxin. Nearly 40 percent of corn tested in Florida during 1977 contained more than 200 parts per billion (ppb). Corn examined from some counties exceeded 1000 ppb. These levels are potentially dangerous if fed to livestock and poultry. In addition to aflatoxin B₁, several other mold toxins are potentially hazardous to animals.

<table>
<thead>
<tr>
<th>Toxin</th>
<th>Molds Involved</th>
<th>Signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aflatoxin B₁,</td>
<td>A. flavus</td>
<td>Reduced feed intake, stunt-</td>
</tr>
<tr>
<td>B₂, G₁, G₂</td>
<td>A. parasiticus</td>
<td>ing, reduced growth, liver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>damage, jaundice, hemorrhage, diarrhea, prostration,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hair color change, reduced immunologic response.</td>
</tr>
<tr>
<td>Ochratoxin</td>
<td>A. ochraceus,</td>
<td>Liver and kidney damage, depressed appetite, diarrhea,</td>
</tr>
<tr>
<td></td>
<td>P. commune</td>
<td>prostration, death.</td>
</tr>
<tr>
<td>Rubratoxin</td>
<td>P. rubrum</td>
<td>Similar to aflatoxin.</td>
</tr>
<tr>
<td>Ergotoxin</td>
<td>C. purpurea</td>
<td>Hyperexcitability, blood clots, dry gangrene, loss of</td>
</tr>
<tr>
<td>Oxalic acid</td>
<td>A niger, P. oxalicum</td>
<td>tail, ears, hooves.</td>
</tr>
<tr>
<td>Penitrem A</td>
<td>Penicillium sp.</td>
<td>Gastric irritation, hemorrhage, CNS damage, coma, death.</td>
</tr>
<tr>
<td>(Tremorgen)</td>
<td></td>
<td>Ryegrass, bermuda grass, maize and paspalum stagg-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gers, muscle tremors, convulsions, mortality.</td>
</tr>
<tr>
<td>Kojic acid</td>
<td>A. flavus A. oryzae</td>
<td>Convulsions, edema, progression,</td>
</tr>
</tbody>
</table>
Zearalenone  
*G. zeae*  
*F. roseum*  
In swine, enlargement of vulva, prolapses, abortions, reduced numbers and sizes of pigs per litter.

Deoxynivalenol  
*Fusarium sp.*  
Reduced consumption to complete refusal of corn.

**Factors Affecting Mycotoxin Production**

1. Drought stress.  
2. Insect damage.  
3. Cracked or damaged kernels.  
4. Pre-storage and storage problems.  
5. Corn varieties  
7. Temperature.  
8. Trace elements (Zn, Cu, Mg).

**Factors Affecting Mycotoxin Toxicity**

1. Age.  
2. Species.  
3. Protein levels.  
4. Vitamins such as A, K.  
5. Concurrent disease such as liver flukes.  

**Testing and Use of Mycotoxin-containing Feeds**

Research has demonstrated a high correlation between the presence of aflatoxin B, and a chemical in mold-contaminated corn that produces a greenish-yellow fluorescence in blacklight. The blacklight, 365 nm, can be utilized to screen corn prior to purchase or use for feed. Generally, one glowing kernel per pound represents about 20 ppb; 10 positive kernels per pound, about 200 ppb. Occasional false positives occur with this screening method. Therefore, assay or testing by official AOAC methods should be utilized to accurately quantitate the level of aflatoxin suggested by the blacklight screening method. This requires submitting samples to laboratories equipped and qualified to conduct testing. The test results can be utilized to assess the problem and aid in any decision for possible use or salvage.

Any utilization of feeds containing aflatoxins or other mold toxins should consider the following:

1. The allowable or tolerance level set by F.D.A. for feed shipped interstate (20 ppb.)
2. The possibility of residues of aflatoxins or their metabolites in milk, meat and eggs.
3. The level of aflatoxins that may cause adverse effects ranging from retarded growth and stunting to hemorrhage and death.
4. The effects of molds or mold toxins other than aflatoxins.
5. Other considerations.

**Interstate Shipment and Blending of Feeds**

The F.D.A. has set a tolerance level of 20 ppb for feed shipped in-
MOLD TOXIN IN FEEDS

terstate. The F.D.A. also allows a 20 ppb level in grains to be processed for human consumption. Feeds and grains in violation can be confiscated.

In Florida and certain other states, the F.D.A. will allow blending of certain aflatoxin-contaminated corn with uncontaminated corn until January 1, 1979. The one-time exception is expected to avert a substantial adverse impact on the feed supply in the affected states. The exemption applies only to corn not previously moved in interstate commerce. Before blending begins, the F.D.A. Atlanta Field Office, 800 West Peachtree Street, NW, Atlanta, Georgia 30309, must approve each plan for blending. The blended feed must not exceed the action level of 20 ppb and can be used only for mature poultry and swine and mature non-milk-producing beef cattle. It can not be used to feed dairy animals. The action level for aflatoxin applies only to unavoidable contamination. Inadequate postharvest drying or faulty storage is considered avoidable, therefore unauthorized.

Residues in Meat, Milk and Eggs

Because aflatoxins or other metabolites are carcinogenic, residues of 0.5 ppb or above in milk are unacceptable. Research suggests the following in relation to residues in milk, meat and eggs:

Aflatoxin Levels in Feeds Consistently Resulting in Less Than 1 ppb Residues When Fed to Livestock and Poultry

<table>
<thead>
<tr>
<th></th>
<th>Swine ppb</th>
<th>Chickens ppb</th>
<th>Dairy Cattle ppb</th>
<th>Feedlot Cattle ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>—</td>
<td>—</td>
<td>50</td>
<td>—</td>
</tr>
<tr>
<td>Meat</td>
<td>200</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Eggs</td>
<td>—</td>
<td>100</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Generally, limited research indicates that any residues disappear in about 7 to 10 days after aflatoxin-containing feed is withdrawn.

Adverse Effects of Aflatoxins

Generally, levels up to 200 ppb do not cause adverse effects. At levels slightly higher, slower growth rates, stunting, jaundice, depression and poor condition may occur. As levels increase further, rough hair coat, hemorrhage, bloody urine, straining and death may result. A less apparent effect is suppression of the immune system resulting in failure to develop sufficient antibodies to resist other diseases. The following chart may be helpful in predicting any adverse effects in livestock and poultry.

Predicted Adverse Effects of Aflatoxins

<table>
<thead>
<tr>
<th></th>
<th>Swine ppb</th>
<th>Chickens ppb</th>
<th>Dairy Cattle ppb</th>
<th>Feedlot Cattle ppb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor perform-</td>
<td>200-</td>
<td>200-</td>
<td>200 +</td>
<td>700 +</td>
</tr>
<tr>
<td>ance, stunting</td>
<td>400 +</td>
<td>1000 +</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemorrhage and</td>
<td>400 +</td>
<td>500-</td>
<td>700 +</td>
<td>700 +</td>
</tr>
<tr>
<td>death</td>
<td></td>
<td>1500 +</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In summary, swine are relatively more susceptible. Poultry are variable and there is apparently breed variation in susceptibility. Some studies indicate a greater tolerance than shown above. Ruminants are very tolerant except for young calves under 3 months of age. Pigs under 40 pounds and chickens under 6 weeks of age are also more susceptible than older animals.

Other Considerations

1. If relatively high levels of aflatoxin-containing feed is fed to livestock, be sure all NRC requirements for proteins, vitamins, minerals and energy are well within recommended amounts in the ration. Moldy or damaged corn or other feedstuffs may be lacking in nutrient value. Marginal or inadequate rations may increase the possibility of adverse effects from aflatoxins.

2. If moldy feed grown on the farm causes problems and no other salvage or utilization can be made, research results suggest that the affected feed may be blended with good feed to an acceptable level and animals watched closely for signs of toxicity or other adverse effects. Be sure to avoid any residue problems in milk, meat or eggs.

3. The only known additive that will economically destroy aflatoxin B₁ already present in corn is ammonia gas bubbled through corn. This is feasible with proper equipment and technique in a closed bin.

4. To prevent mold growth and production of mold toxins in storage, proprionic acid is available commercially. Tests to date indicate proprionic acid is a better grain mold inhibitor than any of the other readily available materials at a reasonable cost.

5. Molds and mold toxins are found most frequently in damaged and cracked kernels. The levels of mold toxins can sometimes be lowered significantly by screening corn to remove the smaller particles.

6. Specific information about use and effects of moldy feeds in horses is not available at this time.

7. Aflatoxins present in grains and other foods intended for human consumption are toxic to humans. Liver damage may occur (short term) and there is a possibility of liver cancer developing later. Thus, the dangers of aflatoxins in foods, such as corn meal, cannot be overstated.

8. Information on grain harvesting, feed storage, insect control, resistant plant varieties and other information related to moldy feed is available in other publications or from other sources.
REPORT OF THE COMMITTEE ON ENVIRONMENTAL RESIDUES

The Environmental Residues Committee met at the USAHA Conference in Buffalo, NY October 31, 1978. The following members and guests were present:

H. Anthony, Manhattan, KS. E. Pilchard, Hyattsville, MD.
D. Bedell, Tifton, GA. F. R. Rellosa, Philadelphia, PA.
R. Gessert, Arlington, VA. L. Ruhr, Columbia, MD.
J. H. Gray, Austin, TX. H. Trabosh, Washington, D.C.
L. D. Keller, Moscow, IN. G. Nelson, St. Paul, MN.
J. Lamout, Sacramento, CA. G. T. Edds, Chairman, Gainesville, FL.

The serious mycotoxin problem in the Southeast U.S. during 1977-1978 resulted in marked economic losses from decreased growth and production in cattle, swine and poultry. In addition, the immunosuppression resulted in higher losses from bacterial, viral and parasitic diseases as well as abortion with decreased numbers and sizes of litters. The minicolumn and TLC methods were useful in diagnosing aflatoxicosis but new and practical diagnostic methods are needed for diagnostic laboratories to properly identify hazardous levels of Zearalenone, Ochratoxin, T-2 toxin, citrinin and tremorgenic toxins on grasses and hay.

Hazardous levels of metals including arsenic, lead, methyl mercury, cadmium, molybdenum and selenium are likewise causing significant animal disease losses. Several of these elements also cause immunosuppression and anemia which reduces animal productivity with possible hazardous residues in tissues.

Several of the federal governmental agencies are reviewing the currently approved pesticides and herbicides as to safety, effectiveness and management procedures to be recommended to reduce hazardous effects in animals or result in hazardous residues for humans. Included in these re-evaluations are the chemicals PCP, PCB, pentachlorphenols, 2, 4-D, 2, 4, 5-T including the dioxins, hexachlorophene, etc.

Since poisonous plants contain alkaloids and/or glucosides which may induce either acute or chronic diseases in animals as well as provide residues which may be teratogenic and carcinogenic for the animals or possibly mankind as well, the Committee strongly recommends that our Veterinary Colleges provide adequate training in identification of such poisonous plants, their principle toxic residues, pharmacodynamics and methods to reduce such animal disease losses.

Finally, the Committee would present a resolution for consideration and approval by the Executive Council and USAHA.
AFRICAN SWINE FEVER IN THE AMERICAS

Robert E. Reichard, D.V.M., M.P.H.

By now the history of African swine fever's (ASF) first incursion in this hemisphere is well known. In May 1971, it broke out on a large premise in Havana, Cuba. Laboratory confirmation of the disease came a month later simultaneously from Russian and Cuban laboratories. After a month of slaughtering infected and contact herds in Havana Province, new outbreaks continued to occur. Since the disease then was still apparently confined to Havana Province only, the government decided to slaughter all the swine—more than 400,000—in the Province. The strong measures taken eradicated the disease from Cuba and gave the Americas 7 more years of freedom from ASF.

On April 30, 1978, swine being fed raw garbage from the international airport in Rio de Janeiro, Brazil, began to die. On May 14, the herd was quarantined. An exotic disease was suspected and on May 25, samples originating from pigs inoculated with a virus isolate from this farm were sent to USDA's Plum Island Animal Disease Center (PIADC). Results confirmed the disease as ASF. Within a few days of the ASF confirmation, a USDA team arrived in Brazil to collaborate in establishing a diagnostic laboratory and to help outline eradication plans. The team was composed of animal health specialists from the Science and Education Administration and the Animal and Plant Health Inspection Service (APHIS).

An epidemiological study of the outbreak had determined swine and pork movements before quarantine of the herd. One such movement had been to one of the city of Rio de Janeiro's numerous suburban slums, or favelas, where disease subsequently appeared. ASF was then diagnosed on several premises feeding garbage to swine outside of the city but still within the State of Rio de Janeiro.

Brazil is one of the world's largest agricultural countries, with a swine population exceeding 40 million head. The swine population of the State of Rio, estimated as less than 1 million head, is located in urban, suburban and some rural areas. Because a large percentage are fed on raw garbage, the Brazilian veterinary service determined that most swine of the State of Rio were either exposed or potentially exposed and recommended that they be depopulated in order to save the remainder of the country's large and valuable swine industry.

While plans for national surveillance and confining the disease to Rio State were being made, ASF was diagnosed in other States of Brazil, including some in which the swine industry was an important segment of agriculture. Most occurrences were on garbage-feeding premises or on premises exposed to garbage-fed swine. The disease apparently had been present in Brazil since at least the previous March.
While national plans for ASF eradication were being consolidated, some of the veterinary services of individual States organized independent campaigns to fight the disease. Some depopulated herds based on clinical and epidemiological evidence of ASF. Other States waited for national coordination of the program before proceeding.

Clinical findings and mortality rates varied widely in infected herds at the time of diagnosis, with some having only a few animals sick or dead, and other premises with heavy exposure and unsanitary conditions with nearly 100 percent mortality.

By mid-July 1978, 30 million dollars had been committed to the ASF campaign, and several Ministries of the National Government were involved. Disease had been diagnosed in ten States of this large country. Local elements of the national campaign included epidemiological definition of areas surrounding infected herds as focal and perifocal.

Focal areas included infected farms, premises adjacent to them where swine were kept, and those with direct or indirect contact with infection, including urban garbage dumps and village pigs fed garbage possibly originating from the infected herds. Discretion was allowed for measures to be taken in focal areas—those in charge could choose to destroy all swine and pork products, or to quarantine herds and intensify inspection. In either case, the infected herd and urban and garbage-fed pigs were to be destroyed.

Perifocal areas included a large area surrounding focal areas, minimally to include adjacent municipalities. Swine census and quarantine of any outward movement of swine and products was required in these areas.

The remainder of Brazil was designated as an “Alert Area” in which notification, investigation, and quarantine of any suspicious swine disease was required. Quarantines remained in effect until negative laboratory results returned.

By mid-September 1978, ASF had been diagnosed on at least one premise in each of 15 Brazilian States, and more than 40,000 swine had been destroyed.

On July 5, 1978, ASF was confirmed in the Dominican Republic, making it apparent that ASF was a real threat not only to South America but also to the countries of the Caribbean, Central and North America.

The Food and Agriculture Organization (FAO), with the cooperation of the Pan American Health Organization (PAHO) of the World Health Organization (WHO), both of the United Nations, held an emergency consultation on the prevention and control of ASF in Latin America in Lima, Peru, on July 13-14, 1978. Importance of the problem was evidenced by the attendance of veterinary service representatives from most countries of the hemisphere.

American countries generally emphasized not only their inability to
diagnose ASF but also the widespread lack of resources, organizational structures, or even, in some cases, legislative authorities to prevent, or, should the disease enter, eradicate ASF. Recommendations from the meeting included many of the measures that are used by the United States to prevent and eradicate exotic diseases. These measures were described as objectives to approach, recognizing the limitations of available resources.

The PIADC had held one course in ASF diagnosis for representatives of the hemisphere prior to the Lima meeting and offered subsequent courses to others. The meeting established PIADC as the ASF reference center for the hemisphere. APHIS also offered the opportunity for other nations to send people to study its animal disease prevention practices.

The meeting provided veterinary services of the Americas with a clear consensus of what is needed to prevent and eradicate ASF. Several countries did not yet have the laboratory capability of diagnosing clinically similar hog cholera, a necessary prerequisite for screening disease which might be suspicious of ASF.

As an assistance to many countries that wished to prevent or eradicate ASF, the FAO arranged with USDA and other countries to provide consultants to the Dominican Republic and to the nations adjacent to Brazil. These have involved both field and laboratory short- and medium-term consultancies, and the establishment of a post for a full-time ASF adviser to the Western Hemisphere.

Also, FAO and the Inter-American Development Bank plan to sponsor courses hosted by the Dominican Republic, to familiarize Latin American and Caribbean countries with practical aspects of ASF eradication. The USDA intends to participate. The first of several currently planned courses is scheduled for early December.

The confirmation of ASF in the Dominican Republic this past July followed 4 months of increasingly severe death losses of swine against which hog cholera vaccination was ineffective.

The Dominican veterinary service decided to eradicate ASF by slaughtering and destroying infected herds. Foreign technical consultants from international organizations and the USDA quickly arrived to help set up laboratory and field capability for ASF eradication.

Field diagnoses of the disease, confirmed by the quickly established ASF diagnostic laboratory of the San Cristobal Central Veterinary Laboratory, led to the conclusion that the disease had already spread throughout the country. In some cases, mortality rates approached 100 percent by the time of diagnosis. However, most affected herds experienced mortality somewhat less than 50 percent.

Although the first reported cases were from the western region of the country, near a dam construction site manned by foreign workers, Dominican veterinarians now believe that the disease probably started in
the Santo Domingo area and spread throughout the country with infected swine, products, and contaminated articles. Garbage containing ASF virus from illegally imported meat products is considered the probable source of disease.

With the assistance of veterinarians previously assigned to other services, such as agricultural extension, and other personnel from various government agencies, almost 300 herds had been, as of the end of October 1978, either destroyed or scheduled for destruction. These ranged in size and management from the largest commercial herd in the country of 17,000 swine to one pig belonging to an individual owner. Swine of entire villages have been depopulated because they were epidemiologically defined as a single herd.

The government estimated that by the end of August 1978, 150,000 swine had been destroyed for ASF control additional to an undiagnosed 120,000 presumed dead from the disease. Laboratory confirmations at that date had reached almost 150.

The Dominican Republic shares the island of Hispanola with Haiti, with a frontier that is long and difficult to control. Both commercial and traditional swine and pork trade had been occurring until the disease was confirmed in the Dominican Republic, some 4 months after the presumed first occurrence of ASF there.

Haiti quickly mobilized to depopulate swine within 15 kilometers of the Dominican border—reportedly some 20-24,000 head. All overland transit from the Dominican Republic was stopped, with the exception of petroleum products. Haiti also seized and destroyed at least some products that had been imported from the Dominican Republic prior to diagnosis there of ASF.

Because of commerce with the Dominican Republic when there was a high incidence of disease, including in border areas, the USDA has designated Haiti as ASF infected for pork and swine importation purposes.

Early in October, the Dominican Republic began, under an agreement with Haiti, to depopulate all swine in an area along their common border. Twenty-two brigades were organized, each headed by a veterinarian or an agricultural engineer. Brigades also included an appraiser from the government agricultural bank, veterinary assistants, soldiers and workers. Depopulation proceeded eastward from the frontier to a straight north/south line which will be a minimum of 15 kilometers from the border.

When infected swine were found in the border area, they were, as in the rest of the country, destroyed. A voucher for $1/kilo liveweight was given to the owners of both infected and healthy swine. Swine from apparently healthy small herds were slaughtered for immediate consumption. Pork from larger herds was sent to public institutions, such as schools, hospitals, and army posts.
Feral swine exist in the border depopulation area, as in some other areas of the Dominican Republic. Military personnel have been assigned their destruction by hunting. The Army was also in charge of prohibiting transit across the border.

In areas of the Dominican Republic outside the border depopulation zone, 24 brigades, each with a veterinarian and helper, were investigating reported cases of suspicious disease. When disease was confirmed as ASF, the brigade was enlarged to appraise, kill and bury swine, and disinfect premises.

Swine from apparently healthy herds went to slaughter normally. In order to go to nationally inspected slaughterhouses, however, they were inspected at the herd of origin by veterinary personnel and sent to plants under permit within 24 hours. If lesions of ASF were found on inspection, the herd of origin was to be destroyed. Trucks leaving slaughterhouses were cleaned and disinfected. There was a periodic prohibition on beef marketing to stimulate pork consumption.

After it became apparent that ASF was spread throughout the country, the Dominican Executive Secretariat for eradication concluded that the way to eradicate the disease in the shortest time would be to systematically depopulate the entire country's swine population, estimated at approximately 1,000,000 head.

Since ASF is strictly a swine disease, their conclusion can be supported from a technical standpoint. No country has completely depopulated a livestock species for the purpose of disease eradication, but depopulating large numbers of animals in at least two countries—Italy and Cuba—has resulted in ASF eradication.

The early acute wave of ASF, with high morbidity and mortality, had somewhat subsided by the end of September 1978. Disease was no longer being diagnosed in larger commercial farms with good sanitation practices. Many smaller commercial farms had already ceased operating, and it was then mainly the small traditional farmer being affected.

Although some cases with high mortality were still being seen in September and October, increasing numbers of diagnoses were being made of a sub-acute or chronic form of the disease. For example, samples were taken from one or two sick animals of a herd, and by the time positive laboratory results returned a few days later, there had been no clinical evidence of disease spread.

The United States Agency for International Development is now actively considering support of the Dominican ASF eradication program.

Review of recent ASF evolution in Spain and Portugal shows that incidence is increasing. Highly prized uncooked pork products are usually illegal in international commerce in the Americas. More of these products contain virus than formerly was the case. Malta and Italy also became
infected early in 1978, Malta for the first time and Italy after more than 10 years of ASF freedom.

Countries of Latin America and the Caribbean have a variety of methods of swine production, including some as modern as any in the world. The poor of these countries, in both urban and rural areas, also have their traditional production, including in-city backyards, on farm workers' small premises, on garbage dumps, and running loose in fields and in villages. A pig or two is often described as the poor man's bank account. Raw garbage is a significant, and often the only, source of feed for most of these swine.

Because of a lack of refrigeration, and for taste preference, a large part of traditionally butchered animals are preserved by curing, resulting in products which may or may not be eventually cooked. It can be readily seen how under these conditions, ASF spreads not only internationally, but, with some of the swine raising practices in the Americas, how it may spread within infected countries.

No vaccine exists for ASF. Nations without the resources and experience for test and slaughter programs are in difficult straits if the disease is introduced. Many of the countries of the Western Hemisphere are included in this category. Allocation of inadequate resources for disease prevention also leads to a less than favorable outlook for the battle against ASF in the hemisphere.
INTRODUCTION

Specimens were received at the Plum Island Animal Disease Center on May 25, 1978, from a swine herd in Brazil suspected of having African swine fever (ASF). The diagnosis of ASF was confirmed on May 31, 1978. The history of low but protracted mortality received with the specimens and results of laboratory procedures indicated that the strain of ASF virus in Brazil was of low virulence. On July 8, 1978, a diagnosis of ASF was confirmed in a swine herd in the Dominican Republic; again, this isolate appeared to be a low virulent virus. Therefore, experiments were conducted to ascertain the low virulence of these isolates and to compare them to a classical or acute form of ASF.

MATERIALS AND METHODS

Procedures used to confirm ASF virus in the Brazilian specimen: Specimens received from Brazil consisted of seven pieces of spleen and one lymph node.

Sections prepared from frozen tissues were negative by immuno-fluorescence for ASF and hog cholera (HC) viral antigens. Tissue suspensions prepared from the specimens were inoculated into swine buffy coat cultures and two of four pigs in an isolation room. A weak hemadsorption characterized by attachment of only a few erythrocytes to a few infected leukocytes was observed in the buffy coat cultures. The two inoculated pigs developed high fever, and one died four days after inoculation (DPI). Blood collected from both of the inoculated pigs during the febrile period produced typical hemadsorption in buffy coat cultures, and ASF antigens were detected in the tissues from the pig that died. The two contact pigs developed fever five days and one died sixteen days after inoculation of the two principal pigs. Blood from the two contact pigs collected during the febrile period produced hemadsorption, and tissues from the pig that died were immunofluorescent positive for ASF viral antigen. Serums from the two pigs that survived were positive 14 DPI for ASF antibody by immuno-electroosmophoresis.2

The hemadsorbing agent in the buffy coat cultures was further confirmed as ASF virus by inoculating cultured material onto Vero cell cultures and then examining the cultures by the immunofluorescent technique using anti-ASF conjugate.3 The cultures were positive for ASF. In addition, two of four pigs were given protective doses of a
hyperimmune HC serum (provided by the National Animal Disease Center, Ames, Iowa), and then all four were inoculated with hemadsorption-positive buffy coat culture material. All pigs developed fever, and blood collected during the febrile period caused hemadsorption in buffy coat cultures. One of the HC immunized pigs died 16 DPI, and the three pigs that survived developed ASF antibody.

Animals: The animals used for these studies were crossbred pigs that ranged in weight from 50 to 70 pounds. Eight pigs were inoculated with the Lisbon 60 strain of ASF virus; nine pigs were inoculated with ASF virus isolated from Brazil; and ten pigs were inoculated with ASF virus isolated from the Dominican Republic.

Inocula: The Lisbon 60 ASF inoculum consisted of a 20% emulsified spleen in blood collected from an experimentally infected pig at the time of high fever. The inoculum had a 50% endpoint porcine buffy coat culture hemadsorption titer of \(10^8\) per ml.

The Brazilian ASF isolate inoculum consisted of equal parts of 20% emulsified spleen in blood collected from a second passage of the virus in pigs and Brazilian ASF isolate infected porcine buffy coat culture. This inoculum had a viral titer of \(10^6\)HAD\(_{50}\) per ml.

The ASF isolate from the Dominican Republic was confirmed in the same manner as the Brazilian isolate. This inoculum had a viral titer of \(10^6\)HAD\(_{50}\) per ml.

Route of Inoculation: Each pig was inoculated intranasally and orally. The pigs were caught in a hog snare, held with their heads raised, and 3 ml of inoculum was placed on the back of the tongue and 1 ml into each nostril using a 5 ml syringe and 20 gauge needle. The pigs were held in the same position until the inoculum was swallowed or inhaled.

Clinical Observations: The pigs were observed and temperatured daily. Thirty ml of blood was collected every other day from the anterior vena cava. Part of the blood sample was mixed with heparin for a total leukocyte count and culture. The remainder was allowed to clot for serum. The blood and sera were frozen at \(-70^\circ\) until used.

Buffy Coat Culture: Porcine buffy coat cultures were prepared as previously described. The heparanized blood was diluted 1:2 with phosphate buffered saline solution and tenfold dilutions of this initial dilution were made up to \(10^4\). Two-tenths ml of each dilution was inoculated into each of three tubes of buffy coat culture. The tubes were observed daily for four days for hemadsorption.

IEOP: Immunoelectroosmophoresis for detention of ASF antibody was performed as previously described.

Necropsy: Pigs that died or were moribund were necropsied. Gross lesions were photographed.
RESULTS

Lisbon 60 Isolate of ASF: Throughout the course of the disease, the pigs were alert when disturbed, remained in good condition and continued to eat. No exudate was observed from the eyes or nostrils. Toward the end of the disease course, the pigs’ skin had a pinkish appearance, and several pigs had diarrhea.

Two DPI, three of eight pigs had temperatures between 104-105°F. At 3 DPI, the temperatures ranged from 105-108°F. The temperatures 5 and 6 DPI ranged from 106-108°F. On day 7 after inoculation, four of the eight pigs were dead. Day 8 PI two more pigs were dead and one moribund; the remaining pig had a temperature of 107°F and was euthanized.

The leukocyte count dropped from the average total leukocyte count of 28,737 on day 0 to 24,450 on 4 DPI.

At necropsy, lesions typical of acute ASF were observed. The severity of reddening of the skin varied. A few pigs had marked reddening of the skin on the ears, extremities of the limbs, tail, and scattered areas of the body.

The spleens were four or more times normal size, dark and friable. Internal lymph nodes, particularly the hepatogastric and renal lymph nodes, were enlarged and dark reddish-black. Several pigs had perirenal edema, numerous petechial hemorrhages in the renal cortex, and extensive hemorrhage around the renal pelvis. Several pigs had an area of many petechial hemorrhages on the serosal surfaces of the cecum and esophageal area of the stomach. The gall bladder wall in a few pigs was edematous. Scattered petechial hemorrhages were in the mucosa of the urinary bladder.

Brazilian Isolate of ASF: The pigs remained in good condition except for one pig that gradually lost weight. Between DPI 8 and 12, the pigs were not too active. They preferred to lie down when another pig was being worked on. The pigs ate throughout the illness; even those that died had been eating until shortly before death. No exudate was observed from the eyes or nostril.

Six of the nine pigs had temperatures between 104-105.2°F on 2 DPI. Three DPI, all pigs were febrile; the temperatures ranged from 104.6 to 108°F. The four pigs that died between 14 and 24 DPI were febrile (105 to 107°F) throughout the course of illness. The temperatures of the pigs that survived returned to the normal range 18 to 20 DPI.

The leukocyte count dropped from an average count of 31,550 on day 0 to 12,344 6 DPI. The day of the lowest count on the individual pigs varied. After 8 DPI, the leukocyte counts even for the pigs that later died returned to the preinoculation level.

One pig was found dead 11 DPI. The spleen was slightly enlarged and had a normal color and consistency. The kidneys had a moderate number of petechia in the cortex. There were scattered petechial hemorrhages in
the urinary bladder mucosa. The submandibular, bronchial and mesenteric lymph nodes were a little enlarged and congested. The hepatogastric lymph nodes were twice the normal size and reddish-black.

A second pig died between the mornings of day 18 and 20 PI. Because of advanced post mortem degeneration, the animal was not necropsied.

A third pig died 16 DPI. The spleen was a little enlarged, but had a normal color and consistency. The hepatogastric, mesenteric and internal iliac lymph nodes had a peripheral reddening. The stomach contained a large blood clot and ulcer in the esophageal area. The large intestine contained a large amount of soft reddish-brown material (blood). Diagnosis was fatal hemorrhage resulting from a gastric ulcer.

A fourth pig was killed 24 DPI. The pig's temperature had ranged between 105 and 108°F since 4 DPI and within 24 hours of euthanasia had dropped to 102°F. The pig was ataxic. The spleen, kidneys, gall bladder, and urinary bladder were normal. The hepatogastric lymph nodes were enlarged. The renal, internal iliac, and mesenteric lymph nodes had a mild subcapsular reddening. Areas of the parietal and visceral pleura were thickened and had a shaggy appearance (pleuritis). One-half of the right apical lobe of the lungs and the tip of the right cardiac lobe were reddish-purple and consolidated. Scattered lobules in the diaphragmatic lobes were distended with air. In the lungs were scattered firm nodules about 1 cm in diameter that had caseous necrotic centers.

African swine fever virus was present in all the blood samples collected from the pigs inoculated with the Lisbon 60 strain on days 2 and 4 PI. Pigs 2, 3, 7, and 9 inoculated with the Brazilian isolate of ASF and which died had ASF virus in their blood from 2 DPI until death. Pigs 1, 4, 5, 6, and 8 had virus in all blood samples collected between 2 and 24 DPI. Thereafter, virus was detected in only an occasional sample.

Antibody against African swine fever virus detected by IEPO was present in serums from all pigs inoculated with the Brazilian isolate after 8 to 12 DPI, except for the pig that died 11 DPI.

The course of the illness induced by the ASF isolate from the Dominican Republic up to the time of writing this report (14 DPI) was similar to the disease caused by the Brazilian isolate. So far only one of the ten pigs died. The prominent lesions in this pig were petechial hemorrhages in the kidneys and an enlarged red hepatogastric lymph node.

DISCUSSION

The Brazilian isolate of ASF virus caused disease signs and lesions different from the classical-Lisbon 60 ASF virus. Cases of classical acute ASF would be rapidly recognized when the disease is introduced into a virgin area because of the associated rapid and high mortality and obvious typical lesions consisting of an enlarged, dark, friable spleen (acute infectious splenomegally), enlarged and hemorrhagic visceral lymph
nodes, particularly the hepatogastric, and petechial hemorrhages in the kidneys.

Forms of ASF like the Brazilian and Dominican Republic isolates pose a greater threat than acute ASF of not being recognized if introduced into the United States for several reasons:

1. Many deaths do not occur within a short period, thus diminished immediate concern.

2. Since mortality is low, the first pigs that die may not be necropsied. This is unfortunate, for it is these pigs which may have some lesions suggestive of acute ASF.

3. Pigs that die several weeks after infection may have lesions of low virulence ASF virus infection — pleuritis; necrotic areas in the lungs, pericarditis, enlarged lymph nodes — but these may not be recognized as lesions resulting from ASF virus infection.

4. Tissues from pigs with low virulence ASF virus infection may not fluoresce with ASF conjugate.

5. The hemadsorption test may be negative.

6. The pigs that survive remain infected, and they or the meat products produced from them are sources of virus for spread of the infection.

Fortunately because of the eradication of MC in the United States, sick or dead pigs that have hemorrhagic lesions in the kidneys or lymph nodes have a high probability of being reported to state or federal regulatory officials. However, because of the nature of lesions in low virulence ASF — scattered focal, consolidated or necrotic lung lesions, pleuritis, pericarditis and/or enlarged lymph nodes — mortality in pigs with these lesions should also be reported to animal health officials.

Suspected cases of ASF, because of the difficulties mentioned above, require the use of several laboratory techniques — immunofluorescence, hemadsorption, IEOP, and animal inoculation. Use of only one or two of the tests may give a false negative.

REFERENCES


SENSITIVITY OF CONTAGIOUS EQUINE METRITIS
BACTERIA TO ANTIBIOTICS:
EVALUATION BY IN VITRO DISK METHOD

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SUMMARY

The causative bacterial agent of contagious equine metritis (CEM) has been tested for in vitro susceptibility to thirty-seven antibiotics by a disk diffusion method. Results obtained with two different media containing heated equine blood (chocolate agar) were similar. A CEM bacterial culture obtained from Ireland in 1977 had a pattern of antibiotic sensitivity and resistance which was indistinguishable from that of bacterial cultures identified as typical CEM-causing bacteria isolated from experimentally infected pony mares.

By the method used, the CEM bacteria are sensitive in vitro to the following antimicrobial agents: Penicillin G, Ampicillin, Carbenicillin, Cephalothin & Cephaloridine, Tetracycline, Chloramphenicol, Erythromycin, Oleandomycin, Bacitracin, Polymixin B, Colymicin (Colistin), Kanamycin, Gentamycin, Tobramycin, Amikacin, Furadantin, Naldixic Acid and Oxolinic Acid. They are completely resistant to Methcillin (and other semi-synthetic penicillins), Streptomycin, Lincomycin and Clindamycin.

INTRODUCTION

The causative agent of contagious equine metritis (CEM) has been shown to be a gram-negative coccobacillus (Platt and others, 1977; Timoney and others, 1977; and Rickett and others, 1977). Susceptibility to antibiotics has been described (Taylor, C.D.E., 1977; Taylor and others, 1978; Timoney and others, 1977; Hughes and others, 1977; and Platt and others, 1977.) Resistance to Streptomycin has been used advantageously in primary isolation media (Timoney and others, 1977).

The present study was undertaken to determine susceptibility of CEM bacteria to other antibiotics in vitro. Resistance and sensitivity of a culture obtained from Ireland in 1977 and preserved at -70°C, and other isolates obtained from experimentally infected pony mares were compared by the disk diffusion method with the aim of obtaining information for possible treatment of the disease.

Mention of a trademark or proprietary product does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture, and does not imply its approval to the exclusion of other products that may also be suitable.
MATERIALS AND METHODS

**Bacterial Cultures:** Cultures of *Staphylococcus aureus* (ATCC 25923) and *Escherichia coli* (ATCC 25922) obtained from the American Type Culture Collection were used as standard control organisms and were included with each day’s tests. A culture of the CEM bacteria was obtained in September 1977 from Dr. P.J. Timoney, Veterinary Research Laboratories, Abbotstown, Castleknock Co., Dublin, Ireland. Two lyophilized CEM cultures were received from Dr. T. Swerczek, University of Kentucky, Veterinary Science Department, Lexington, KY. Preservation of bacterial cultures was accomplished by coating 5 mm dia. glass beads with an equal volume of a viable subculture in cooked meat medium (Difco, Detroit, MI 48200) and sterile, defibrinated equine blood. The coated glass beads were then placed in sterile tubes and frozen at –70°C. Subcultures for antibiotic testing were obtained by aseptically removing a frozen bead and placing it on the surface of a Eugon Chocolate Agar (ECA) plate, prepared as described below. The bead was rolled on the agar surface and the plate was incubated at 37°C in a 5% CO₂-air incubator. CEM bacteria isolated from experimentally infected pony mares were subcultured once on ECA plates. Tubes of Eugon broth with no added hemoglobin were inoculated with bacterial growth picked from first subculture or the “bead” plates and incubated at 37°C in a 5% CO₂-air incubator. After 4-5 hours, broth cultures of *S. aureus* and *E. coli* were equivalent to turbidity to a 2-5 on the McFarland Turbidity Scale (McFarland 1907) and were diluted with sterile broth to one-half the McFarland Scale turbidity of 1. CEM bacteria were grown at 37°C for 18-24 hours in Eugon broth and were used at a turbidity of about 2 on the McFarland Scale.

**Preparation of growth media and culture plates:** Chocolate agar medium was prepared from Eugon Agar (ECA) and Mueller-Hinton (MHCA) Agar (Baltimore Biological Laboratory, Cockeysville, MD 21030) held at 50°C by adding 5% sterile, defibrinated equine blood followed by heating at 70°C for 20 minutes. Agar-containing medium was cooled to 50°C before pouring into disposable petri dishes (Scientific Products, McGraw Park, IL 60085). One hundred-fifty mm dishes containing approximately 60 ml of medium were used for antibiotic disk testing. Isovitalex, 1% (Baltimore Biological Laboratories, Cockeysville, MD 21030) was incorporated into MHCA medium. It was not possible to obtain reproducible growth of CEM organisms on any commercially available semi-solid medium without addition of 5% blood. Eugon broth (Baltimore Biological Laboratories, Cockeysville, MD 21030) was prepared according to manufacturer’s directions and cooked meat medium (Difco, Detroit, MI 48200) was purchased already prepared.

**Antibiotic Disk Assay:** The Bauer-Kirby method (Bauer and others, 1966: Federal Register 1972 and 1973), with slight modification, was followed. To prepare plates for antibiotic disk susceptibility testing, the surface of each 150 mm plate was covered with 10 ml of broth culture
adjusted to the turbidity described above, the excess was removed by aspiration immediately and residual moisture on the surface of the plate allowed to dry at ambient temperature with the lid of the plate slightly open. Antibiotic disks (Difco, Detroit, MI 48200) were dropped on the plates (12 disks per plate) with a dispenser (Difco, Detroit, MI 48200). Each disk was tapped gently with sterile forceps after deposition on the plate surface. Plates containing antibiotic disks were placed in the 5% CO₂-air incubator within 30 minutes after dispensing the disks. After 18-24 hours incubation, the zone sizes of inhibition of growth were measured with calipers. Growth of CEM bacteria was not as heavy as the *S. aureus* and *E. coli* standard control organisms. Zones of inhibition were most easily seen by viewing the surface of the plate with oblique lighting. Additional incubation for another 24 hours slightly increased the visibility of the growth intensity, but did not decrease the growth inhibition zone sizes.

RESULTS

Growth inhibition or lack of inhibition of the CEM Irish culture which had been preserved at −70°C (Tables I and III) and identified CEM isolates (Tables II and IV) obtained from experimentally inoculated and clinically diseased pony mares are shown in tabular form. Also shown in Tables I-IV are 95% confidence limits and U.S. Food and Drug Administration recommendations for interpretation of growth zone sizes indicative of resistance, intermediate susceptibility or sensitivity. Antibiotic disks were used at the concentration indicated and CEM bacteria were tested on both Eugon Chocolate Agar and Mueller-Hinton Chocolate Agar with 1% Isovitalex. The CEM Irish culture preserved at −70°C was tested for susceptibility at least nine times with all antibiotics listed except Bacitracin, which was tested on only six occasions. Sixteen cultures of CEM bacteria which were isolated from experimentally inoculated and clinically diseased mares were also tested for antibiotic susceptibility. Isolates were identified by colony morphology, gram-stain characteristics and microscopic morphology, catalase and oxidase tests and positive agglutination reactions (Rommel and others, 1978).

Two additional CEM bacteria cultures were tested. These were isolates obtained from Kentucky in March of 1978 and a lyophilized culture, SK188, which was provided by Dr. T. Swerczek, University of Kentucky, Veterinary Science Department, Lexington, KY. The latter has been used as a prototype for preparation of antigen for agglutination and complement fixation tests of sera from infected mares (Dr. Swerczek personal communication). All cultures of CEM obtained from Kentucky produced clinical disease in pony mares at PIADC and the organisms were recovered from uterine swabs or cultures of exudate. Antibiotic susceptibility profiles were typical of the CEM Irish bacteria used at PIADC. The only minor differences in antibiotic susceptibility noted
were that both organisms were clearly Vancomycin and Neomycin sensitive and both were more sensitive to Tetracycline as evidenced by the 7-16 mm larger diameter of growth inhibition zones. Standard deviations of the growth zone inhibition sizes obtained were less than 20% of the mean for antibiotics evaluated in 75% of the test results and 25% of the mean for antibiotics evaluated in approximately 90% of the test results. The lower limits of 95% confidence intervals for results obtained and shown in Tables I and II were higher than the zone size of growth inhibition which is recommended by the F.D.A. as indicative of sensitivity. In only a few of the many tests performed was growth zone inhibition size slightly smaller (high range of intermediate sensitivity) than the size designated as sensitive.

CEM was considered to be resistant or in the intermediate susceptibility range for all antibiotics listed in Tables III and IV. These results are summarized in Table V. Viomycin and Mandelamine results are listed in Tables III and IV because recommendations for interpretation of results obtained with disk diffusion sensitivity testing have not been put forth by the U.S. Food and Drug Administration. CEM bacteria were completely resistant to Streptomycin, Lincomycin, Clindamycin and Methcillin. The latter antibiotic is also used for testing susceptibility to Oxacillin, Cloxacillin, Dicloxacillin and Nafcillin which are all semi-synthetic penicillins. There was significant resistance to Vancomycin, and Rifampin. Neomycin disks produced zones of growth inhibition in the intermediate range given for 30 microgram disks which were not available for use. Results obtained with Novobiocin, (Tables III and IV) Oxolinic Acid and Tobramycin (Tables I and II) were not clearly interpretable because it is not generally advisable to test these antibiotics on blood-containing media. However, zones of growth inhibition obtained with Oxolinic Acid and Tobramycin were significantly larger than the diameter indicative of resistance. We therefore consider CEM bacteria sensitive to these agents. CEM bacteria were sensitive by in vitro criteria to all other antibiotics listed in Tables I and II.

Growth zone sizes of the standard control organisms, S. aureus and E. coli (data not shown) were within the limits suggested by the manufacturer of the antibiotic disks. Table V shows the summarized provisional interpretation of resistance, intermediate susceptibility or sensitivity to the antibiotics tested based on results shown in Tables I-IV.

DISCUSSION

Disks containing antibiotics have been used to measure in vitro inhibition of growth of the causative microbial agent of CEM. Growth inhibition was evaluated on Eugon and Mueller-Hinton Chocolate Agar. The second subculture of a CEM bacteria obtained from Ireland in 1977 was preserved at -70°C and tested along with CEM bacteria isolated from pony mares showing clinical disease after infection with the original preserved organism.
Measurement of CEM bacterial growth around the disks was less easily visualized than that of the standard control ATCC organisms, *S. aureus* and *E. coli*, because CEM growth on semi-solid media was slower and less opaque. Results obtained with Eugon and Mueller-Hinton Chocolate Agar were comparable.

The disk diffusion method of testing antibiotic susceptibility was subject to the usual day-to-day variations, and it was not unanticipated that variations would be greater with the CEM organism than with standard control organisms such as *S. aureus* and *E. coli* (Center for Disease Control, Personal Communication). The latter well-characterized microorganisms show standard deviations of 10% or less of the mean of growth zone size inhibition patterns when variables such as inoculum size, pH of the medium, etc. are carefully controlled. Nevertheless, the mean and standard deviation of results obtained indicated that reproducibility of measurement of *in vitro* susceptibility of CEM bacteria to the antibiotics tested by the disk diffusion method is sufficient to consistently determine resistance and sensitivity *in vitro* on both Eugon and Mueller-Hinton Chocolate Agar. Further, the actual range of growth zone inhibition size and the 95% confidence limits shown in Tables I-IV clearly indicate that CEM can be considered sensitive *in vitro* to all antibiotics listed in Tables I and II because the lower limit of the 95% confidence limits of growth zone inhibition size was greater in all cases than U.S. Food and Drug recommendations for interpretation as sensitive, intermediate or resistant to an antibiotic. In only a few cases actual results were obtained that fell into the high intermediate to sensitive interpretation range. Thus, standard deviations as great as 20-25% of the mean allowed fairly easy distinction of sensitivity to antibiotics listed in Tables I and II.

The Sulfa group of antibiotics, including Gantrisin, were tested; but results were very variable ranging from complete resistance to varying degrees of susceptibility. Therefore, no attempt has been made to categorize Sulfa susceptibility. Novobiocin results indicate it should be placed in the resistant category although it is not recommended that this disk be used on media containing blood. CEM appears to be sensitive to Oxolinic Acid and Tobramycin although these disks are also not indicated for use on blood-containing media. The results obtained with Sulfa derivatives, Novobiocin, Oxolinic Acid and Tobramycin are most likely due to the slow growth of the organism, increased CO₂ tension or the use of blood-containing media. More definitive results must await until there is more rigorous elucidation of growth requirements *in vitro*. Minimal inhibitory concentrations can then be determined in a convenient manner and antibiotics placed in the resistant or intermediate range of antibiotic susceptibility can be more carefully evaluated. While it was quite evident that standard deviations of growth zone inhibition sizes of the CEM bacteria were not as low as those indicated for the *S. aureas* and *E. coli* as the maximum acceptable (Bailey and Scott, 1974) for these well tested and characterized test organisms, the provisional results provide infor-
formation for further testing by dilution technics when growth requirements have been established. Slow growth of CEM bacteria, increased CO₂ tension and the use of blood-containing media as mentioned above, have undoubtedly contributed to the variations observed. However, because of the large number of antibiotics to be evaluated and the number of CEM cultures to be tested, it was not feasible to obtain initial antibiotic susceptibility information in any fashion other than by the disk diffusion method. It is realized that some of antimicrobial agents tested may have limited veterinary application or are largely used for treatment of human disease. However, it was not the intent of the authors to use the in vitro information obtained in order to make therapeutic recommendations. In addition, the sensitivity-resistance profiles may have future epidemiological value.

The in vitro results obtained will hopefully be of value to provide some basis for efficacious and rational use of antibiotics for treatment, prophylaxis and elimination of carrier states or chronic infections. To the knowledge of the authors, there has been no systematic clinical testing or use of antibiotics thus far. In vitro susceptibility can be used as a guide, but the only absolute criterion of microbial response to antibiotics is the clinical response of the animal when adequate dosage of the appropriate antibiotic is administered. Hopefully, the present communication will provide a basis for clinical use of a variety of antibiotics where it is clear to the clinician there is a strong possibility of CEM infection and where a positive culture has been obtained.

REFERENCES
TABLE I

<table>
<thead>
<tr>
<th>Antibiotic Disk and Concentration</th>
<th>ECA Medium&lt;sup&gt;3&lt;/sup&gt;</th>
<th>MHCA Medium&lt;sup&gt;3&lt;/sup&gt;</th>
<th>Growth Zone&lt;sup&gt;4&lt;/sup&gt;</th>
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<tr>
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<td>95% Confidence Limits&lt;sup&gt;5&lt;/sup&gt;</td>
<td>95% Confidence Limits&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Size Indicative of Sensitivity</td>
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<tr>
<td>Penicillin G 5μ</td>
<td>28.4 26.1-30.8</td>
<td>27.3 24.1-30.4</td>
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<tr>
<td>Ampicillin 10μ</td>
<td>31.2 28.2-34.3</td>
<td>30.6 27.4-33.8</td>
<td>14</td>
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<td>Carbenicillin 100μ</td>
<td>43.6 39.7-47.1</td>
<td>38.9 32.4-45.4</td>
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<tr>
<td>Cephalothin 30μ</td>
<td>29.3 27.0-31.7</td>
<td>26.2 21.1-31.3</td>
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<td>Cephaloridine 30μ</td>
<td>28.1 24.2-32.0</td>
<td>23.6 18.7-27.5</td>
<td>18</td>
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<td>Tetracycline&lt;sup&gt;a&lt;/sup&gt; 10μ</td>
<td>25.6 26.8-32.4</td>
<td>29.3 24.1-34.6</td>
<td>(30μg)&lt;sup&gt;7&lt;/sup&gt;</td>
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<td>Chloramphenicol 10μ</td>
<td>33.6 29.6-37.6</td>
<td>29.9 24.5-35.3</td>
<td>(30μg)&lt;sup&gt;6&lt;/sup&gt;</td>
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<td>Erythromycin 5μ</td>
<td>35.1 32.3-37.9</td>
<td>31.9 29.1-34.8</td>
<td>(15μg)&lt;sup&gt;6&lt;/sup&gt;</td>
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<td>Oleandomycin 15μ</td>
<td>35.1 31.4-38.8</td>
<td>29.2 22.9-35.6</td>
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<tr>
<td>Bacitracin 5μ</td>
<td>19.5 17.3-21.8</td>
<td>17.3 15.0-19.7</td>
<td>(10μ)</td>
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<td>Polymyxin B 100μ</td>
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<td>16.1 14.6-17.6</td>
<td>(300μg)</td>
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<td>Colymycin 10μ</td>
<td>20.0 17.7-23.3</td>
<td>17.5 14.8-20.2</td>
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<td>Kanamycin 10μ</td>
<td>24.2 22.1-26.3</td>
<td>22.3 19.1-25.5</td>
<td>(30μg)&lt;sup&gt;6&lt;/sup&gt;</td>
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<td>23.6 20.5-26.0</td>
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<td>Tobramycin 10μ</td>
<td>24.4 22.5-26.3</td>
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<td>26.8 25.4-28.2</td>
<td>25.4 21.8-29.0</td>
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Footnotes

1 Eugon and Mueller-Hinton Chocolate Agar were prepared with 5% sterile, defibrinated equine blood.

2 The CEM Irish culture held at -70° C was tested for antibiotic susceptibility at least nine or more times with all antibiotic agents listed except Bacitracin which was used on only six occasions.

3 ECA: Eugon Chocolate Agar and MHCA: Mueller-Hinton Chocolate Agar.

4 Interpretation of growth zone size indicative of sensitivity is according to recommendations of the U. S. Food and Drug Administration and is given in mm.

5 Results given as diameter in mm.

6 Growth Zone size of inhibition by Doxycycline, Chlortetracycline, Terramycin and Declomycin ranged from less than 1% to 25% larger than inhibition zones of Tetracycline.

7 Figures given in parenthesis are antibiotic disk concentrations for which U. S. Food and Drug Administration recommended zone sizes have been designated for interpretation of resistance, intermediate range susceptibility and sensitive.
TABLE II

CEM Bacteria Susceptibility to Antibiotics In Vitro by Growth Inhibition
Disk Diffusion Assay on Eugon Chocolate Agar and Mueller-Hinton
Chocolate Agar: CEM Irish Bacteria Isolated from Infected Pony Mares

<table>
<thead>
<tr>
<th>Antibiotic Disk and Concentration</th>
<th>ECA Medium</th>
<th>MHCA Medium</th>
<th>Growth Zone</th>
</tr>
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<td>95% Confidence Limits</td>
<td>95% Confidence Limits</td>
<td>Size Indicative of Sensitivity</td>
</tr>
<tr>
<td>Penicillin G 5µg</td>
<td>27.2 ± 2.1</td>
<td>27.1 ± 2.1</td>
<td>24.6 ± 2.1</td>
</tr>
<tr>
<td>Ampicillin 10µg</td>
<td>28.4 ± 2.4</td>
<td>27.4 ± 2.4</td>
<td>23.3 ± 2.3</td>
</tr>
<tr>
<td>Carbenicillin 100µg</td>
<td>38.5 ± 3.8</td>
<td>33.1 ± 3.1</td>
<td>28.0 ± 3.0</td>
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<tr>
<td>Cephalothin 30µg</td>
<td>34.1 ± 3.8</td>
<td>29.6 ± 2.6</td>
<td>26.6 ± 2.6</td>
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<tr>
<td>Cephaloridine 30µg</td>
<td>25.8 ± 2.5</td>
<td>24.2 ± 2.2</td>
<td>21.0 ± 2.1</td>
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<td>31.6 ± 3.1</td>
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<td>30.8 ± 3.0</td>
<td>31.3 ± 3.1</td>
<td>26.9 ± 3.6</td>
</tr>
<tr>
<td>Erythromycin 5µg</td>
<td>35.9 ± 3.9</td>
<td>32.5 ± 3.2</td>
<td>29.5 ± 3.5</td>
</tr>
<tr>
<td>Oleandomycin 15µg</td>
<td>34.7 ± 3.7</td>
<td>31.5 ± 3.1</td>
<td>28.7 ± 3.4</td>
</tr>
<tr>
<td>Bacitracin 5µg</td>
<td>21.1 ± 2.1</td>
<td>19.5 ± 1.9</td>
<td>16.7 ± 2.3</td>
</tr>
<tr>
<td>Polymyxin B 100µg</td>
<td>20.5 ± 2.0</td>
<td>15.9 ± 1.5</td>
<td>15.0 ± 1.6</td>
</tr>
<tr>
<td>Colymicin 10µg</td>
<td>22.1 ± 2.2</td>
<td>17.0 ± 1.7</td>
<td>16.1 ± 1.7</td>
</tr>
<tr>
<td>Kanamycin 10µg</td>
<td>22.9 ± 2.3</td>
<td>22.3 ± 2.2</td>
<td>20.5 ± 2.1</td>
</tr>
<tr>
<td>Gentamycin 10µg</td>
<td>24.3 ± 2.4</td>
<td>22.5 ± 2.1</td>
<td>19.5 ± 2.1</td>
</tr>
<tr>
<td>Tobramycin 10µg</td>
<td>22.5 ± 2.2</td>
<td>21.9 ± 2.1</td>
<td>19.2 ± 2.1</td>
</tr>
<tr>
<td>Amikacin 10µg</td>
<td>23.2 ± 2.1</td>
<td>21.1 ± 2.0</td>
<td>19.0 ± 2.0</td>
</tr>
<tr>
<td>Furadantin 150µg</td>
<td>44.8 ± 4.4</td>
<td>43.6 ± 3.7</td>
<td>39.2 ± 3.4</td>
</tr>
<tr>
<td>Nalidixic Acid 10µg</td>
<td>28.3 ± 2.5</td>
<td>25.9 ± 2.2</td>
<td>22.9 ± 2.1</td>
</tr>
<tr>
<td>Oxolinic Acid 2µg</td>
<td>24.4 ± 2.4</td>
<td>24.1 ± 2.3</td>
<td>21.3 ± 2.2</td>
</tr>
</tbody>
</table>

Footnotes
1 Eugon and Mueller-Hinton Chocolate Agar were prepared with 5% sterile, defibrinated equine blood.
2 Sixteen isolates identified as CEM bacteria from experimentally inoculated and clinically diseased mares were tested.
3 ECA: Eugon Chocolate Agar and MHCA: Mueller-Hinton Chocolate Agar.
4 Interpretation of growth zone size indicative of sensitivity is according to recommendations of the U.S. Food and Drug Administration and is given in mm.
5 Results given as diameter in mm.
6 Growth zone size of inhibition by Doxycycline, Chlortetracycline, Terramycin and Declomycin ranged from 1% less to 12% larger than inhibition zones of Tetracycline with the exception of the growth zone size around the Terramycin disk on Mueller-Hinton Chocolate Agar which was 20% (5.6 mm larger than inhibition designated as sensitive) less than the inhibition zone given by Tetracycline.
7 Figures given in parenthesis are antibiotic disk concentrations for which U.S. Food and Drug Administration recommended zone sizes have been designated for interpretation of resistance, intermediate range susceptibility and sensitive.
### EQUINE METRITIS BACTERIA

**TABLE III**

CEM Bacteria Susceptibility to Antibiotics In Vitro by Growth Inhibition

Disk Diffusion Assay on Eugon Chocolate Agar and Mueller-Hinton Chocolate Agar: CEM Bacteria from Ireland Held at -70°C

<table>
<thead>
<tr>
<th>Antibiotic Disk and Concentration</th>
<th>ECA Medium</th>
<th>MHCA Medium</th>
<th>Growth Zone Size for Interpretation of Susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X&lt;sup&gt;5&lt;/sup&gt;</td>
<td>95% Confidence Limits</td>
<td>X&lt;sup&gt;5&lt;/sup&gt;</td>
</tr>
<tr>
<td>Vancomycin 30µg</td>
<td>12.6</td>
<td>11.1-14.1</td>
<td>11.0</td>
</tr>
<tr>
<td>Rifampin 5µg</td>
<td>24.8</td>
<td>22.2-27.4</td>
<td>22.7</td>
</tr>
<tr>
<td>Novobiocin 10µg</td>
<td>18.4</td>
<td>16.2-20.6</td>
<td>20.2</td>
</tr>
<tr>
<td>Neomycin 10µg</td>
<td>18.9</td>
<td>17.3-20.5</td>
<td>18.4</td>
</tr>
<tr>
<td>Methicillin 5µg</td>
<td>0</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td>Streptomycin 10µg</td>
<td>0</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td>Lincomycin 2µg</td>
<td>0</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td>Clindamycin 2µg</td>
<td>0</td>
<td>---</td>
<td>0</td>
</tr>
<tr>
<td>Viomycin&lt;sup&gt;6&lt;/sup&gt; 10µg</td>
<td>15.1</td>
<td>12.1-18.1</td>
<td>14.4</td>
</tr>
<tr>
<td>Mandelamine&lt;sup&gt;6&lt;/sup&gt; 3µg</td>
<td>29.4</td>
<td>25.5-33.3</td>
<td>28.6</td>
</tr>
</tbody>
</table>

Footnotes

1 Eugon and Mueller-Hinton Chocolate Agar were prepared with 5% sterile defibrinated equine blood.

2 The CEM Irish culture held at -70°C was tested for antibiotic susceptibility at least nine or more times with all antibiotic agents listed.

3 ECA: Eugon Chocolate Agar and MHCA: Mueller-Hinton Chocolate Agar.

4 Interpretation of growth zone size indicative of resistant (Res), intermediate susceptibility (Inter) and sensitive (Sen) is given according to recommendations of the U. S. Food and Drug Administration and is shown as diameter in mm.

5 Results given as diameter in mm.

6 U. S. Food and Drug Administration recommendations for interpretation of In Vitro results are not yet available.
**TABLE IV**

CEM Bacteria Susceptibility to Antibiotics In Vitro by Growth Inhibition Disk Diffusion Assay on Eugon Chocolate\(^1\) Agar and Mueller-Hinton Chocolate\(^1\) Agar: CEM Irish Bacteria Isolated from Infected Pony Mares\(^2\)

<table>
<thead>
<tr>
<th>Antibiotic Disk and Concentration</th>
<th>ECA Medium(^3)</th>
<th>MHCA Medium(^3)</th>
<th>Growth Zone(^4) Size for Interpretation of Susceptibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\times 5)</td>
<td>(\times 5)</td>
<td></td>
</tr>
<tr>
<td>Vancomycin 30(\mu g)</td>
<td>15.3</td>
<td>11.4</td>
<td>Res: 9, 10-11, 12</td>
</tr>
<tr>
<td>Rifampin 5(\mu g)</td>
<td>25.3</td>
<td>21.6</td>
<td>Inter: 24, 25</td>
</tr>
<tr>
<td>Novobiocin 10(\mu g)</td>
<td>20.0</td>
<td>17.9</td>
<td>Sens: 17, 18-21</td>
</tr>
<tr>
<td>Neomycin 10(\mu g)</td>
<td>17.6</td>
<td>17.7</td>
<td></td>
</tr>
<tr>
<td>Streptomycin 10(\mu g)</td>
<td>16.0-19.2</td>
<td>15.9-19.6</td>
<td></td>
</tr>
<tr>
<td>Lincomycin 2(\mu g)</td>
<td>0</td>
<td>0</td>
<td>9, 10-13: 14</td>
</tr>
<tr>
<td>Clindamycin 2(\mu g)</td>
<td>0</td>
<td>0</td>
<td>11, 12-14: 15</td>
</tr>
<tr>
<td>Erythromycin 6(\mu g)</td>
<td>14.0</td>
<td>14.1</td>
<td>16, 17-20: 21</td>
</tr>
<tr>
<td>Mandelamine 3(\mu g)</td>
<td>29.8</td>
<td>30.8</td>
<td>14, 15-16: 17</td>
</tr>
</tbody>
</table>

Footnotes

1 Eugon and Mueller-Hinton Chocolate Agar were prepared with 5% sterile, defibrinated equine blood.

2 Sixteen isolates identified as CEM bacteria from experimentally inoculated and clinically diseased mares were tested.

3 ECA: Eugon Chocolate Agar and MHCA: Mueller-Hinton Chocolate Agar.

4 Interpretation of growth zone size indicative of resistant (Res), intermediate susceptibility (Inter) and sensitive (Sens) is given according to recommendations of the U. S. Food and Drug Administration and is shown as diameter in mm.

5 Results given as diameter in mm.

6 U. S. Food and Drug Administration recommendations are not yet available.
TABLE V

Provisional Interpretation of In Vitro Antibiotic Susceptibility of Contagious Equine Metritis Bacteria

<table>
<thead>
<tr>
<th>SENSITIVE</th>
<th>INTERMEDIATE or RESISTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penicillin G</td>
<td>Bacitracin</td>
</tr>
<tr>
<td>Ampicillin</td>
<td>Polymixin B</td>
</tr>
<tr>
<td>Carbenicillin</td>
<td>Colymycin</td>
</tr>
<tr>
<td>Cephalothin</td>
<td>Kanamycin</td>
</tr>
<tr>
<td>Cephaloridine</td>
<td>Gentamycin</td>
</tr>
<tr>
<td>Tetracyclines</td>
<td>Tobramycin</td>
</tr>
<tr>
<td>Chloramphenicol</td>
<td>Amikacin</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>Furedantin</td>
</tr>
<tr>
<td>Oleandomycin</td>
<td>Naldixic Acid</td>
</tr>
<tr>
<td></td>
<td>Oxolinic Acid</td>
</tr>
</tbody>
</table>

*Status uncertain until U. S. Food and Drug Administration recommendations become available.
ETIOLOGY OF MALIGNANT CATARRHAL FEVER OUTBREAK IN MINNESOTA

F.M. Hamdy, DVM, PhD., A.H. Dardiri, DVM, PhD., C. Mebus, DVM, PhD., R.E. Pierson,* DVM, D. Johnson,** DVM, PhD.

SUMMARY

In Spring 1977, a malignant catarrhal fever (MCF) outbreak occurred in a dairy herd near Minneapolis. Specimens from two sick animals were received at Plum Island Disease Center (PIADC) for a diagnostic investigation. MCF was transmitted to experimental cattle. A herpesvirus was isolated in cell culture from a kidney tissue specimen of the original outbreak material and from a PIADC experimental animal. The two viral isolates were characterized as MCF virus. Characterization was based on results of complement fixation, immunofluorescence, and virus neutralization tests using African MCF virus and antiserum as a reference. The viral isolates from the Minnesota MCF outbreak and the African MCF virus were serologically related. Harvests of cell cultures infected with the Minnesota viral isolates did not induce a clinical disease. However, eight animals immunized with the two viral isolates survived a challenge with lethal doses of the virulent African MCF virus. A similar dose of the virulent African MCF virus was lethal to a susceptible control animal and to one out of two animals immunized with the attenuated African MCF virus.

INTRODUCTION

Malignant catarrhal fever (MCF), an acute, rarely subacute, disease of cattle, buffalo and other ruminants, is characterized by inflammation of the upper respiratory tract and digestive tract, lymphadenopathy, photophobia and corneal opacity.

In Africa, wildebeest become inapparently infected and transmit the disease to cattle and buffalo during calving. The etiological agent of MCF was isolated from a wildebeest-cow and characterized as a herpesvirus.7

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**University of Minnesota Veterinary School, St. Paul, Minn.

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Outside of Africa, no etiological agent has been established for MCF in cattle and the disease is diagnosed on the basis of clinical and pathological findings. Epizootiological circumstances associate the disease in cattle to contact with sheep, especially at the time of lambing.1 3 8 11

Recently, Straver and Van Bekkum15 have isolated a herpesvirus from a European bison caged in a zoo in the Netherlands. Using a fluorescent antibody (FA) technique, and immunoelectronmicroscopy (IEM), this isolate was found to be related to the African wildebeest-derived MCF virus.

This report describes a study of the etiology of an outbreak of MCF that occurred in Minnesota in spring of 1977.

HISTORY

The affected herd had 40 Guernsey cows which had been in contact with lambing ewes for 4 months prior to the onset of the outbreak. Clinical signs observed in the cattle included pyrexia, marked hyperemia of the oral mucosa with eventual sloughing of the tips of the oral papillae, hematuria, bilateral panophthalmitis, necrotic lesions in the vulva, interdigital erosions, and thickening and leathery feeling of the teats. Six animals died within a four week period. After the sheep were separated from the herd, no additional morbidity or mortality occurred.

MATERIALS AND METHODS

Source of Inoculum:

Specimens of spleen, lymph node, kidney, tonsil, liver, lung, and 500 ml heparinized blood were collected from 2 moribund animals that were euthanized on 5/25/77 (Accession 707) and 6/1/77 (Accession 707B). The specimens were chilled on wet ice and sent to Plum Island Animal Disease Center (PIADC) for confirmatory diagnosis.

From each accession, approximately 10% (w/v) tissue suspension in phosphate buffer saline (PBS) were prepared by finely mincing the tissues with scissors. Fifty ml of the heparinized blood was centrifuged at 800 xg for 30 min., and the buffy coat cells (BCC) were separated. Individual tissue suspensions and the BBC were inoculated into calf thyroid cell culture (CTCC), and a pool of the tissue suspensions and the remaining heparinized blood from each accession were inoculated into 2 steers.

Calf Thyroid Cell Cultures (CTCC)

Primary CTCC were grown on Falcon plastic* flasks of 75 cm² growth surface in minimal essential medium (Earle's salts), pH7.3, containing 0.5 lactalbumin hydrolysate, 2% bovine serum and one hundred units of penicillin and 100 µg of streptomycin per ml. Maintenance medium was similar to the growth medium but without bovine serum. Two-tenths ml of BCC and tissue suspensions and of corresponding tenfold dilutions

*Falcon Plastics, Div. of BioQuest, 1959 William Drive, Oxnard, CA 93030
were inoculated onto confluent CTCC monolayer. Maintenance medium was added after 1 hr incubation at 37°C and then the cells reincubated at 37°C. The cultures were examined for development of cytopathic effect (CPE). Uninoculated normal cultures served as controls. The cultures were passaged by being trypsinized and mixed with trypsinized normal CTCC and then seeding the mixed cell population. Five passages were made and were examined microscopically for development of CPE. BCC from inoculated steers were inoculated onto CTCC and examined for CPE as described before. Tissue suspensions from necropsied steers were also prepared and inoculated onto CTCC and observed for CPE.

**Inoculation of steers with animal tissues and blood**

Fifty ml of each tissue suspension and heparinized blood pool were inoculated into each of 2 steers both intramuscularly and into a prescapular lymph node. The inoculated steers were observed daily for development of clinical disease signs or lesions. Twice a week they were bled and tested for viremia by inoculation of BCC onto CTCC or for development of MCF virus neutralizing (VN) antibodies. At the time of fever, leukocytes were counted.

In addition, heparinized blood and nasal secretion were collected from steers at the time of fever. Fifty ml of heparinized blood from steers with clinical disease signs were passed into each of two steers. The inoculated steers were observed clinically and tested for viremia and/or VN antibodies. Nasal secretion collected in cell culture medium was centrifuged and the supernatant used to inoculate CTCC. Figure 1 summarizes the experimental design of the animal and cell culture inoculation.

**Inoculation of Steers with Cell Culture propagated viral isolates**

The viral isolates (Figure 1) obtained from this work were propagated in CTCC and the harvest from the 3rd passage was used to inoculate 2 steers. Twenty ml of the virus harvest were inoculated intramuscularly into each steer. Inoculated steers were observed for four months. During that time each steer was examined for development of viremia or VN antibodies to the African MCF virus as described before.

**Histopathology**

The two animals that developed clinical MCF (Figure 1) were necropsied and the gross lesions were recorded. Specimens were fixed in 10% buffered formalin, dehydrated in graded alcohol, and embedded in paraffin wax. Sections were cut and stained with hematoxylin and Eosin (H&E) and examined with a light microscope.

**Fluorescent Antibody (FA) Staining**

CTCC grown on coverslips in Leighton tubes were inoculated with 0.1 ml CTCC harvest from the 3rd passage of 707K and 441 NS viral isolates. At 2 days post inoculation (DPI) coverslips were removed, washed in PBS and stained with FA conjugates specific for MCF, infectious bovine rhinotracheitis (IBR) and pseudo-rabies (PR) as described elsewhere.²
Complement Fixation (CF) test

Antigens were prepared from the 3rd cell culture passage of 707K and 441 NS and also from normal CTCC lysate and examined for MCF viral specific CF activity using MCF immune bovine serum prepared against the African wildebeest-derived MCF virus.

Electron Microscopy (EM)

Cultures from the 3rd passage of 707K and 441 NS viral isolates were washed with PBS, fixed in glutaraldehyde-osmium, dehydrated in ethyl alcohol-propylene oxide series and embedded in Epon 812. Thin sections were cut with ultramicrotome (Sorvall, Newtown, Conn.) placed on un supported grids, stained with uranyl acetate and lead citrate and examined with a Phillips 201 electron microscope.

Cross Neutralization (CN) between 707K and 441 NS viral isolates and other bovine herpesviruses

Cell-culture harvests from the 4th passage of the 707K and 441 NS viral isolates were centrifuged at 5000 xg for 30 min. The supernatant fluids were used in a virus neutralization test against antiserums to African MCF, IBR, PR and herpesvirus mammilitis (HVM) using serum at a constant dilution (ten-fold) and serial ten-fold dilutions of the viral harvest. A negative serum control and a homologous positive control for each virus-serum system was also included. Titers were calculated as neutralization indeces, i.e., the logs10 of virus neutralized by the serum.

Immunization of steers with 707K and 441 NS viral isolates

Two groups of 4 steers, 2 of which had been inoculated with the first steer blood passage and 2 with cell culture viral harvest from 707K and 441 NS viral isolates were used (Fig. 1). These steers did not develop clinical signs during 120 days observation period and consequently received five injections of the corresponding virus isolate over a period of six weeks. The inoculum was composed of cell culture-virus harvested at approximately 50% CPE and concentrated 20X by positive pressure dialysis using an Amicon apparatus with 10 PM membrane* which allows general retentivity of materials of molecular weight > 10,000. Serum antibody titers to the African MCF virus were measured by virus neutralization test. Two steers received attenuated African MCF virus in the same manner and served as controls.

Cross Protection Between 707K and 441 NS viral isolates, and African MCF virus

Each of the 8 animals that were previously immunized with 707K or 441 NS viral isolates were challenged with 50 ml of virulent African MCF virus infected steer blood. The two steers previously immunized with attenuated African MCF virus and a susceptible control steer were simultaneously challenged with an equal dose of African MCF virus infected blood.

*Amicon, Inc., Lexington, Massachusetts
The animals were kept under clinical observation for 3 months during which time they were tested for viremia and antibody titers.

RESULTS

Clinical Findings

Two of the animals inoculated with blood and tissue suspensions from the Minnesota outbreak material developed clinical signs and lesions similar to those induced by the African isolate of the MCF virus. Figures 2 and 3 are clinical charts of the two reacting animals. These animals developed a leukopenia. The incubation periods were 42 and 65 days and the disease course was approximately seven days. Inflammation of the buccal mucosa and upper respiratory tract was observed in the two animals.

Pathological Findings

Gross lesions common to both animals were: reddening and blunting of some conical buccal papillae, brown crusty muzzle, enlarged prescapular lymph nodes, reddening and edematous areas in the mucosa of the urinary bladder, reddened ridges in the cecco-colic mucosa and prominent Peyer's patches. In addition, animal 427 had a nasal exudate, increased lacrimation, a few whitish foci on the oral epithelium of the lower lip, whitish mucoid exudate on the pharyngeal mucosa and numerous erosions in the esophagus. Animal 441, which developed diarrhea, had a deep brownish-red abomasal mucosa and foci of brownish material adherent to the mucosa of the cecocolic area of large intestine.

Histological lesions in the mouth of animal 427 were areas of epithelial necrosis and erosions and lymphoreticular cell proliferation in the lamina propria. The eyelid had scattered necrotic conjunctival epithelial cells and a lymphoreticular cell infiltrate in the lamina propria. The kidneys had scattered small foci of lymphocytes in the cortex. Portal areas of the liver had a marked lymphoreticular cell proliferation. The adrenal glands had numerous lymphoreticular cell foci in the cortex and medulla. Lymph nodes had enlargement of reticuloendothelial cells in the sinusoid, enlarged fibroblastic nuclei in the trabeculae and infiltration of the trabeculae by lymphoreticular cells. These changes were more severe in the prescapular lymph node and in addition this node had focal areas of necrosis and fibrinoid material in the medulla. The urinary bladder mucosa had a severe lymphoreticular cell proliferate in the lamina propria. Several arteries in the rete mirabile cerebri and an occasional artery in sections of urinary bladder, spleen, lung, small intestine, cecum and lymph node had degenerate or inflammatory cell infiltration of the wall. Lymphoreticular cell cuffing was present in sections of the spinal cord and brain.

Histologic lesions in animal 441 were similar but less severe except for one section of small intestine that had marked lymphoreticular cell proliferation, vesicular degeneration and some fibrinoid material in the submucosa.
Figures 4-7 represent examples of histologic lesions in the oral mucosa, brain and liver.

**Virus Isolation in CTCC**

The 2nd passage of the CTCC inoculated with the kidney suspension from Acc. 707 revealed CPE (Fig. 8). The CPE was essentially cell rounding and less cell fusion than in CPE induced by other herpesviruses. Cultures inoculated with the other tissue suspensions remained normal through five serial passages.

The cultures inoculated with the nasal secretion from steer #441 revealed CPE on the 2nd passage. The CPE was similar to the one produced by 707K viral isolate.

Other cultures inoculated with tissue suspensions or BCC did not develop CPE for five serial passages.

**FA Test**

CTCC inoculated with 707K or 441 NS viral isolates and stained with MCF conjugate fluoresced brightly (Fig. 9). Nuclear as well as cytoplasmic fluorescence was observed in infected cells. Fluorescence was blocked in cultures treated with MCF immune bovine serum before staining with the conjugate. No fluorescence was observed in infected cultures stained with IBR or PR conjugate, or in uninoculated control cultures stained with MCF, IBR or PR conjugate.

**CF Test**

Antigens prepared from the 3rd cell culture passage of 707K and 441 NS viral isolates each gave positive CF titer of 64 against the African MCF viral antiserum. Control CTCC lysate from uninfected culture gave negative results at the initial dilution which was two-fold. Negative CF results were also obtained with all antigens treated with normal bovine serum.

**CN between 707K and 441 NS viral isolates and other bovine herpesviruses**

Complete neutralization of the 707K and 441 NS viruses occurred with the African MCF immune serum. The neutralization indices were $\geq 3.5$ log$_{10}$ similar to that of the homologous system. Likewise African MCF virus was neutralized by serums prepared against 707K and 441 NS viral isolates. No neutralization occurred with IBR, PR or HVM antiserums or normal bovine serum. Results of the cross-neutralization tests are presented in Table 1.

**Ultrastructural Morphology**

Thin sections of CTCC infected with 707K and 441 NS viral isolates at the third passage level had a condensation of the chromatin at the periphery of the nucleus (Fig. 10) and herpesvirus particles in different developmental stages in both the nucleus and the cytoplasm. (Fig. 11) Nucleo-capsids were seen in the nucleoplasm of infected cells (Fig. 10 &
12). Some of the capsids were empty, others had an electron dense core. The capsids measured approximately 100 nm. with cores of 35 nm. Enveloped nucleocapsids were also observed in the nucleoplasm and surrounded by fragments of nuclear membrane. They measured approximately 180 nm. In the nucleus of some infected cells there were nucleocapsid aggregates in the form of crystaline array (Fig. 12). Some of the virions were surrounded by vesicles (Fig. 12). Some virions were also seen extra-cellularly (Fig. 12 insert).

Cross Protection

Steers immunized with 707K or 441 NS viral isolates developed high titers of VN antibodies against the African MCF virus (Table 2). The mean titer was 1247. These steers resisted challenge with the African MCF virulent infected blood that was fatal to a susceptible control (Table 3). Only 2 of the 8 steers showed transit elevation of the body temperature; no other clinical sign was observed. The other animals remained normal for an observation period of 3 months.

The susceptible control steer developed typical clinical signs and lesions after an incubation period of 12 days and died after a 22 day period of illness. Pathological findings were similar to those characteristic of MCF. One of the 2 steers immunized with the attenuated African MCF virus resisted challenge and remained normal for an observation period of 3 months. The second steer developed signs and lesions characteristic of MCF and succumbed 20 days after challenge. The incubation period was 13 days and the course of the disease was 7 days. The pathological examination revealed severe lesions characteristic of MCF.

DISCUSSION

MCF has long been recognized in Africa as a wildebeest- or sheep-associated disease affecting cattle and buffaloes. A form of presumably sheep-associated MCF has long been prevalent in U.S. cattle and throughout the world. Only the wildebeest-associated MCF in Africa has an established etiology. The similarities of clinical and pathological lesions in the 2 forms made researchers to hypothesize similar etiologic agents. The morbidity rates in natural MCF outbreaks and disease transmission experiments are relatively low. However, almost all animals which develop signs of this disease die. Virus isolation from these affected animals are very difficult and therefore the question about the etiologic agent of the sheep-associated form remained. An attempt to isolate the etiologic agent from MCF cases in the U.S. was reported recently by Storz and his co-workers. The authors recovered different viral agents, but no relationship to the African MCF virus or to the clinical disease was established. As a result of our work, the first isolation of a herpesvirus with MCF virus characteristics from the "presumably" sheep-associated MCF form in U.S. cattle was demonstrated. Using CF, FA and CN tests, the Minnesota viral isolates were
MALIGNANT CATARRHAL FEVER

immunologically related to the African wildebeest-derived MCF virus. CN was among the tests used to study the relationship between the viruses of the 2 MCF forms, and it has been suggested by the international committee of taxonomy of viruses as the prime serological relationship for qualification as a member of the herpesvirus genus. In addition the ultrastructural morphology of the virus infected cells were similar in this study to that reported for the African MCF virus.

Disease transmission by blood and tissue suspensions took place successfully from the original material from the outbreak. The loss of virulence of the virus upon 2nd passage in cattle is a difficulty, also reported by other workers in MCF transmission experiments. The loss of virulence may have been due to virus mutation or alteration during propagation of the wild type virus. The wild type is the actual cause of the MCF outbreak. Other explanation is that the inoculum did not have sufficient infectious virulent virus to induce the disease. Successful transmission of the “presumed” sheep-associated MCF have almost always followed transfusion of large volumes, 500-1500 ml, of whole blood. Even then the rate of infectivity and the number of serial passages have been limited. An alternative explanation is that blood and tissues suspension pool was used as inoculum in the first passage and blood alone in the 2nd passage. This change in inoculation materials may explain the difference in infectivity or rather virulence of the 2 inocula. In this regard, it is interesting that the origin of the 2 viral isolates was the kidney and nasal secretion. These 2 specimens are rarely used materials in disease transmission. Lack of use of such specimens in inoculation may account for the low rate of success in MCF transmission.

The protection of 8 steers by immunization with the Minnesota viral isolates against challenge with a fatal dose of the virulent African MCF supports the conclusion of a close immunologic relationship between the etiological agents of the African and Minnesota MCF.

The failure of one of 2 steers to become immunized with the attenuated African MCF virus and the protection of the 8 steers by the Minnesota viral isolates suggest that the latter are better immunogens than the attenuated African MCF virus. The steer that died had VN antibodies in a higher titer than its mate that resisted challenge. This might indicate that VN antibodies are not the sole factor in resistance. Cell mediated immunity probably has a role in infection and resistance to MCF similar to the role reported in other herpesvirus diseases.

This work also demonstrates for the first time that immunity to MCF could be induced by repeated inoculation of cell culture propagated virus. The failure of other investigators to protect cattle against MCF may be attributed to differences in the virus immunogenicity or differences in the antigenic mass administered to the animals.

Although sheep are generally considered as inapparent reservoir of MCF, virus isolation from sheep has not been accomplished and the MCF
virus-sheep association has only been based on circumstantial evidence. This was also the case in the Minnesota MCF outbreak in which the disease occurred at a time of cattle-sheep association and the disease stopped after separation of the sheep from the cattle.

ACKNOWLEDGEMENT

The authors acknowledge the able technical assistance of T. Franke, J. Giovanelli and S. Pyne.

REFERENCES

MALIGNANT CATARRHAL FEVER

LEGENDS OF FIGURES

Figure 1. Diagnostic scheme of Minnesota malignant catarrhal fever outbreak, 1977. MCF = malignant catarrhal fever. Numbers 707 and 707B are accession numbers of the Minnesota MCF outbreak. Numbers in circles represent number of steers inoculated. B&T = inoculum of blood and tissue suspensions. B = blood inoculum. K = kidney tissue inoculum. NS = nasal secretion inoculum. CTCC = calf thyroid cell culture. + = positive reaction; a + reaction in steers designates clinical fatal MCF and in CTCC designates MCF virus propagation and development of characteristic CPE. 707K virus = virus isolated from kidney of accession 707. 441 NS virus = virus isolated from nasal secretion of steer #441. One arrow = one inoculation. Multiple arrows = multiple inoculations.

Figures 2 and 3. Clinical charts of 2 reacting steers inoculated with Minnesota malignant catarrhal fever accession material. DPI = days post inoculation. Temp. = rectal temperatures in °Fahrenheit. WBC = white blood cell count/cu mm.

Figure 4. Oral mucosa from a bovine animal inoculated with blood and tissue suspensions from Minnesota malignant catarrhal fever outbreak. The upper half of the epithelium is necrotic and there are scattered necrotic cells in the stratum spinosum. Bar = 1 μm

Figure 5. Blood vessel in a section through the corpus quadrigemina from a bovine animal inoculated with blood and tissue suspensions from Minnesota malignant catarrhal fever outbreaks. The cells in the vessel wall are enlarged, increased in number and there is an increased amount of eosinophilic material in the wall. Bar = 100 μm

Figure 6. Lymphoreticular cell proliferation in the cerebellar meninges from the same animal as in Figure 5. Bar = 100 μm

Figure 7. Liver from a bovine animal inoculated with blood and tissue suspensions from the Minnesota malignant catarrhal fever outbreak. The portal areas are infiltrated by lymphocytes. Bar = 100 μm

Figure 8. Photomicrograph of second passage of calf thyroid cell culture inoculated with kidney tissue suspensions from accession 707.

Figure 9. Photomicrograph of fluorescent antibody reactions of calf thyroid cell culture inoculated with 707K viral isolate and stained with MCF conjugate.

Figures 10 and 11. Two photoelectron micrographs of a thin section of calf thyroid cell culture inoculated with 707K viral isolates. C = capsid, NC = nucleocapsid, V = virion, Ve = Vesicle. Bar = 1 μm

Figure 12. A photoelectron micrograph of a thin section of calf thyroid cell culture inoculated with 707K viral isolate. Nucleocapsids in crystaline array are noted. Bar = 1 μm
Table 1. Cross Neutralization between Minnesota MCF virus isolates and other bovine herpesviruses

<table>
<thead>
<tr>
<th>Virus</th>
<th>African MCF</th>
<th>IBR</th>
<th>PR</th>
<th>HVM</th>
<th>707K</th>
<th>441 NS</th>
<th>Control normal serum</th>
</tr>
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<tbody>
<tr>
<td>707K</td>
<td>&gt;3.5*</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>&gt;3.5</td>
<td>&gt;3.5</td>
<td>0</td>
</tr>
<tr>
<td>441 NS</td>
<td>&gt;3.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>&gt;3.5</td>
<td>&gt;3.5</td>
<td>0</td>
</tr>
<tr>
<td>African MCF</td>
<td>5.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5.3</td>
<td>5.3</td>
<td>0</td>
</tr>
<tr>
<td>IBR</td>
<td>0</td>
<td>4.5</td>
<td>ND</td>
<td>ND</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>PR</td>
<td>0</td>
<td>ND</td>
<td>4.7</td>
<td>ND</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>HVM</td>
<td>0</td>
<td>ND</td>
<td>ND</td>
<td>5.3</td>
<td>0</td>
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</table>

707K and 441 NS are 2 viral isolates from malignant catarrhal fever outbreak in Minnesota

MCF = malignant catarrhal fever; IBR = Infectious Bovine rhinotracheitis

PR = pseudorabies; HVM = herpesvirus mammilitis

*Numbers = neutralization indices of serums tested at tenfold dilution

ND = not done
<table>
<thead>
<tr>
<th>Steer Number</th>
<th>Immunogen</th>
<th>Viremia during Immunization</th>
<th>VN Titer against African MCF virus*</th>
</tr>
</thead>
<tbody>
<tr>
<td>604</td>
<td>707K</td>
<td>+</td>
<td>1172</td>
</tr>
<tr>
<td>606</td>
<td>707K</td>
<td>+</td>
<td>1141</td>
</tr>
<tr>
<td>686</td>
<td>441NS</td>
<td>-</td>
<td>1414</td>
</tr>
<tr>
<td>689</td>
<td>441NS</td>
<td>+</td>
<td>1141</td>
</tr>
<tr>
<td>751</td>
<td>441NS</td>
<td>-</td>
<td>1320</td>
</tr>
<tr>
<td>754</td>
<td>441NS</td>
<td>-</td>
<td>1231</td>
</tr>
<tr>
<td>755</td>
<td>707K</td>
<td>-</td>
<td>1141</td>
</tr>
<tr>
<td>777</td>
<td>707K</td>
<td>-</td>
<td>1414</td>
</tr>
<tr>
<td>019</td>
<td>African MCF virus</td>
<td>+</td>
<td>1000</td>
</tr>
<tr>
<td>020</td>
<td>African MCF virus</td>
<td>+</td>
<td>708</td>
</tr>
<tr>
<td>818</td>
<td>Control</td>
<td>NA</td>
<td>0</td>
</tr>
</tbody>
</table>

707K & 441NS are 2 viral isolates from malignant catarrhal fever outbreak in Minnesota

MCF = malignant catarrhal fever

*Numbers represent the serum dilution that protected 50% of the cultures tested.

NA = not applicable
Table 3. Response of steers immunized with African and Minnesota MCF viral isolates to challenge with virulent African MCF virus

<table>
<thead>
<tr>
<th>Steer Number</th>
<th>Immunogen</th>
<th>Viremia after Challenge</th>
<th>Incubation period (days)</th>
<th>Disease course (days)</th>
<th>Clinical Response</th>
<th>Termination</th>
</tr>
</thead>
<tbody>
<tr>
<td>604</td>
<td>707K</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>606</td>
<td>707K</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>686</td>
<td>441NS</td>
<td>-</td>
<td>14</td>
<td>4A</td>
<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>689</td>
<td>441NS</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>751</td>
<td>441NS</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>754</td>
<td>441NS</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>755</td>
<td>707K</td>
<td>-</td>
<td>-</td>
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<td>Resistant</td>
</tr>
<tr>
<td>777</td>
<td>707K</td>
<td>+</td>
<td>15</td>
<td>2A</td>
<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>019</td>
<td>African MCF virus</td>
<td>+</td>
<td>12</td>
<td>6</td>
<td>-</td>
<td>Death 18 dpc</td>
</tr>
<tr>
<td>020</td>
<td>African MCF virus</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Resistant</td>
</tr>
<tr>
<td>818</td>
<td>Control</td>
<td>+</td>
<td>12</td>
<td>23</td>
<td>-</td>
<td>Death 35 dpc</td>
</tr>
</tbody>
</table>

A Recovery after temporary body temperature elevation

707K and 441 NS are 2 viral isolates from malignant catarrhal fever outbreak in Minnesota

MCF = malignant catarrhal fever

dpc = days post challenge
Fig 2

Fig 3
FOREIGN ANIMAL DISEASE PROGRAMS IN CENTRAL AMERICA

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At an FDA seminar in June 1973 in Chicago, Dr. Don Van Houweling said: "To communicate with someone effectively requires recognition by the recipient that the information is important." I hope that my information will be presented in a manner which will encourage you to receive it. Whether I do that or not remains to be seen. However, let me assure you that I work in a critical region with a large livestock population (Table I). I am told that our disease surveillance and investigative work has a high price tag. A recent University of Minnesota study projected losses of $10 billion during the first year alone if Foot and Mouth Disease became established in livestock in the United States (U. S.) and spread unchecked. This report in the proceeding of the Eighty First Annual Meeting of USAHA deserves your reading.

Although Foot and Mouth Disease (FMD) has not been reported in the U.S. since 1929, Animal Health Officials have recognized the vulnerability of the U.S. to its introduction from our infected neighbors to the South. The last outbreak in Mexico in 1946 prompted action. Consequently, cooperative agreements have been signed and programs established in Mexico, the Central American Countries, and Panama to assist in their efforts to prevent the introduction of foreign animal diseases, and to prepare for their eradication should they gain entry. As a result of these agreements, USDA, Veterinary Service veterinary advisors have been assigned in Mexico, El Salvador, Nicaragua, Costa Rica and Panama. I am the veterinarian assigned to El Salvador with the additional responsibility of working in Guatemala. In these agreements, both parties contribute to formulating and coordinating programs to investigate all reports of vesicular and other exotic diseases; develop and enforce quarantine laws to prevent the spread of FMD or the introduction of other foreign animal diseases, and make preparation to carry out an extensive FMD eradication program, should an outbreak occur. These efforts have been initiated and fostered by a regional international organization chartered and funded by Mexico, the Central American countries, and Panama. Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) is headquartered in San Salvador, El Salvador; and though the U. S. is not a member, OIRSA has an agreement with USDA which provides a vehicle for communication and cooperation on a regional basis.

Currently plans are underway to complete the Pan American highway through the Darien Gap. The USDA has agreements with Columbia and Panama with assigned veterinary advisors to help prevent the northward spread of FMD during construction and after completion of the highway. This could be called the first line of defense.
In a sense, I work in the second line of defense. The U. S., El Salvador, Guatemala agreements generally follow the pattern of most Central American countries and are termed "Convenio Antiaftoso Bilateral (CAB)." Each country provides a veterinarian which forms a team to conduct the field activities. The U. S. counterpart and the CAB counterpart in each country have the following cooperative activities:

a) Continue surveillance and epidemiologic studies for vesicular and other exotic diseases.

b) Investigate and attend reports of resiicular and other exotic diseases.

c) Collect diagnostic material for laboratory diagnosis.

d) Participate in organizing livestock owners in vigilance groups to report the appearance of any exotic disease.

e) Develop educational programs for training human resources in the methods of prevention, control and eradication of FMD, Rinderpest, and other exotic diseases.

f) Assist in the development and improvement of prevention, control, and eradication procedures for FMD, Rinderpest, and other exotic diseases.

g) Recommend and place into operation effective legislation to improve present systems that will provide for immediate eradication should outbreaks occur.

h) Develop and distribute informational material to inform livestock owners about FMD and other exotic diseases.

i) Assist, by recommendation only, in improving import procedures of the host government.

j) Conduct other activities related to prevention of FMD, Rinderpest, and other exotic diseases, such as advise, review, and evaluate periodically any prevention program put into effect by the host agricultural ministry.

k) Report and notify both governments of the appearance of any exotic disease, as well as the activities of the cooperative program.

The diseases common to the U. S. seen in this area are clostridial infections, internal and external parasites, brucellosis, tuberculosis, leptospirosis, encephalomyelitis, equine infectious anemia, anaplasmosis and nutritional deficiencies. The foreign animal diseases most commonly seen are equine and bovine babesiosis (chronic to per acute), hog cholera and vesicular stomatitis (VS). The results of many of our investigations for vesicular conditions reveal VS, primarily the New Jersey type (Table 2).

A survey of the literature indicates a large volume of research with vesicular stomatitis virus (VSV), however, it has essentially all been done in "molecular biology." The fact that VSV is capable of causing a disease
has almost been lost to some research personnel. Let me assure you that in Central America we are concerned with this disease as more than a laboratory entity. Not only does it give us concern because of its clinical similarity to FMD but it can disrupt a dairyman's or cattleman's operation and reduce production significantly. In tropical areas, many livestockmen utilize dual purpose breeds. Sporadic yearly infection rates of from 5 to 15% in these herds can produce a significant disease problem.

Mason and co-workers have reported on VS in Mexico from 1949 to 1976. My limited investigations generally agree with their findings with few exceptions. They reported feet lesions with an attack rate of 8%. In El Salvador, feet lesions are rarely observed in livestock (Table 2). Lesions in horses are seldom seen, and/or seldom reported where I work. Our observations have raised some of the same questions about VS as Mason and co-workers posed. These relate to transmission epidemiology, and disease distribution and incidence. We would like to see an extensive, concomitant ecological study carried out in the Central American area to find some answers to these basic disease mechanisms. There is already a lot of information on hand. When a vesicular disease investigation is made, not only are tissue and serum samples taken, but a 5 page questionnaire with 55 data blanks is completed. The samples are delivered to Centro Panamericano de Fiebre Aftosa, Rio de Janeiro, Brazil for laboratory diagnosis. The questionnaires (filled data sheets) are maintained in the CAB files for reference or future use. These can be made available to researchers for study.

I want to mention another very important part of the programs in the Central American countries. The information and educational activities form a large part of our work.

The Ministries of Agriculture, OIRSA, and USDA provide some excellent disease brochures and posters. USDA has already produced some timely films on exotic diseases. There will be 10 films when the series is completed. The 4 being used now have been well received by livestock producers, government officials, veterinarians, public health officials, customs police, and animal health inspectors. We can and do go almost anywhere to give a program. The recent African Swine Fever outbreaks in South America and the Dominican Republic have accelerated the desire for information about exotic diseases from all agricultural groups. As I have said, my work could be called a second line of defense against exotic diseases. I hope it stays that way.
REFERENCES

MYCOPLASMA MYCOIDES SUBSP. CAPRI AND MYCOPLASMA AGALACTIAE ISOLATION FROM GOATS IN THE UNITED STATES: A REVIEW INCLUDING UNPUBLISHED FINDINGS

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United States Department of Agriculture, Science and Education Administration, Federal Research, Plum Island Animal Disease Center, Greenport, Long Island, New York 11944

Mycoplasmosis of small ruminants is a serious problem in certain countries and is the cause of important economic losses to the animal industry. The two most important diseases of sheep and goats produced by mycoplasma are contagious caprine pleuropneumonia (CCPP) caused by *Mycoplasma mycoides* subsp. *capri* (*M. capri*) and contagious agalactia caused by *Mycoplasma agalactiae* (*M. agalactiae*).

The mycoplasma isolations from goats in Mexico and the USA identified as *M. cupri* or *M. agalactiae* described in detail in this paper are summarized in table 1.

The first confirmed outbreak of CCPP on the North American continent occurred in Mexico in 1964. During a thirty-day period, more than fifty percent of the 1200 infected goats died. Two other outbreaks were described in Mexico in 1967 involving 3,000 goats. In each incidence, *M. capri* was identified as the causative agent.

In 1955, a highly fatal disease occurred in young goat does and kids in California. A severe polyarthritis and septicemia was observed at necropsy. A mycoplasma was isolated which produced severe cellulitis and high mortality in experimentally inoculated goats and pigs. This California goat mycoplasma however, was not related to *M. cupri* or *Mycoplasma mycoides* subsp. *mycoides* (*M mycoides*).

In 1966, *M. capri* was isolated from a goat for the first time in the USA. This isolation was from the eye of a goat recovering from experimental brain surgery at Yale University, School of Medicine in Connecticut. The goat had developed a temperature of 105.8°F and a mild conjunctivitis. This Connecticut mycoplasma was identified as *M. capri* by biochemical, serological and animal infectivity studies at the Plum Island Animal Disease Center (PIADC) and the Mycoplasma Reference Laboratory in London, England.

A goat died in 1967 at Texas A&M University with gross pathology of pneumonia. The case was originally diagnosed as CCPP because of

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clinical signs and close proximity to Mexico where the CCPP exists. A mycoplasma was cultured and sent to PIADC where it was assayed as non-pathogenic for inoculated goats, sheep or calves and not related to *M. mycoides* or *M. capri*.

Two mycoplasma cultures isolated from goats in Maryland, one in Pennsylvania and one in New York were received at PIADC for identification in 1970. One to ten goats were affected on each premises exhibiting signs of pneumonia, keratitis, arthritis or an intermandibular swelling. All cultures were highly virulent for goats and identified as *M. capri*.

A mycoplasma was incriminated as the causative agent in an epizootic of keratoconjunctivitis in a herd of 300 milking goats in Northern California in 1970. Mastitis or pneumonia was not observed and apparently the isolate was not identified. During two other separate outbreaks of caprine keratoconjunctivitis the disease was characterized by severe ocular involvement. *Mycoplasma conjunctivae* was identified and keratoconjunctivitis was reproduced in experimentally infected goats from a pure culture.

On an Arizona farm in 1971, 11 out of 11 kid goats died within four days. Clinical signs of swollen joints, recumbancy, diarrhea and inappetence had been observed. One of the 70 adult goats on the premises showed evidence of clinical illness. Necropsy of two kids showed lung consolidation and fibrinous pericarditis from which a mycoplasma was cultured. The mycoplasma was identified as *M. capri* at PIADC.

In 1977 several mycoplasma cultures and serums from goats were received at PIADC from the University of Arizona for identification. These goats obtained locally and assembled for research at a university field station located at Mesa, Arizona developed clinical signs of pneumonia and arthritis. Mycoplasma was isolated and all were positive for *M. capri* by biochemical and serological assays. Two of the isolates were inoculated intrathoracically into goats and by intubation into steers. The goats died showing typical CCPP lesions, while the steers remained clinically normal. Two of the goat serums showed antibodies to *M. capri*.

Even more recently, in 1978 six mycoplasma cultures were received at PIADC from Dr. D. E. Jasper of the University of California in Davis. These isolates were collected from goats exhibiting signs of arthritis, mastitis, chronic purulent mastitis or peritonitis. They were non-reactive with common domestic strains of mycoplasma antisera available at the university. All six cultures have been identified as *M. capri*.

Two additional mycoplasma cultures were received within the past few months at PIADC from Dr. Jasper. One culture was isolated from mastitis in a sheep and the other from a joint lesion in a goat. The sheep mycoplasma was typed as identical to the Texas goat mycoplasma of 1967, entirely non-related to *M. capri*. The goat isolate was non-
pathogenic for inoculated nonlactating goats. Serological and biochemical tests identified this isolate as indistinguishable from *M. agalactiae*. This is the first identification of the causative agent of contagious agalactia of sheep and goats in the USA or in the Western Hemisphere.

Isolation and identification of *M. capri* and *M. mycoides* has been made from goats in Australia for the first time. The properties of these mycoplasma strains were consistent with those of the USA, being associated with signs of fibrinous peritonitis, pneumonia, arthritis and mastitis.

Much controversy is present in the literature regarding cross-reaction between *M. mycoides* and *M. capri*. The Mexico and USA mycoplasma isolates identified prior to 1977 as *M. capri* have been classified into group 8 by Al-Aubaidi. This group also contains many strains from throughout the world previously identified as *M. capri* and are all serologically indistinguishable from *M. mycoides*.

Immuno-electrophoretic methods show antigenic relationships between the exotic Vom strain of *M. capri* and the virulent Gladysdale strain of *M. mycoides*. This same study showed four USA mycoplasma isolates identified as *M. capri* were also related to the Vom strain as well as to *M. mycoides*.

Early work has shown that goats may harbor strains of *M. mycoides* pathogenic for cattle. The Connecticut isolate of 1966 was also found to be pathogenic for calves. The recent identification of *M. agalactiae* for the first time in the USA certainly adds to the possible seriousness of the overall picture of mycoplasmosis in certain small ruminants and possible danger to all ruminants. Even though the morbidity and mortality has been negligible and sporadic up to now, at least six states of the USA have shown an incidence of *M. capri*.

Oesophageal pharyngeal (OP) samples using a cup probang have been an effective means to recover mycoplasma. Recent experimental studies have shown isolation of *M. capri* from OP samples for up to four months in clinically healthy goats exposed to *M. capri*. These OP isolates have been virulent in one hundred percent of inoculated goats.

A survey of goats and sheep in the USA to determine the extent of *M. capri* infection could include probang samples for mycoplasma isolation and serum samples for detection of antibody. There is serologic cross-reactivity between *M. capri* and *M. mycoides*, however, reliable field evidence is not available to show cross-infectivity between goats and cattle suffering from pleuropneumonia.

Should the fact that *M. capri* does not produce pleuropneumonia lesions in cattle comparable to those produced by *M. mycoides* and also because *M. mycoides* does not produce similar lung lesions in goats as seen in *M. capri* remain a criteria for nomenclature of the USA isolates? Could *M. mycoides* originating in cattle now be adapted to only be infective for goats? Is a trigger mechanism such as certain stress syn-
dromes necessary to change the relatively mild condition now present in the USA into an explosive epizootic? More work in these areas is necessary to answer these and other questions concerning the extent of *M. capri* in the small ruminants of the USA.

REFERENCES


Table 1. *Mycoplasma mycoides* subsp. capri (*M. capri*) and *Mycoplasma agalactiae* (*M. agalactiae*) identified from goats from Mexico and the U.S.A.

<table>
<thead>
<tr>
<th>Source</th>
<th>Year</th>
<th>No. Infected goats</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>1964</td>
<td>1200</td>
<td><em>M. capri</em></td>
</tr>
<tr>
<td>Mexico</td>
<td>1967</td>
<td>3000</td>
<td><em>M. capri</em></td>
</tr>
<tr>
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<td>1966</td>
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<td><em>M. capri</em></td>
</tr>
<tr>
<td>Maryland</td>
<td>1970</td>
<td>2</td>
<td><em>M. capri</em></td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1970</td>
<td>1</td>
<td><em>M. capri</em></td>
</tr>
<tr>
<td>New York</td>
<td>1970</td>
<td>10</td>
<td><em>M. capri</em></td>
</tr>
<tr>
<td>Arizona</td>
<td>1971</td>
<td>11</td>
<td><em>M. capri</em></td>
</tr>
<tr>
<td>Arizona</td>
<td>1978</td>
<td>10</td>
<td><em>M. capri</em></td>
</tr>
<tr>
<td>California</td>
<td>1978</td>
<td>6</td>
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</tr>
<tr>
<td>California</td>
<td>1978</td>
<td>1</td>
<td><em>M. agalactiae</em></td>
</tr>
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PURIFICATION OF FOOT-AND-MOUTH DISEASE VIRUS INFECTION-ASSOCIATED ANTIGEN

D. O. Morgan, D. M. Moore and P. D. McKercher

ABSTRACT

Foot-and-mouth disease virus infection-associated antigen (FMD-VIAA) produced from baby hamster kidney cell culture after infection with FMD virus (FMDV) O, Brugge was extracted by means of an ion exchange resin and concentrated by ultrafiltration. Affinity chromatography columns (AFC) were prepared with immunoglobulin G (IgG) from the serum of swine taken 8 weeks after infection with FMDV O, Brugge. Purified FMD-VIAA eluted from the AFC was immunologically active as shown by both complement-fixation and immunoprecipitation procedures. Injection of purified FMD-VIAA (1.5 mg) in Freund's adjuvant into rabbits failed to elicit demonstrable quantities of antibody. However, injection of FMD-VIAA-swine IgG immune complexes into both rabbits and guinea pigs elicited antibodies specific for FMD-VIAA. Polyacrylamide gel electrophoretic analysis of the AFC-purified FMD-VIAA (160 µg protein/ml) showed only one protein component. These procedures provide FMD-VIAA of suitable purity for use in immunological tests that should be more sensitive than precipitation in agar gel.

INTRODUCTION

Foot-and-mouth disease (FMD) is a syndrome produced by infection of cloven-hoofed animals with FMD virus (FMDV). This simple statement, when considered in view of the seven immunologically distinct types of FMDV and the multitude of subtypes, becomes a very complex situation for workers who must identify a particular FMDV isolate or determine whether an animal has experienced FMD. Cowan and Graves' described an antigen associated with FMD virus infection-associated antigen (VIAA) which appears to be serologically identical regardless of the type or subtype of FMDV which induces the infection. Tissue cultures infected with FMDV produce demonstrable amounts of VIAA, and animals infected with FMDV show an antibody response to VIAA produced in vivo. Evidence has been presented that VIAA is present in the FMDV particle; however, other work has demonstrated that the detection of...
antibodies to VIAA in animals vaccinated with inactivated FMDV vaccine is an infrequent event; thus, the association of VIAA production with virus replication supports *in vitro* evidence that this antigen is FMDV-RNA polymerase.

The agar gel diffusion test (AGDT) for antibodies to FMD-VIAA has been widely used in both laboratory and field situations. There appears to be no argument with a positive finding of antibodies to FMD-VIAA; however, negative findings are less valid and point up the need for a procedure with increased sensitivity. Purification of FMD-VIAA would allow standardization of the AGDT procedure and the development of more sensitive tests such as radioimmunoassay and colorimetric immunological assays. This report describes a procedure for producing FMD-VIAA to a degree of purity suitable for these purposes.

**PROCEDURES AND RESULTS**

**FMD-VIAA**

Baby hamster kidney (BHK-21, clone 13 cells) were infected with FMDV, type O, Brugge isolated from bovine tongue tissue and subsequently passaged 7 times in primary bovine kidney cells. The infected cells were harvested after approximately 18 hours of incubation (37°C) at which time the cell sheets had been destroyed. The harvested material was frozen (–20°C), thawed and clarified by low-speed centrifugation. One gram of Sephadex A50 was added per liter of clarified harvest material and stirred slowly at 4°C overnight. The Sephadex A50 was allowed to settle out and was placed into a chromatography column after the supernatant had been decanted. The column was washed with 4 gel-bed volumes of 0.02 M Tris, 0.15 M NaCl, pH 7.6, after which the VIAA was eluted with 0.1 M Tris, 0.75 M NaCl, pH 7.6. This eluate was then serially passed through an Amicon XM300 filter (retains globulin proteins of 300 Kilodaltons (Kd) and larger), an Amicon XM100 filter (retains globular proteins of 100 Kd and larger) and an Amicon PM30 filter (retains globular proteins of 30 Kd and larger). Immunodiffusion analysis of these products showed FMD-VIAA in the retentate of the XM300, XM100 and PM30 filters but not in the PM30 filtrate. Thus, the FMD-VIAA activity showed considerable size heterogeneity (i.e., >300 Kd to <100 Kd) but with no apparent qualitative differences on immunodiffusion analysis.

**Antisera**

Immunodiffusion analyses were performed with guinea pig hyperimmune sera produced by infection as a reference serum. Anti-FMD-VIAA

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*a* Pharmacia Fine Chemicals, 800 Centennial Ave., Piscataway, NJ 08850.

antibodies could not be shown in the serum of rabbits (35 days postinoculation) which had been given injections of 1.5 mg of affinity chromatography purified VIAA. However, antibodies to FMD-VIAA were demonstrated in the sera of both rabbits and guinea pigs given injections of FMD-VIAA immune complexes. These antisera, while containing anti-VIAA, were not as potent as the guinea pig hyperimmune sera. In order to produce the immune complex material, microscope slides (25 X 75 mm) were coated with 3 ml of 0.8% agarose. Three parallel troughs (0.1 ml volume) 57 mm long and 5 mm apart were cut into the agar. The outside troughs were filled with anti-VIAA sera taken from swine 6 weeks after infection with FMDV, type O, Brugge. The center trough was filled with an FMD-VIAA preparation (PM30 retentate) diluted in such a manner that the arcs of precipitation fell equidistant from the center trough and each of the outside troughs. After 48 hours of development, the precipitin arcs were excised and washed in physiological saline (1 part gel, 500 parts saline) with constant stirring at 4°C for 72 hours and daily changes of saline. The washed gel was ground in a small blender and emulsified in oil adjuvant. The guinea pigs were given injections equivalent to 25 precipitin arcs (estimated to be 300 μg VIAA) at 0 and 25 days and bled 10 days later.

Affinity Chromatography

In view of the considerable amount of immunoglobulins which would be needed, only bovine and swine sera were considered. Immuneelectrophoretic analyses indicated the anti-VIAA activity to be in the IgG₂ of swine sera and in both the IgG₁ and IgG₂ of bovine sera; thus, one was able to produce a more potent reagent (activity/mg protein) with the swine sera. The serum that gave the strongest reaction with VIAA in the AGDT was selected from a group of 6 swine convalescent (6 weeks) of FMDV O, Brugge infection. The immunoglobulins were precipitated with 50% saturated (NH₄)₂SO₄ (SAS). The precipitated were washed twice with 50% SAS, reconstituted in H₂O, dialyzed versus 0.02 M Tris, pH 7.6 and applied to a column of DEAE-cellulose equilibrated with the same buffer. Most of the anti-VIAA activity did not adhere to the column (IgG₂), and only trace amounts of activity could be eluted from the column. The IgG₂ containing column effluent was concentrated by pressure dialysis to a concentration of 40 mg/ml. One gram of cyanogen bromide activated sepharose and 400 mg of the swine IgG₂ were incubated at 4°C for 18 hours with constant agitation; approximately 100 mg of swine IgG₂ was coupled. The complexed immunoglobulin-sepharose was placed into a column, washed with 0.02 M Tris, 0.15 M NaCl, pH 7.6 until the % transmission 254 nm read 100; flushed with 3 gel-bed values of 1 M

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⁵Sigma Chemicals, St. Louis, Mo. 63178.
⁴Pharmacia Fine Chemicals, 800 Centennial Ave., Piscataway, NJ 08850.
NaSCN; flushed with 0.02 M Tris, 0.15 M NaCl, pH 7.6. The samples, either XM300 retentate or PM30 retentate from VIAA production, were applied, after which the column was washed with 0.02 M Tris, 0.15 M NaCl, pH 7.6 until the % transmission at 254 nm became 100%. The adsorbed FMD-VIAA was then eluted with 4 gel-bed volumes of 1 M NaSCN and concentrated to approximately one-half the sample volume by pressure dialysis versus 0.02 M Tris, 0.3 M NaCl, pH 7.6.

Samples of VIAA taken through the purification process were examined for polypeptide composition by polyacrylamide gel electrophoresis (PAGE) in 12.5% acrylamide slab gels containing 0.1% sodium dodecyl sulfate and 8 M urea. Figure 1 shows the many proteins contained in the DEAE-Sephadex extract, the Amicon XM300 retentate and the Amicon PM30 retentate. When passed over the swine anti-VIAA IgG affinity chromatography column, the Amicon XM300 retentate lost a protein component. The eluate of the column contained the absorbed protein component as well as additional protein bands. The Amicon PM30 retentate also lost the same protein component on the affinity chromatography columns, but elution produced only a single protein component representing the absorbed protein. The degree of purity obtained by affinity chromatography of the PM30 retentate versus the XM300 retentate may represent VIAA obtained free of possible contaminating large molecular weight protein(s).

DISCUSSION

Procedures for the production of crude FMD-VIAA suitable for AGDT have been quite adequately put forward. The relative amount of such FMD-VIAA activity in a particular preparation can be determined with the complement-fixation test with guinea pig hyperimmune sera induced by infection with a type of FMDV different from that used to produce the VIAA. However, the quantitative measurement of FMD-VIAA in crude preparations is confounded by the heterogeneity of the size of the VIAA components. The unknown nature, particularly that of the large VIAA components (i.e., those retained by the Amicon XM300 filter), presently prevents a proper quantitation of the VIAA in crude preparations. The "small VIAA" appears to have more antigenic activity per milligram of protein that the "large VIAA" promoting the presumption that the latter is not a polymer or aggregate, but rather VIAA, which is complexed with another component. One must then be concerned with the antigenicity of this "other component" with using convalescent antisera as well as the possibility of inducing an apparently positive VIAA reaction in sera from animals vaccinated with crude harvest virus vaccine. Ability to quantitate the specific antigen will allow one to select the most suitable FMDV isolate for VIAA production as well as to optimize the production procedures.

The most potent anti-VIAA sera obtainable in large quantities is usually that of an FMD convalescent bovine. Under the same conditions, a highly potent swine antiserum is encountered less frequently; however,
in swine, the anti-VIAA immunoglobulins are confined to the IgG\textsubscript{2} fraction whereas in the bovine, the anti-VIAA activity is apparently located in more than one IgG subclass. Thus, swine sera were used in this investigation because they could be made into a more potent (activity/mg protein) reagent for affinity chromatography. The use of large animals as a serum source eliminates the production restrictions imposed by the blood volume of smaller animals.

When one is able to reproducibly ascertain the optimum number of micrograms of FMD-VIAA and control antisera dilutions, the AGDT can be standardized eliminating the bothersome interlaboratory differences. In addition, procedures with greater sensitivity (e.g., radioimmunoassay) can be used to eliminate present concern over "weak reactors" and reduce the number of anti-VIAA-negative animals to definable limits.

A negative anti-VIAA AGDT finding means that a particular animal was probably not exposed to FMD at 2 or 3 weeks prior to sampling. In epidemiologic surveys, a reduction and more accurate definition of this point in time would be most desirable, particularly in an outbreak situation. Further, a more accurate determination of the time of appearance of antibodies to VIAA would be a valuable adjunct to clinical observations during the challenge phase of vaccine evaluation. These postulates lead directly to the concept of quantitation of antibodies to VIAA (i.e., anti-VIAA titer) in which comparisons of sequential sample titers would be of value in interpreting both colostrally acquired antibodies to VIAA and, perhaps, the time interval from infection or exposure. These suggested increases in sensitivity would also likely make the anti-VIAA test of much greater value in the field of FMDV carriers, many of which are negative with the AGDT.

The quality and quantity of materials obtainable with the affinity chromatography procedure are suitable for adapting highly sensitive radio labelling as well as colorimetric immunological procedures for the quantitation of FMD-VIAA, and these adaptations are currently in progress with the "small VIAA."

ACKNOWLEDGMENT

The excellent technical assistance of Jay Card is gratefully acknowledged.

REFERENCES


FIGURE LEGEND

Fig. 1. Slab polyacrylamide gel electrophoresis of polypeptides in various virus infection-associated antigen preparations: (A) DEAE-Sephadex extract; (B) Amicon XM300 retentate; (C) Amicon XM300 retentate not adsorbed to the affinity chromatography column; (D) Amicon XM300 affinity chromatography column eluate; (E) Amicon PM30 retentate; (F) Amicon PM30 retentate not adsorbed to the affinity chromatography column; (G) Amicon PM30 affinity chromatography eluate; (H) reference foot-and-mouth disease virus type A₁, capsid polypeptides.
REPORT OF THE COMMITTEE ON FOREIGN ANIMAL DISEASES

Chairman: Thomas G. Murnane
Co-Chairman: C. John Mare


The Committee on Foreign Animal Diseases met on October 31 and November 1, 1978 during the annual meeting of the USAHA held at the Statler Hilton Hotel, Buffalo, New York. Fourteen of the committee members and approximately twenty guests attended the meetings.

During 1978 we witnessed the occurrence of yet another exotic equine disease, contagious equine metritis, in the US. This is the fourth exotic equine disease introduced into the US in the past twenty years and is illustrative of the serious threat of foreign animal diseases to this species. The outbreaks of African Swine Fever in Brazil and the Dominican Republic pose a serious threat to the swine industry throughout the Western Hemisphere. The Committee noted with great satisfaction the prompt and meaningful assistance extended to these countries by the US in the diagnosis of the disease, professional and technical support, training given Brazilian and Dominican veterinarians and technicians and, as well, the measures taken to enhance the capabilities of veterinary diagnosticians in the US and other countries.

INTERNATIONAL OPERATIONS

As reported to the Committee last year, cooperative agreements between the United States and all of the Latin American countries extending from Mexico to, and including, Colombia have been signed for the prevention, control, and eradication of foot-and-mouth disease (FMD) or any other disease that may pose a threat to the U.S. livestock or poultry industries.

Vesicular Disease Diagnostic Laboratory in Panama

Plans have been developed and ground is about to be broken for the construction of a regional vesicular diagnostic laboratory in Panama. This laboratory, under the direct supervision of the Panama-U.S. Commission for the Prevention of Foot-and-Mouth Disease, will accept and process suspicious vesicular samples from Central America and Panama. This will not only aid in the logistics of sample submission, but
will decrease considerably the time from the taking of a sample to the reporting of the results.

Pan American Highway

The U.S. Government continues to withhold funds for the construction of the remaining segment of the Pan American Highway on the Isthmus of Panama until Colombia can provide assurance that an adequate FMD-free zone and associated surveillance exists in that country.

The U.S. financial assistance agreement to Colombia to accelerate the activities for control and eradication of FMD in the area adjacent to Panama will expire on December 31, 1970. A report was made to this Committee last year that the program would reorganize to provide for a Joint Colombia-U.S. Commission which would eliminate existing administrative and operational problems and insure that full authority would be provided to the Program Directors to adequately administer, control, and supervise the program. Whereas some of the administrative and operational problems have been eliminated, the proposal has never been formally accepted by the Colombian Government. In addition, certain aspects of the program have deteriorated, the most evident of which is the uncontrolled influx of people and animals into the northwest area of Colombia adjacent to the border of Panama. These activities seriously jeopardize the effectiveness of the program. The Senior Review Group, as established by the agreement, met October 23-24, 1978, to discuss the progress of the program, its effectiveness, and to what extent both parties should participate monetarily for its continuation. The Colombians were advised what USDA could contribute toward continuation of the program. If the Colombian Government cannot provide the additional costs to at least maintain the program at its present level, the U.S. will have to decide whether to continue participation. Mid-December was selected for a final decision on this matter.

The Committee is concerned for the continuing delay in achieving an acceptable program and for the pressures which may increase to relax or compromise requirements for an effective FMD control program. The Committee firmly supports the US position to withhold construction funds until an effective program becomes fully operational in Colombia.

US/Mexico Screwworm Program

The committee has maintained an interest in the progress of this international program because of the potential for eradicating screwworm in the US and the possible application of experience and techniques to the control and eradication of other exotic parasites and insect-borne diseases.

The screwworm program suffered a severe setback during this year. Arizona, New Mexico, California and Texas have reported a significantly greater number of cases so far this calendar year compared to the same time-span last year. Adverse weather, difficulties experienced by the Mexico-American Commission involving maintenance problems of air-
craft for pupae transportation and fly dispersal, and the movement of infested animals, have contributed to the increase and spread of the parasite. Cases occurred in central Texas, hundreds of miles from known infestations, but near slaughtering plants receiving sheep from the more western states.

A new approach to control screwworms is under testing by Federal research. It is called the Screwworm Adult Suppression System (SWASS) consisting of an attractant, a bait, and a pesticide that will attract and kill wild screwworms that feed on the bait. This will reduce heavy populations and enhance the effects of the sterile fly technique, which is more effective against low populations of wild flies.

INTERNATIONAL ANIMAL DISEASE RESEARCH PROGRAMS

The Committee on Foreign Animal Diseases is very concerned at the reduction of U. S. Agency for International Development research and applied technology funds resulting in curtailment in USAID supported international animal disease research programs. The hemoprotozoal diseases research which achieved modest success is being phased out, and while USAID will continue contributing to field operational programs in Zanzibar and Somalia, they are expected to phase down a tsetse fly project in Mali.

Although some programs appear safe in FY '79, e.g. support work at the Mali Central Veterinary Laboratory on diagnostics and biological production, and the Collaborative Research Support Program on Small Ruminants, very few new starts are expected. This apparent USAID deemphasis of international animal disease research programs is counterproductive to the objective of upgrading health, nutrition and social well-being of underdeveloped countries, and signals increasing trouble for the control and eradication of international disease threats.

An ad hoc group within the Committee on Foreign Animal Diseases has been appointed for the purpose of documenting the decline in US support to international animal disease research and to seek means for reversing this trend.

WORLD ANIMAL DISEASE SITUATION

The foreign animal disease situation poses serious threats to livestock health and economy in the Western hemisphere. The appearance of the less virulent chronic form of African Swine Fever in Brazil and the Dominican Republic will increase the difficulties in diagnosing and eradicating the disease in this hemisphere. The Rift Valley fever epizootic in Egypt is likely to spread to the Middle East creating serious public and animal health problems and expanding the base of infection and potential for greater dissemination.

The following report of world-wide occurrence of animal diseases is based primarily upon published information from the Office Internationale des Epizootic (OIE).
Foot-and-Mouth Disease (FMD)

In April 1978, an outbreak of virus type C was reported in the USSR in a collective farm bordering Poland. Type C has not previously been reported in the USSR. Type C outbreaks of unknown origin were also reported in Switzerland on March 28, 1978, previously free since March 1973; in April 1978 in France, previously free since January 1975; and in the Federal Republic of Germany, Denmark is now considered FMD-free. In March 1978, the island of Bali was officially declared free of FMD (last reported case type O in February 1974). FMD persists on a widespread basis in South America; however, more effort is being put into vaccine programs with some areas showing significantly decreased incidence of FMD as a result of the successful vaccine programs.

In the last half of 1977, and to the present time, the following types of FMD have appeared in the following continents:

- **North America** - Plum Island Type 0,
- **South America** - O, A, C
- **Europe** - C, A
- **Asia** - A, A22, 0, 01, C, Asia 1
- **Africa** - SAT1, SAT, O1, SAT1, A

The United States found that FMD type O1 had spread from its isolation facility at Plum Island Animal Disease Center to the clean animal holding facility on the Island. All animals were slaughtered and complete disinfection was carried out. There was no spread to the continental United States.

**African Swine Fever (ASF)**

This disease remains endemic in Africa. In Portugal in 1977 there was an increase of outbreaks of ASF from an average of around 70 cases a month during the first 6 months to an average of 600 outbreaks/month in the last 6 months. Spain had an average of 84 outbreaks per month in the first 6 months of 1977, which increased to an average of 97 outbreaks in the last 6 months of 1977. In March 1978, ASF was diagnosed in Malta by the Animal Virus Research Institute, Pirbright, United Kingdom. Also in March, ASF was diagnosed on the island of Sardinia, Italy. As of this report, ASF has spread throughout these islands. On June 1, 1978, ASF was diagnosed in samples sent from Brazil by the Plum Island Animal Disease Center, USA, and samples were confirmed positive from the Dominican Republic on July 6, 1978. Evidence indicates that both the Dominican Republic and Brazil had the infection since early 1978. The Committee urges financial assistance be extended the Dominican Republic to accelerate the eradication of ASF in the Republic.

**Rinderpest (RP)**

Outbreaks were reported in Asia (India) and Africa (Sudan, Mali, Saudi Arabia, Senegal, and Nigeria).
Contagious Bovine Pleuropneumonia (CBPP)

Outbreaks were reported in Africa (Ivory Coast, Ghana, Senegal, Cameroon, Guinea, Nigeria, Angola, Upper Volta, Mali, Niger, and Sierra Leone), Asia (India), and the Middle East (Kuwait). Kuwait reported 38 cases in January, 0 in February and March, 20 in April, 29 in May, 51 in June, 60 in July, and 631 in August.

Lumpy Skin Disease

Reported only in Africa (Ivory Coast, Madagascar, Botswana, South Africa, and Swaziland).

Rift Valley Fever (RVF)

Rift Valley fever, an acute, febrile, insect-borne viral disease of sheep, cattle, goats, and humans, entered the Arab Republic of Egypt during the spring of 1977. The disease, which probably entered southern Egypt from the Sudan, reached epizootic proportions during the summer and fall with conservative estimates of 20,000 people sick and over 200,000 animals dead. Although the disease can be spread by direct contact between infected and susceptible animals (including humans), by fomites and by aerosol transmission, the primary method of transmission among animals and humans appeared to be by vectors, primarily the mosquito, Culex pipiens. The Rift Valley fever epizootic subsided during the winter months of December, January, and February, but with the advent of spring this year, the epizootic resumed its explosive spread lending credence to the hypothesis of vector transmission. Morbidity and mortality statistics for the 1978 season are not yet available; however, some epidemiologists anticipate that the epizootic will again continue until the winter months.

A project under PL480 has been established in Egypt for production of RVF vaccine in tissue culture. The epizootiology of the disease will also be studied.

Hog Cholera

The United States was declared free on January 31, 1978. The disease is endemic in Europe, Asia, South and Central America, Mexico, and Africa.

Swine Vesicular Disease (SVD)

Reported in Hong Kong in December 1977, and in Italy in December 1977, January, February, March, April, and May 1978. In August, the Federal Republic of Germany declared itself free of SVD since it had been one year since her last outbreak. On September 11, however, she reported an outbreak. On September 11, however, she reported that an outbreak occurred in one pig-raising establishment in Germany. Thirty-six pigs out of 102 were affected. All were slaughtered. Great Britain has not had a reported case since June 1977, and on August 12, 1978, declared herself free of SVD.
**FOREIGN ANIMAL DISEASES**

**Bluetongue**
A new strain was found in insects in Northern Australia. This was identified as type 20.

**Newcastle Disease**
This disease was reported in Europe, Asia, North America, South America, Central America, and Oceania. The United States has eradicated the viscerotropic velogenic form of this disease. France has declared herself free of Newcastle disease.

**Teschen Disease**
Malagasy and USSR

**Sheep Pox**
Reported in Turkey, Jordan, Iraq, Iran, Tunisia, Israel, Egypt, Kenya, Libya, Senegal, Syria, Kuwait, Mali, and Morocco.

**Dourine**
This trypanosomal disease was reported in Europe (Italy) and Africa (South Africa, Morocco).

**Glanders**
Only one country, Turkey, has reported glanders so far this year.

**African Horse Sickness (AHS)**
Reported in South Africa, Swaziland, and Lesotho.

**Contagious Equine Metritis (CEM)**
This emerging disease has been reported in the following countries: France, Ireland, England and the United States (Kentucky).

The occurrence of another exotic disease of equines in the US was of concern and interest to this Committee. The Committee discussed the proposed changes in regulations governing the importation of horses into the US. The proposed changes would permit the quarantine of imported horses at any premise approved by the Veterinary Services. The limited information available to the committee indicates the proposed changes would weaken US defenses against importation of diseased horses. If this is — or might be — true, the committee opposes the proposed changes in import regulations affecting horses.

**FOREIGN ANIMAL DISEASE SURVEILLANCE AND TRAINING**

**Measures Taken Following Outbreaks of African Swine Fever in Western Hemisphere**
Following the diagnosis of African swine fever (ASF) in Brazil, in June, 1978, a veterinarian from Emergency Programs, USDA was assigned to work with Brazilian authorities in combating the disease. Another USDA veterinarian, experienced in emergency disease eradication, as well as several laboratory specialists from Veterinary Services, USDA, have
also participated in the program in Brazil. The government of the Dominican Republic requested US assistance after the outbreak of ASF in that country. A team of eight professionals was sent immediately to work with the Dominicans in assessing the extent of infection and identifying methods of control. Measures were taken by Veterinary Services, USDA, to alert animal health officials and personnel, industry, and other State and Federal agencies of the threat of these outbreaks to the swine industry of the United States. Laboratories in Peru, Ecuador, Colombia and Venezuela were evaluated by USDA and FAO officials for their capabilities to diagnose hog cholera and ASF.

Since June 1, 1978, when Plum Island Animal Disease Center made the definitive diagnosis of African swine fever in Brazil and later in the Dominican Republic on July 6, 1978, the Center has trained 70 veterinarians and microbiologists from the Western Hemisphere to diagnose ASF. In addition, four scientists experienced in diagnosing ASF were sent to Brazil and the Dominican Republic to help these countries set up operating laboratories for the diagnosis of ASF.

Two veterinarians from each of the Central American and major Caribbean nations were given clinical and postmortem experience with ASF and laboratory training in the diagnosis of this disease by the hemadsorption, fluorescent antibody, agar-gel diffusion, and immunoelectroosmophoresis tests. Each participant was supplied with laboratory manuals in Spanish or English, and the necessary diagnostic reagents to immediately begin diagnostic testing for this disease in their respective countries. A similar course was given to U.S. diagnosticians from 15 licensed hog cholera diagnostic laboratories across the country.

Foreign Animal Disease Surveillance in US

During FY 1978 (Oct. '77-Sept. '78) foreign animal disease surveillance activities of the USDA resulted in 64 investigations of disease situations reported to be suspicious of exotic diseases. All were negative. There were no cases of vesicular stomatitis confirmed in the United States during fiscal year 1978.

Contagious equine metritis (CEM) was diagnosed in Kentucky as a result of a surveillance program of mares and stallions imported from CEM-infected countries prior to the ban on such importations. Spread was limited to a 2 to 3 week period in February and March 1978. A plan was developed for the control of CEM in the United States, and approval and support of this plan was obtained from the equine industry. Twenty-six foreign animal disease diagnosticians and other Veterinary Services veterinarians received training on contagious equine metritis at the Plum Island Animal Disease Center (PIADC) and were used in the CEM surveillance program. In addition, PIADC trained 27 laboratory personnel in the isolation and identification of the CEM organism.

Emergency and Foreign Animal Disease Training

During fiscal year 1978 (October 1, 1977 - September 30, 1978), five
Regional Emergency Animal Disease Eradication Organizations (READEO's) were fully staffed and maintained to rapidly respond to outbreaks of emergency diseases. A total of 14 veterinarians completed Foreign Animal Disease Training Courses in FY 1978. This brings the total of foreign animal disease diagnostician available to conduct investigations of suspicious reports to 212. A Vector Control Seminar was conducted September 28, 1978, for READEO and other vector control specialists to enhance their performance in dealing with disease outbreaks involving vectors. Fourteen wildlife specialists completed a 3-day training course.

Two Foreign Animal Disease Seminars for diagnostician were conducted. Over 155 diagnostician attended these seminars which reviewed the diagnosis and other aspects of the major foreign animal diseases affecting livestock, poultry, and big game animals. A Wildlife Disease Seminar was held at the University of Georgia, Athens, Georgia, for 15 foreign animal disease diagnostician who indicated a special interest in wildlife and wildlife diseases. This seminar was sponsored by the University of Georgia and Veterinary Services, Animal and Plant Health Inspection Service, United States Department of Agriculture. By agreement with the USDA, the University of Georgia will increase surveillance for exotic diseases in wildlife species, train personnel, and cooperate in solving disease problems involving both domestic and wildlife species.

A training course was developed and conducted by the Military Liaison Officer (MLO) with the USDA. Fourteen military veterinarians were trained in exotic diseases and procedures used in the eradication of such diseases. In addition, the MLO participated in training activities at eight military installations. During September 1978, the MLO position was abolished by the Department of Defense on a full-time basis. Since then, the MLO position has been filled on a consulting basis by an officer of the US Army Veterinary Corps.

Five Foreign Animal Disease Awareness Seminars were offered to inform students of veterinary medicine, veterinary faculty members, practicing veterinarians, and animal health officials of the threat of these diseases to this country’s livestock, poultry, and wildlife populations, and the necessity for the prompt reporting of suspicious cases.

During FY 1978, a USDA veterinarian was trained in Australia in the epidemiology of ephemeral fever, a viral disease of cattle, and in other Australian arboviruses. A 16 mm color movie and color slides were developed to aid in the early recognition of ephemeral fever should it gain entry into the United States.

Training Aids and Animal Disease Data Bank

The 10 exotic diseases training films being prepared by Emergency Programs of the Animal and Plant Health Inspection Service and the Plum Island Animal Disease Center, USDA received a concentrated effort. Films covering the following diseases have been completed and
distributed: (1) swine vesicular disease, (2) foot-and-mouth disease, (3) African swine fever - hog cholera, (4) rinderpest, and (5) African horse sickness. The following are in the final stages of production: (1) ephemeral fever, (2) contagious bovine pleurpneumonia, (3) sheep pox - goat pox, and (4) malignant catarrhal fever. The footage for the film on viscerotropic velogenic Newcastle disease-fowl plague has been produced, and the film is in the planning and developmental stage. These films are in both English and Spanish. Pseudorabies, a vital domestic disease, was also added to the USDA Foreign Animal Disease Data Bank, and a bibliography on this disease was distributed worldwide to interested parties. A new trypanosomiasis bibliography and an update of the African swine fever bibliography were distributed world-wide. Agriculture Handbook No. 518, "Surveillance and Collection of Arthropods of Veterinary Importance," was published and distributed to Federal, State, university, and industry veterinarians and entomologists.

RESEARCH ON VESICULAR DISEASES

The virus vesicular disease group consists of foot-and-mouth disease (FMD), swine vesicular disease (SVD), vesicular exanthema of swine (VES) and vesicular stomatitis (VS). The following report is confined to a generalized synopsis of reports selected on the basis of their direct relevance to the disease situation and does not offer total coverage.

Foot-and-Mouth Disease Virus (FMDV)

The large number of research reports on FMD necessitated that references be selected; thus the omission of a particular report does not reflect on its quality.

A cost-benefit analysis of FMD vaccine programs shows the profitability of these programs. Epidemicologic studies indicate that the tests for antibodies to FMD virus infection-associated antigen (VIA) is a good tool for the estimation of FMD incidence in the cattle populations of FMD endemic areas.

Yaks have been reported to be as susceptible to FMD as cattle. Work with FMD-carriers continues to be hampered by the inability to experimentally transmit infection via exposure. Investigations on the persistence of FMDV in animal products have been extended to butter and wool.

An FMDV typing system based upon virus neutralization rather than complement-fixation appears to be more efficient and realistic. Particular vaccine production problems were encountered with FMDV A Morrocco and SAT-2 outbreaks during the past year. This indicated that tests based upon virus neutralization provide the most logical feasible solution to the problems of selecting vaccine strains and alternatives. Types and subtypes of FMDV currently found in South America were discussed with emphasis on their pattern of occurrence.

Biochemical research on FMDV emphasized analysis of virus and viral components: genome mapping, analysis of virulent versus avirulent,
peptide sequencing and cell attachment. Evidence has been presented for an internal enzyme responsible for the segments of FMDV-RNA. Related immunochemical research illustrates the need for more highly specific antisera for measuring antigenic determinants on the viral components. A consensus by research workers on the virus polypeptide nomenclature has been reached and the polypeptide most involved with immunogenicity as it relates to virus neutralization has been designated FMD-VP7.1 2 4 9 10 12 20 25 35 45

The developmental improvement of production methods of FMDV in large-scale suspension culture systems has received much attention.36,49,50 Means for inactivating FMDV for vaccine have been improved and made safer through the introduction of a new method of introducing ethyleneimine into the preparation.3,16,18 The purification of an active ingredient of saponin has maintained the adjuvant properties and reduced the undesirable reaction at the inoculation site.11 The use of oily adjuvants in FMD vaccines is increasing, and research reports indicate that it produces highly desirable effects with little complications at the inoculation site.15 28 32

Swine Vesicular Disease Virus (SVDV)

Surveys conducted in Great Britain on several thousand serum samples taken from animals presented for slaughter show some incidence, but no evidence, of widespread undetected infections with SVDV.22 23 Similar investigations in Japan detected numerous low titers causing the authors to suggest that Japanese swine may have an inapparent infection with Coxsackievirus B5 (CB5) which causes no clinical signs but gives rise to low antibody titers.29

Several workers have reported the biochemical analysis of SVDV and data showing similarity to Coxsackievirus. Antisera have been developed which show immunologic distinction between SVD virions and SVD-RNA free capsids.21 34 48

Central nervous system lesions have been described with SVDV and CB5 in swine, and a serologic relationship between SVDV and CB5 in the pig has been demonstrated, but no clinical manifestations of disease in swine with CB5 could be demonstrated.30

A live virus vaccine for SVD has been developed in East Germany. It produces slight transient clinical signs in a significant number of vaccinated pigs (no data on protection found).31

Killed SVDV vaccines were reported to be efficacious when used alone or in combination with FMD vaccines in oil adjuvant.13 19 32

Vesicular Exanthema of Swine Virus (VESV)

It appears that VES remained an extinct disease of swine during 1977-78. However, there were further reports of the occurrence of antibodies to San Miguel sea lion virus.44 47

Several reports of biochemical analysis of caliciviruses appear to in-
dicate a greater similarity between VESV and SMSV than exists between either of these and feline calicivirus (FCV).5,7

Vesicular Stomatitis Virus (VSV)

The majority of VSV investigations reported during the past year concerned molecular biology. There are, however, some reports of relevance to this committee even though they do not directly deal with the disease.

Pseudotypes of VSV are readily made in the laboratory. Of particular interest is the chimera with togaviruses.27 46 52 53 54

Reichman has proposed the classification of the New Jersey serotypes of VSV into two subtypes on the basis of neutralization tests and nucleic acid homology.38

Suffin et al. showed that VSV could cause abortion in ferrets and they point out that this should be examined from the standpoint of public health.51

While there is official interest in development of a VS vaccine there appears to be a paucity of research in this area.

REFERENCES


CONTAGIOUS EQUINE METRITIS OUTBREAK IN KENTUCKY
Dr. Tom S. Maddox, Kentucky State Veterinarian

Late in the spring in 1977, word was spread to U.S. Thoroughbred owners, stallion managers, laboratory personnel and equine veterinarians that a venereal disease was occurring among Thoroughbreds in Ireland and England. The symptoms were, to say the least, alarming as were the signs of fear caused by its rate of spread and that apparently all mares exposed were infected. Infection caused a high number of conception failures and a profuse vaginal discharge was experienced 2 to 8 days post breeding to certain stallions. Reports were given of early abortion and early return to heat. Infected stallions did not demonstrate any clinical symptoms or autopsy lesions, therefore, it is believed they act only as mechanical carriers of the causative organism.

As far as has been observed thus far, the primary method of transmission occurs during copulation or by visits to the breeding shed for that purpose and the ensuing exposure that occurs in such operations such as teasing, genital examinations and washing techniques. The spread of the disease in Europe (Ireland, England and France) and Australia had been described by Dr. Knowles in published articles and at many meetings and will not be iterated in this presentation. I will be mainly concerned with the epizootic in Kentucky and its consequences and ramifications.

As I said, as early as June 1977, word reached this country that an apparently different contagion was occurring in Europe that was having a dire effect on conception rates in the Thoroughbred breeding stations. Then in August, Australia banned shipment of horses from England and Ireland. In late summer of 1978, APHIS, VS, Plum Island Disease Center, and the American Association of Equine Practitioners sent a fact-finding team to England and Ireland to investigate. A representative was also dispatched to France. These people came back with news that it was, in fact, there as the newspapers had already published, but at the same time did not voice great alarm nor issue any warning that great disaster would ensue if immediate action was not taken. The USDA did issue a ban on importation of horses from affected countries on September 9th; however, it was not immediate and did allow time for importation of those already committed for shipment. Two Thoroughbred stallions imported from France have been incriminated as the animals that introduced the disease in the United States. One entered on August 30th and the other on September 7th.

Very soon after the quarantine edict was issued the USDA submitted a list of imported Thoroughbreds that had entered the U.S. since CEM was known to exist and asked for cultures if, in fact, these animals were in Kentucky. Each station was given this chore. At the time I was impressed by the promptness of the preparation of such a list but was not
excited about the chore of accomplishing this task nor excited about asking owners to present a "safe-in-foal" mare for our people to probe and examine with a speculum. Also, the timing was such that no activity was occurring in the breeding farms and help for such an undertaking was practically non-existent. I personally played down this project as much as possible. I did consult with the University of Kentucky to confirm their ability to get cognizant of the laboratory aspects of the disease, and our diagnostic laboratories sent technicians to Plum Island for training in culture. As the breeding season began, preparations were being made to receive cultures from mares on this list as soon as they had foaled and a gainful culture could be obtained. Reporting procedures were defined. The presence of CEM in the United States was discovered on February 28, 1978, by Dr. David C. Parrish. He made a provisional clinical diagnosis of CEM in a maiden Thoroughbred mare 13 days after the mare had been covered by a stallion that had been imported from France 6 months earlier. Laboratory confirmation of his diagnosis was made by Dr. Thomas Swerczek at the University of Kentucky. Four days after the original case was recognized, CEM was diagnosed in the second mare covered by the same stallion. A day later, two more mares, both bred to a second stallion standing on another stud farm and which had also been imported from France the previous summer, were found infected. Alerted to the presence of the disease in Kentucky, veterinarians found CEM in a mare bred to a second stallion on the same stud as the first French horse, as well as in mares bred to other stallions standing on the same stud as the second imported horse. Within a period of less than 3 weeks, CEM had been identified in mares bred to 5 stallions on the two stud farms.

On March 6th, I placed a moratorium on all breeding of Thoroughbreds in Kentucky and movement of breeding animals that remained in force until a Federal quarantine was written and published on April 3rd.

It seemed evident at the time that the infection was confined to the two farms where the French stallions stood and to the mares bred there prior to March 6th. When the moratorium was declared, we identified 412 mares that had been covered by 58 stallions on the two studs suspected to be the source of the infection. Most of these mares had been returned to breeding farms and nurseries by this time. All of the mares became subject to careful veterinary surveillance. Bacteriological cultures were obtained from those where we deemed it necessary. Serums were collected from 92% of the 220 mares bred by 28 stallions on one farm and 87% of the 192 mares covered by 30 stallions on the second farm. This sample represented the majority of mares covered by each stallion on both farms before breeding was interrupted. Fifty-four mares bred to stallions on these two farms were found to be infected. During the same period 602 serums were tested from mares that had been covered during the pre-moratorium period by other stallions without finding any serological evidence of infection. The 54 mares found positive for CEM by
either culture or by CFT had been covered by 16 stallions. Twenty-nine of the infected mares had been cultured positive for CEMO; 25 were found to be CF positive without having been cultured or having had one or more negative cultures. Eleven of these mares have since been found positive to culture for CEMO. We have serologically tested over 2,000 mares bred to 138 stallions on 44 other stud farms since without finding any evidence of CEM infection with the exceptions noted below. The University of Kentucky Laboratory has tested more than 5,000 serums without finding evidence of any further infection among our brood mare populations. Some of these of course, are repeat samples.

Text-figure 1 displays the record of our investigation of Farm No. 1. Thirty-three mares covered by 10 different stallions were found to be infected. The index case of CEM occurred after cover of the first mare bred to an imported stallion (No. 1) on February 8. Interpretation of these data suggests that the infection was transmitted by human agency in the breeding shed to at least 5 other stallions on this stud which subsequently transmitted the disease to mares covered by them. Stallion No. 7 covered 14 mares for which infection was detected by both bacteriological culture and serology in only 2. The stallion covered 7 mares after the first mare infected; but only 1 of these became infected. This observation is difficult to interpret in respect to whether the stallion itself became contaminated with the organism or whether the infection was transmitted by human agency to the mares only. Both the mares which became infected were bred on a day when an infected stallion had been in the same breeding shed. Stallion No. 8 bred only one mare after its first mare became infected. That mare did not present either bacteriological or serological evidence of CEM. Stallion No. 9 covered 14 mares of which one, bred seventh in the series, was found serologically positive. The stallion double-covered this mare two days later but none of the 7 mares covered in sequence thereafter became infected. The mare in question was found to have been imported from France the previous year. Although we do not have sufficient data to determine the duration of the CF antibody titer in infected mares, we interpret this, for the moment, as a possible example of a long term CFT positive mare that experienced infection in France but was not shedding the organism at the time of cover in Kentucky. Stallion No. 10 bred 8 mares before the moratorium was declared; none became infected. The stallion was found to be infected by culture taken 10 days after it covered the last mare in the series and that mare was covered on a day when four other infected stallions were used in the same breeding shed. This suggests that the stallion was contaminated by human agency in the breeding shed.

The same form of record for the second farm's stallions is shown in Text-figure 2. The index case for this group was the first mare bred by the imported stallion (No. 1). The sequence of cases that appear for stallions Nos. 2, 3, and 4 suggest that, as for farm No. 1, lateral transmission of the disease occurred by human agency in the breeding shed.
following which the contaminated stallions infected mares. The case of stallions No. 5 and 6 appears similar to that for stallion No. 7 in the group on Farm No. 1.

The only evidence for CEM infection in mares not bred to stallions on these two farms has been the finding of a low titer of CF antibodies in three mares. Two of these were imported in foal from Ireland in the summer of 1977 and neither was covered by any Kentucky stallion during the 1978 season. Both mares had a foal by their side sired by the same Irish stallion and the cases are presently regarded in the same category as the imported mare found CF positive after being bred to stallion No. 9 on Farm No. 1 (see Text-Fig. 1). The third mare found positive to the CF test following cover by a stallion standing on a farm for which no evidence of the presence of CEM could be found, had been imported from France in 1973. The mare has since produced two foals by natural breeding in the United States. The mare has maintained a low CFT titer in several subsequent samplings. No other mare covered by the stallion to which this mare was bred in 1978 has shown any evidence of being infected by CEMO.

During the moratorium period, all of the stallions identified with infected mares were treated following the methods originally described in the British Code of Practice. The Kentucky Code of Practice included the additional requirement that the treated stallion cover a known negative mare after treatment and that this mare be shown free of CEMO before the stallion became eligible for return to service. Each of the stallions was returned to service after treatment and the mares bred to them were carefully monitored for the occurrence of infection by clinical examination, culture if indicated, and by serological testing. No cases of CEM were recognized in any mare covered by these stallions or by any other stallion on the studs where the infection originated after treatment was carried out.

I am reasonably certain that this epizootic was new to the Thoroughbred population in Kentucky. A disease so contagious and occurring in such a closely knit agricultural society where competition is the name of the game would not have gone unnoticed or unannounced.

To people in regulatory veterinary medicine this small foci of a foreign disease is a chance to study what actions are needed to contain and eradicate, to praise proper actions and to criticize our shortcomings. However, to the many facets of this segment of agri-business in Kentucky, it meant a lot of new things and thoughts to a lot of people.

Probably Dr. Dan Simpson of Great Britain described it best by saying it is a "harrowing experience." To say the least, it is that. To the stallion manager it is a very major impediment to his getting a task completed that he only has a very short time to complete. To the mare owner it is a cause of fear and near panic—the thoughts of missed estrus while awaiting a culture result, the fear that the preceding mare was infected
and if the stallion later becomes infected and my mare didn't settle
does cause doubt and possibly a barren mare results from only suspicion. If
he feels he has strep or pseudomonas and he does infuse he is accused of
"covering up." There is literally no end to his frustrations. To the farm
manager it has meant a new way of life as far as handling the genitalia of
his charges. The use of disposable drapes, gloves, coverals, speculums,
etc., has become commonplace and mandatory. To the vanning agent, it
has meant more expense and less hauling. He must practice expensive
and time consuming practices and the moratorium has been a telling blow
on business. To our livestock inspectors and VMO's it has meant many
long hours of travel, tracking and a totally new concept of quarantine, The University of Kentucky Animal Science Laboratory has gone
through a "harrowing experience and an astronomical expense." To the
Veterinary practitioners it has meant all of these things I've mentioned
plus a total re-evaluation of practices and procedures. To all of us it has
meant an endless series of meetings that have caused us to give an almost
total disregard of other important duties.

When the laboratories reported that evidence was there to say we had
CEM, I began to learn many facets of Kentucky's Thoroughbred
Breeding establishments that I didn't know before. I saw that it was a
very tightly knit industry confined almost 99% in 3 or 4 counties. It is
almost like one big farm with only roads and fences to separate small
units and yet on closer scrutiny it is polarized and complex. You can feel
the competition of the race track extending into all phases of the in-
dustry. Only here the stakes are higher and the purses even greater. Self-
interest is the key to survival. We, in the Department of Agriculture,
have been very gratified and fortunate to have the leaders of such a
successful industry rally to our support. Their advice and counsel in
helping us write a "Code of Practice" has been hard to measure it has
been so great. Often, though, I got the feeling that the rate of attendance
and the willing participation was not really contribute but to protect
these great vested interests, but how else does any endeavor succeed but
by teamwork and contribution. To all of these people I am very grateful
and humble. As I have said many times, "It couldn't have happened to a
nicer bunch."

It would give my ego a great lift to say that our promptness to respond,
our efficient laboratories, our speed of quarantine and the available help
of the USDA have kept the spread localized to only two stallion barns and
a comparatively few mare bands; but that alone did not do it, if it is, in
fact, done. The genuine fear of this disease that these people have and
their honest desire to improve and protect the breed has had its effect.

In retrospect, I would say that if we do have CEM stopped cold and if,
in fact, it does not pose a threat in the next breeding season, there are a
few points that need correcting should a new disease arise in the future. I
list these as constructive criticism only.
No. 1. When reports come from a foreign country that such a threat is posed, the stop movement should begin at the same time the investigation begins. If the “rumor” proves false, no great harm is done when the quarantine is lifted. Investigation should be done quickly and decisively. In other words, it took the USDA from June to late September to quarantine Ireland, England, France and Australia. It took from 10am March 8th to 1pm March 10th to quarantine Kentucky.

No. 2. When it is positive that the disease is present in any locality in the U.S., then able people should be assigned and told to enjoy and complete the task. The constant threat of change and indecisiveness as to what bureau or division is responsible leaves the working people or “Indians,” if you please, upset about who the hell are the “chiefs.”

No. 3. When the assigned epidemiologist completes the study and proves conclusively that the spread is contained and all known infected animals are identified, listed and located, then restrictions should be promptly lifted on all other animals and allow movement to occur and the economy of the industry to return to normal.

No. 4. When movement does begin again, the state agency needs better control over which can and which cannot move. Our agency did have 5 of the 412 animals leave the state in the first few days after the quarantine was changed to allow non-involvement breeding animals to return to their home state. Fortunately, we discovered the mistakes early and no great harm was done.

No. 5. Probably culture techniques and shipment of specimen problems caused us to believe the two infected stallions were clean and maybe laboratory services need to work constantly to be sure of all the ramifications of each bacteria or virus. To feel complacently safe by using the protocol furnished by English Laboratories was a mistake.

Hopefully, because of the limited size of our affected population, we have a useful estimate of the number of brood mares that may remain a source of infection. The problem of CEM in Kentucky remains one of accurate detection of the source of any future infection which may exist in the form of chronic carrier mares.

I would like to acknowledge the valuable assistance of Dr. Jack Bryans of the University of Kentucky, and Dr. Joe Hendricks in furnishing the information to prepare this presentation.

To Tom Harris, Kentucky Commissioner of Agriculture, for his strong leadership in putting together a committee of industry and getting them to agree to the use of the Kentucky Code of Practice and to all the members of this Committee for recognizing the fact that once you compromise with a disease you have lost the battle. To all those people that worked to complete the many tasks that had to be accomplished with dispatch and accuracy, especially the University of Kentucky Pathology Department and Dr. Tom Swerczek, the University of Kentucky...
Newtown Pike Diagnostic Laboratory, and Dr. Donahue, and Dr. R. H. Singer, Barbara Smith, Dr. Presley Winner and his APHIS-VS staff, and the Kentucky Department of Agriculture Regulation Enforcement Officers.
**Contagious Equine Metritis**

**Slide 1**

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- ✶ Infected Mare; First Cover
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♀ INFECTED MARE, FIRST COVER
♀ INFECTED MARE DOUBLED; SECOND COVER
♀ UNINFECTED MARE
[♀] INFECTED MARE; ANOTHER INFECTED STALLION IN BREEDING SHED SAFETY PREVENTION
♀ INFECTED STALLION [CEM CULTURE]
REPORT OF THE COMMITTEE ON INFECTIOUS DISEASES OF HORSES

Chairman: Dr. C. L. Campbell, Tallahassee, Florida

Members: Dr. W. L. Anderson, Dallas, Texas; Dr. Jesus Castaneda Garcia, Maracay, Venezuela; Dr. A. H. Dardiri, Greenport, N.Y.; Dr. C. S. Duncan, Selkirk, N.Y.; Dr. R. K. Farrell, Pullman, Wash.; Dr. Jack M. Gaskin, Gainesville, Fla.; Mr. E. F. Hackett, Columbus, Ohio; Dr. John B. Healy, Sacramento, Calif.; Mr. E. H. Honnen, Englewood, Colo.; Mr. Floyd Jones, Austin, Texas; Gen. Wayne O. Kester, Golden, Colo.; Dr. H. C. King, Laurel, Md.; Dr. Wayne Kirkham, West Lafayette, Ind.; Dr. Ralph C. Knowles, Hyattsville, Md.; Dr. T. S. Maddox, Frankfort, Ky.; Dr. S. R. Nusbaum, Trenton, N.J.; Dr. E. I. Pilchard, Hyattsville, Md.; Mr. Wilson Powell, Tallahassee, Fla.; Dr. Victor Schroeder, Mexico D.F., Mexico; Mr. John Smiley, Augusta, Me.; Dr. M. B. Teigland, Miami, Fla.; Dr. Charles D. Vail, Littleton, Colo.; Dr. Elna White, Weimar, Texas; Dr. Sam Winkelmann, Austin, Texas

The Committee on Infectious Diseases of Horses was privileged to hear a paper on Contagious Equine Metritis in Australia given by Dr. David J. Matthews, Veterinary Attaché of the Australian Embassy. CEM is the equine disease which has been of most concern to the industry during the last year. The Committee has been thoroughly apprised of the action that has taken place in Kentucky following the discovery of CEM in that state which has resulted in a very good set of practical guidelines for handling the disease. The Committee wishes to commend the Kentucky regulatory officials for their bold and forthright actions early in the campaign which very well may have resulted in precluding the spread of the disease to other parts of the United States.

We note, however, that for various reasons, including pregnancy and apathy, approximately 69 of the 500 plus horses imported into the United States from England, France, Ireland, and Australia between the period July 1, 1976 through September 3, 1977, have not completed culturing procedures and been found free of CEM, and it is imperative at this time that state animal health officials place quarantines on these risk animals preparatory to conducting the procedures necessary to determine the absence or existence of the disease therein. Such testing should be as follows:

Mares:

1. Any animal bred once in the United States since entry should have two sets of cultures (as in the Kentucky CEM Code of Practice) each taken in early estrus.

2. Any animal bred twice in the United States since entry should have one set of cultures (as described in the Kentucky CEM Code of Practice) taken in early estrus.
Stallions:

1. Any stallion should have covered at least three mares since his entry into the United States with no evidence of CEM in any of the mares. If such a stallion has not bred three test mares he shall be, as a precaution, handled in parallel to affected stallions as stated in the Kentucky CEM Code of Practice (as to scrubbing and testing).

All cultures should be run in the U.S. Department of Agriculture CEM recognized laboratories.

When the remaining import animals have met these criteria, it is recommended that they be released from quarantine.

The Kentucky CEM Code of Practice has heretofore been furnished to the regulatory officials by the Kentucky State Veterinarian in September of this year.

In view of the fact that CEM has only been in the scientific community since the early part of last year, there is much to be learned regarding the diagnosis and handling of this disease. The committee wishes to stress the importance of further unified efforts worldwide in obtaining the needed answers through further research.

In concert with the foregoing recommendation, the Committee requests that National Veterinary Services Laboratory personnel determine if standardization of antigen for conducting the complement fixation and slide agglutination tests for the detection of CEM is possible. If in the affirmative, such standardization techniques should be properly evaluated by the American Association of Veterinary Laboratory Diagnosticians, and if approved by this organization, NVSL should make the antigen available to USDA CEM recognized laboratories at the earliest possible moment so as to provide a mare screening procedure on serum 15 to 40 days post breeding adjunctive to diagnostic culturing techniques.

Concern was expressed by the Committee on reported retrenchments of disease control programs related to the equine industry, specifically equine piroplasmosis, equine infectious anemia, and contagious equine metritis. The Committee was told that the priorities placed on programs involving these diseases were in the low category and the conclusions reached were that these federal programs could be entirely scrapped. For those of us who are interested in the future welfare of the nation's equine industry it is imperative that we recognize the catastrophic impact of such action, and to this end a quite forceful resolution has been directed to the Resolutions Committee for action by this body deploring the possibility of the loss of federal funding of these important programs and the disastrous effect it could have on the industry.

The Committee considered a proposed rule published in the Federal Register Volume 43, No. 151, August 4, 1978, which would amend Part 92 of CFR to permit the entry of horses into the United States at any port
designated by the U.S. Customs Service as an international port or airport where a quarantine facility has been provided by the importer. The original purpose of the proposed amendment was to provide a means for allowing the importation of horses for competitive events on an infrequent basis since the waivers currently granted, if allowed on repetitive occasions, could no longer be justified by APHIS. Representatives of USDA present, however, pointed out that no means had been developed to restrict importations to such infrequent occasions as was originally intended, and it was admitted that should the proposal as presented be adopted as a part of CFR, it is conceivable that importations of equine through other than existing import quarantine facilities might well escalate beyond the capabilities of the Department to efficiently and safely control. The Committee therefore felt that such a departure as is proposed in this amendment would be contrary to sound principles of disease control in the acceptance of animals into the United States, and therefore strongly voices objection to the adoption of the proposal. It should be pointed out however, that existing import facilities for the acceptance of competitive event horses have been reported to be in less than optimal condition for this class of animal, and we urge that the Department take steps as are necessary to provide such housing at these import stations as would be conducive to the continued consignment of competitive event animals into this country. This expression of the Committee should immediately be forwarded to the Deputy Administrator for his consideration relative to the disposition of this proposed amendment.

The committee received a report that certain groups associated with the thoroughbred industry had requested of regulatory officials in a racing state that horses kept in constant training or moving back and forth from training centers and farms where there is no infection be exempt from the requirement of a negative AGID test for equine infectious anemia. In evaluating this request the Committee reviewed and confirmed its previous position that horses going to assembly points be tested negative for EIA prior to such assembly.

Last year a subcommittee was appointed to consider the development of proposed standards for EIA accredited herds. Data received in response to a questionnaire submitted to regulatory officials of the several states would indicate there is not sufficient interest at this time to warrant such standards.

Respectfully submitted,

C. L. Campbell, Chairman
Effective application of feed additives (antibiotics and chemotherapeutics) is more critical today than ever before. With costs of feed, labor, housing, equipment, utilities and all other swine production inputs increasing, high conception rate, large litter size, rapid rates of gain and efficient feed conversion are critical to survival in the swine industry. Our present day systems of multiple farrowing, early weaning and confinement rearing have largely developed since the introduction of antibiotics as feed additives. It is doubtful that we could profitably produce pigs in these systems without effective use of antibiotics.

The safety and efficacy of antibiotics have been researched and debated since their initial introduction. How many times have you heard the following: antibiotics are losing their effectiveness; higher and higher levels are required to do the job; and, the organisms have developed resistance and the old antibiotics are no longer effective? These observations or questions were being raised in the early years of antibiotic usage, but still some of the most useful ones are those first introduced.

We have all seen research station reports in which there was little or no response to antibiotics. This is not necessarily a result of development of resistance or loss of effectiveness. It may be that there were no growth depressing organisms in the environment during that particular experiment. Many experiments are conducted in an environment in which every effort is expended to reduce the potential problems of growth depressing organisms. The pens are thoroughly cleaned and disinfected before the experiment is started; the house may be left empty for a period of time between experiments to avoid perpetuating disease problems from one group to another; only the obviously healthy pigs are selected for the experiment; and, during the course of the experiment, any poor-doing or sick pigs are treated or removed from the experiment. In addition, every attempt is made to provide a nutritionally adequate diet and ideal management. Also, the pigs are often housed in small groups with more than adequate space. Shouldn’t these precautions minimize microbial problems, hence minimize antibiotic responses?

Contrast the above management procedures to the practical farm situation. All the pigs, including runts, are involved. It is often impractical and sometimes impossible to thoroughly clean between groups. One cannot afford an empty house for any period of time. The pigs are housed in relatively large groups. Cost of housing requires that floor space be limited. These are the conditions that result in maximum responses to antibiotics. Is it any wonder that the magnitude of the response varies from time to time? The average response and consistency of response are the important considerations.
Table 1 presents a summary of 128 experiments at Experiment Stations and 32 experiments on farms (field tests). Note that the percentage improvement in gains (28.4 vs 16.9%) and feed efficiency (14.5 vs 7.0%) is substantially greater in field experiments than in research station experiments. The reason for the greater response in field experiments can be explained by the factors mentioned previously such as more pigs per pen, less floor space per pig, less selectivity of pigs at start of experiment, etc. Most of our estimates of the economic benefits from use of feed additives are based largely on Experiment Station results, thus are probably underestimating the actual benefits by a substantial amount.

### TABLE 1

**RESPONSE TO ANTIBACTERIALS**  
*(STARTER PIGS)*

<table>
<thead>
<tr>
<th>Location</th>
<th>% Improvement</th>
<th>A.D.G.</th>
<th>F/G</th>
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<tbody>
<tr>
<td>32 Field Test</td>
<td></td>
<td>28.4</td>
<td>14.5</td>
</tr>
<tr>
<td>128 Exp. Sta. Test</td>
<td></td>
<td>16.9</td>
<td>7.0</td>
</tr>
</tbody>
</table>

12,000 pigs  
Drugs — ASP-250, Tylan-Sulfa, Tetracycline, Mecadox

Antibiotics differ in their bacterial spectrum and the organisms in the environment vary tremendously. Thus, it seems obvious that there will be differences among antibiotics in consistency and magnitude of response. Some of these antibiotics that have been thoroughly researched and have proven to be very effective are ones that are being highly scrutinized for safety and efficacy at the present time, with the possibility of being removed from the approved list of feed additives. Loss of these, tetracyclines and penicillin, would certainly increase the costs of producing pork, by reducing performance, paying more for alternatives, or from the cost of developing effective substitutes.

The most beneficial feed additives are those that will give the most consistent response. Consistency of response is usually associated with a broad spectrum of antibacterial activity. Antibiotics are like insurance, in that those which provide the broadest protection under a wide range of growth reducing circumstances are the most useful as growth promotants.

Often it has been proposed that checks for sensitivity pattern be used to determine the antibiotic of choice. This may be advisable for some instances of therapeutic usage. However, if one waits until problem organisms are identified and tested for antibiotic sensitivity before selecting a feed additive, much of the economic advantage for using the
additive has already been lost. To date, there is little research evidence that associates growth response to the usual sensitivity checks.

Much of the concern about feed additive usage of antibiotics is related to the development of antibiotic resistance. The intestinal population of gram negative enterbacteracia, particularly the coliforms, will rapidly become resistant to the tetracyclines. This resistance is transferrable among certain organisms. The fear is that a pathogenic organism will develop resistance and pass from animal to man or the antibiotic resistance will pass from a non-pathogen to a pathogen, and this in turn cause a public health problem. After more than 25 years of use, there is no direct evidence available to substantiate that feed additive usage of antibiotics has caused a problem in the treatment of diseases in man or animal. Committees and task forces have been investigating this since the early days of antibiotics. It appears that reason and scientific evidence may give way to fear, emotion and politics in future decisions regarding use of antibiotics and other chemicals in agriculture. Some rationalize this away by the assumption that we can afford to be ultra-conservative because of our present day abundant food supply. In future years we are likely to find that some of the alternatives are far less desirable than the antibiotics that have been thoroughly evaluated and widely used for these past 25 years.

It is important that antibiotics or any other drug be used only as tested and approved. We should not jeopardize the future benefits to be derived from their use by using incorrect levels, by using unapproved combinations or by not following withdrawal requirements. The manufacturers of drugs, premixes or complete feeds containing drugs are required by law to include on the label or feed tag any special restrictions on their usage. It is very important that these restrictions be adhered to by manufacturers, producers and veterinarians. The data available to date demonstrate that when antibiotics are fed at the approved levels and for the approved stages of production there have been no identifiable problems of health safety associated with their use.

We hear periodic reports of drugs being used that have not been properly tested and cleared. For example, a recent T.V. newsmen contended that he saw a "barrel" of chloramphenical in a feed plant in North Carolina and implied that it was being used as a feed additive. Feed manufacturers and veterinarians know that this drug has not been cleared for therapeutic or feed additive usage in food producing animals. To use it jeopardizes the continued use of other drugs.

At present the Inspection Services are finding residues of drugs (mostly sulfa residues) in about 9 to 13% of the pork carcasses sampled. These residues are usually in liver or kidney tissues. Follow up studies by the Food and Drug Administration suggest that 65% of these violations are a result of treatment. Research data further indicates that these pigs are being marketed too soon after receiving a high level treatment with sulfa; or, in case of feed additive violations, the pigs have not been fed a
sulfa-free diet for 5 to 7 days prior to marketing. The required withdrawal time for sulfa drugs has been lengthened and should markedly reduce the violation. However, merely extending the time will not help unless they are adhered to. It may be that the high treatment levels being prescribed result in crystalization or precipitation of sulfa in kidney or liver tissue and markedly extend the time required for clearance. Also, it is probable that some feed handling systems are not easily cleaned resulting in the withdrawal diets being contaminated in the mixers, storage bins, conveyors or feeders. Very low levels in the withdrawal diets may be sufficient to keep liver and kidney tissue above the violative level of 0.1 ppm. About 70% of these violations associated with feed additive usage of sulfa drugs have been estimated to result from failure to observe the proper withdrawal time. Whatever the explanation for the residues, we must strive to reduce the incidence of violations. Failure to do so will result in loss of very valuable drugs to the swine industry.

**Efficacy:** The greatest benefits are gained from usage during the critical stages of the production cycle.

During the breeding period, antibiotics will improve conception rate, farrowing rate and litter size. Numerous reports illustrate the benefits during this stage. A relatively high level (0.5 to 1.0 gram per sow per day) of antibiotic is required and the antibiotic should be absorbable. The conception rate on first service may be improved by as much as 15 to 25 percent and litter size by an average of 0.5 or more pigs per litter. In practice one may start feeding the antibiotic fortified feed about one week before the start of breeding and continue for a three week period. Table 2 presents a summary of data from several experiments comparing the advantages of having antibiotics in the breeding diet. Note that farrowing rate was improved by an average of 7.4% and litter size was increased by 0.5 pigs per litter. Either the improved farrowing rate or the increased litter size should more than offset the added cost of the antibiotic.

**TABLE 2**

**ANTIBIOTICS AT BREEDING TIME AND REPRODUCTION IN SOWS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Treated</th>
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<tbody>
<tr>
<td>Farrowing rate, %</td>
<td>72.6</td>
<td>80.0</td>
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<tr>
<td>Live pigs/litter</td>
<td>9.9</td>
<td>10.3</td>
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<tr>
<td>7 reports, 1394 sows</td>
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Before and after farrowing is another critical stage of the production cycle for which antibiotics are particularly beneficial. Improvements in the general health and well being of the sow aid her in coming to milk more quickly and in producing more milk during those early critical hours.
of the pig's life. Because of the complexity of sow research, we have less definitive data to support the benefits during this stage; however, the vulnerability of young pigs to disease, inadequate food or other stresses is well recognized. We cannot expect to get a sufficient level of antibiotics through the milk to be of much benefit to the pigs. The improvement in baby pig performance and liveability can largely be attributed to the milk production by the sow.

For experimental purposes, we have completely discontinued the use of antibiotics in one of our University of Kentucky herds. We maintained accurate records on that closed, SPF, Yorkshire herd from 1963 to 1977. Antibiotics were not used during the years of 1972 to 1977. A comparison (Table 3) of the reproductive performance as measured by conception rate and litter size before and after discontinuing use of antibiotics provides evidence of the benefits of antibiotics in the sow feeding program.

### TABLE 3

**EFFECT OF ANTIBIOTICS ON REPRODUCTIVE PERFORMANCE**

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<tr>
<td>No. litters</td>
<td>398</td>
<td>288</td>
</tr>
<tr>
<td>Conception ratea, %</td>
<td>89.9</td>
<td>78.3</td>
</tr>
<tr>
<td>Total pigs/litter</td>
<td>11.0</td>
<td>9.8</td>
</tr>
<tr>
<td>Live pigs/litter</td>
<td>10.0</td>
<td>8.6</td>
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<tr>
<td>Pigs weaned/litter</td>
<td>8.9</td>
<td>7.3</td>
</tr>
<tr>
<td>Incidence of MMAb, %</td>
<td>10</td>
<td>66</td>
</tr>
<tr>
<td>Pig wt. at 3 wk.</td>
<td>12.8</td>
<td>11.4</td>
</tr>
</tbody>
</table>

*aConceived on first service

*bMastitis-Metritis-Agalactia—% of sows showing some sign of MMA including elevated body temperature, vaginal discharge, hardened udder or evidence of not allowing pigs to nurse or no milk available.

We did not use antibiotics continuously prior to 1972. However, we did normally have antibiotics in the farrowing, lactation and starter diets. We also were experimenting with various feed additives during the growing-finishing stages of production.

The creep and starter diets should definitely be fortified with antibiotics. The first few weeks of the pig's life is the period of greatest response in terms of improved survival, increased growth rate and improved feed conversion. Unfortunately, there is no satisfactory method,
at present, of continuously providing antibiotics prior to the time the pig is eating substantial quantities of feed. We could likely overcome much of the stunting and mortality that occurs during that first week after farrowing if we could continuously provide the protection offered by feed additives. Having the protection in the creep feed and in the starter and grower feeds is important. Table 1 illustrates the type of response to expect in young pigs.

After the pigs are 8 to 10 weeks of age the percentage response to antibiotics declines and the levels needed for maximum performance are lower than that needed for the more critical stages of life. During this growing-finishing stage, the levels used may be reduced, in order to reduce cost, without sacrificing the benefits already established (Tables 4, 5).

**TABLE 4**

**RESPONSE TO ANTIBACTERIALS (GROWING PIGS)**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Control</th>
<th>Antibacterial</th>
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<tbody>
<tr>
<td>Avg. daily gain, lb.</td>
<td>1.28</td>
<td>1.49</td>
</tr>
<tr>
<td>Improvement, %</td>
<td></td>
<td>10.9</td>
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<tr>
<td>Feed/gain</td>
<td>2.92</td>
<td>2.79</td>
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<tr>
<td>Improvement, %</td>
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<td>4.5</td>
</tr>
</tbody>
</table>

118 exp.; 390 reps.; 2650 pigs per treatment.
Drugs: Va., Bac., Mec., Tyl-Sul., Tyl., ASP, Tet.

**TABLE 5**

**RESPONSE TO ANTIBACTERIALS (G-F PIGS)**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Control</th>
<th>Antibacterial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. daily gain, lb.</td>
<td>1.51</td>
<td>1.58</td>
</tr>
<tr>
<td>Improvement, %</td>
<td></td>
<td>4.6</td>
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<tr>
<td>Feed/gain</td>
<td>3.48</td>
<td>3.41</td>
</tr>
<tr>
<td>Improvement, %</td>
<td></td>
<td>2.0</td>
</tr>
</tbody>
</table>

59 exp.; 280 reps.; 1361 pigs per treatment.
Drugs: Pen-Strep., Bac., Tyl., Va., Fla., Tet.

The finishing stage, however, is the most critical in terms of observance of withdrawal times. It is advisable to use an antibiotic that has no withdrawal restrictions in the finishing ration. Our systems of marketing and slaughtering are such that many pigs may be slaughtered
within a few hours of removal from their pens. Also, we usually "top-out" the heavy pigs rather than marketing as a group. It is usually impractical to use a drug with a one to five day withdrawal restriction. If one abides by such withdrawal restrictions, it is necessary to remove the drug before the first pigs go to market. This means that lighter weight pigs may be off the drug several days or weeks before marketing.

**Safety:** Use drugs only as tested and approved.

It is important that all producers, feed manufacturers and veterinarians use antibiotics in accordance with their label restrictions. Failure to do so by a few may jeopardize their continued availability. Under our present systems of production, feed additives are a valuable part of our total feeding and management program. Without them, costs of production will increase and the price of pork to the consumer will be higher.

The Food and Drug Administration has published in the Federal Register their proposal to discontinue the feed additive usage of penicillin, tetracyclines and any combinations including them. They do propose to allow them to be used for therapeutic purposes on a prescription basis.

There are real questions about whether this proposed action would have any effect on total usage of these drugs. Experiences in Great Britain, where similar restrictions were imposed, suggest that it would not. If it does not reduce usage, the proposed action will only serve to hamper production with no benefits being derived therefrom.

The safety of feed additive usage of antibiotics has been debated by committees, scientific task forces and regulatory agencies for more than a decade. In fact, scientists have been debating these issues since the introduction of antibiotics in the early 1950's. There are basically two sides of the issue. One being there is no question that use of certain antibiotics will result in resistant micro-organisms and that the resistance is transferrable among organisms common to man and animals. Discontinuing feed additive usage of antibiotics is seen as one way of reducing the total usage of antibiotics, thereby reducing the total environmental pool of resistant organisms. Scientists on this side of the issue agree that we have no direct evidence that feed additive usage has contributed to disease problems in man, but they maintain that we neither have evidence that it could not happen. They are of the opinion that the laboratory and challenge data available are sufficient to document each link in the chain of events that would lead to a public health problem. These scientists feel that we could increase food costs to pay for an added degree of security from health risks.

The other side of the issue, supported by equally competent and concerned scientists, is that there are great benefits from feed additive usage that cannot be realized on prescription basis. These scientists agree that antibiotic usage leads to resistant organisms in the animal
environment, but can see no evidence that this has contributed to drug resistance in man. It is felt that the antibiotic resistance problem in man is primarily a result of the widespread therapeutic and prophylactic usage of antibiotics in man and that restricting the use in animals would have very little, if any, effect on disease therapy in man.

This is a very simplistic statement of a very complex issue and certainly the issue is not readily divided into two sides as I've done. There are probably more scientists that work in these areas that can really see neither side of the issue clearly and feel that if we are going to err, we should err to the side of protecting human health.

The Food and Drug Administration maintains that valid questions of safety, even though they may be theoretical in nature or unfounded by direct evidence, have been raised and that researchers must prove the drugs to be safe. Scientists have been responding to this challenge for the past 4 to 5 years and haven't satisfied the agency with proof of safety.

Herein lies the dilemma. It is scientifically impossible to prove, beyond a shadow of doubt, that anything is absolutely safe. It would appear at this time that the present concept, "prove that it is safe," held by the regulatory agencies must be tested in the courts. Should the courts uphold this concept, many products now being used will fall by the wayside. This concept should be of grave concern to every citizen of our country. Relatively speaking, however, we are a bunch of "fat cats" that don't become concerned until we are directly affected.

None of us are interested in willfully adulterating our food supply or our environment with harmful substances. But the present climate, within the regulatory agencies and some vocal segments of our society that proclaim to represent the consumer, suggests that everything is hazardous until proven safe. Is it a climate that will allow us to continue to have the abundant food supply and other necessities to which we have become accustomed?
REPORT OF THE COMMITTEE ON
PHARMACEUTICALS & TOXICOLOGY

Chairman: Dr. Roland A. Gessert, Arlington, Va.


The Committee on Pharmaceuticals & Toxicology recognizes that resistance development and transferred resistance do occur with widespread use of antibiotics in livestock. However in spite of transferred resistance development, the ability to control infectious disease has not become diminished. FDA enforcement of its proposed regulations limiting use of penicillin and tetracyclines in animal feeds have been delayed by Congress pending completion of further studies by NAS/NRC.

The committee points out that current carcinogenicity study policy does not accurately pinpoint potential carcinogens. Official cancer policy does not differentiate mechanism of action—whether it is a direct or indirect carcinogen. It also does not look at the maximum tolerated dose, the detoxification mechanism, nor the general metabolism of the compound. Current official cancer policy also considers benign tumors to be precursors of malignant tumors; authorities on cancer recognize that this is not true. The health profession should recognize that the current methods of determining oncogenicity are an overkill and that determination methods should be refined so that only those substances and manners of use which truly do cause cancer in man are banned from the realm of human exposure.

Good animal laboratory regulations were published as proposals 2-3 years ago. FDA & EPA have been operating under these proposed regulations, using them somewhat as guidelines, during this ensuing period. It appears that following these regulations to the letter is exceedingly difficult and prohibitively costly. However where experienced and practical inspectors have utilized these as guidelines, the laboratories have been able to operate in accordance with the intent of the Act and the regulations. It would appear advisable that the proposed regulations continue to be used as guidelines or an educational tool, rather than strict law which few commercial, academic, or government laboratories can follow.

EPA have revised toxicity testing guidelines which soon will be published as proposals. Scientists on the guideline formulating committee wish a degree of flexibility in the guidelines to accommodate differences in toxicity (as shown by subchronic or other studies), differences in metabolism, type of chemical, and other factors. Legal advisors to the committee demand inflexible rules on the conduct of the
study. The committee urges sufficient flexibility of the guidelines to permit adequate determination of safety and toxicity without imposing undue meaningless rigidity to the testing procedures. The committee also urges relative uniformity to the testing procedures required by EPA, FDA, OSHA, and other governmental and regulatory agencies.

Under FIFRA, the pesticide act, it is illegal for veterinarians to take a pesticide from a large container to a smaller container for dispensing to his client. It also is not legal for a veterinarian to dispense a restricted use pesticide to a client. Further, it is not lawful for a veterinarian to use (or dispense) a pesticide for other than the labeled use. To accommodate the veterinary profession and promote animal health, the EPA, at the instigation of the AVMA, proposes to issue a PESTICIDE ENFORCEMENT POLICY STATEMENT (PEPS) which will permit the veterinarian to decant a pesticide from a large container to a smaller container, provided adequate labeling is furnished. Also, the PEPS will provide that a veterinarian may formulate his own pesticide formulation or mixture providing he applies it himself, but he is not permitted to dispense a restricted use pesticide on a "large scale," or to hold himself out as a pesticide operator.

In a sense, pesticides are used by veterinarians as "drugs." And pesticides for use on man are regulated as drugs by FDA, and are not necessarily registered by EPA. The policy of FDA is that veterinarians may use, dispense, or prescribe any drug which their professional judgment dictates, recognizing their legal responsibility under malpractice provisions of the Practice Acts and responsibility that foods are not adulterated. The AVMA contends that veterinarians should be permitted the same consideration for pesticides that are used for drugs, and propose petitioning for changes in the regulations, or the act itself, if necessary. The committee supports the AVMA in this matter.

During the past year the following new animal drug entities were approved by FDA:

- Cyclothiazide — a diuretic for use in dogs
- Mibolerone — an estrus control agent for dogs
- Uredofos tablets — an anthelmintic for dogs & cats — approved February 1978; withdrawn from market in Sept. 1978
- Furosemide syrup — a diuretic for use in dogs
- Febantel Paste — an anthelmintic for use in horses
- Glycobiarsol tablets — an anthelmintic for elimination of whipworms in dogs
- Cephapirin benzathine — an antibiotic for dry cow treatment of bovine mastitis
- Gonadorelin diacetate tetrahydrate — for treatment of cystic ovaries in cattle
VACCINATION OF CHICKENS WITH INFLUENZA A/TURKEY/OREGON/71 VIRUS AND IMMUNITY CHALLENGE EXPOSURE TO FIVE STRAINS OF FOWL PLAGUE VIRUS

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United States Department of Agriculture, Science & Education Administration, Agricultural Research, Northeastern Region, Plum Island Animal Disease Center, Greenport, New York 11944

SUMMARY
Immunity of chickens vaccinated with influenza A/turkey/Oregon/71 (HavlNav2) virus was challenged 21 days postinoculation with 5 strains of virulent influenza A viruses containing avian subtype 1 hemagglutinin (Havl). Vaccination afforded 82 to 100% protection against immunity challenge with the 5 strains. One vaccinated chicken which survived challenge with influenza A/FPV/Brescia/02 virus still had this virus in its cloaca 14 days postchallenge.

INTRODUCTION
Inoculation of chickens with influenza A/turkey/Oregon/71, an avirulent virus with avian subtype 1 hemagglutinin (Havl) has been shown to stimulate a protective immune response to influenza A/FPV/Dutch/27, a virulent fowl plague virus (FPV); virulent challenge virus was not recovered from the trachea of the chickens for 14 days after challenge when the experiments were terminated.\(^2\) The efficacy of influenza A/turkey/Oregon/71 virus as a vaccine against 4 other lethal influenza A viruses with Hav1 hemagglutinin as well as influenza A/FPV/Dutch/27, which was included as a control is reported here.

MATERIALS AND METHODS
Embryonated eggs: Viruses were passaged, assayed for infectivity and isolated from tracheal swabs in 10-11-day-old embryonated chicken eggs. Eggs were from specific pathogen-free, seronegative nonvaccinated dams.

Viruses: The following viruses were passaged in embryonated eggs and harvested as pools of amniotic and allantoic fluids (AAF).

Vaccine virus — A/turkey/Oregon/71 (HavlNav2)
Immunity challenge viruses — A/FPV/Alexandria/45 (HavlN1)
A/FPV/Brescia/02/(HavlNeq1)
A/FPV/Dutch/27(HavlNeq1)
A/FPV/Rostock/34(HavlN1)
A/turkey/England/63(HavlNav3)

Sera: Serum samples were obtained from chickens before vaccination, before immunity challenge exposure, and 14 days after immunity challenge exposure.
VACCINATION OF CHICKENS WITH INFLUENZA

Virus isolation: Chicken tracheae were swabbed on days 1-4 after vaccination and tracheae and cloacae were swabbed on days 1-4 and 14 after immunity challenge exposure. Swabs were placed in 1 ml Hanks' balanced salt solution containing 0.5% lactalbumin hydrolysate, 1% gelatin, 2000 units penicillin, 2000 µg streptomycin, and 200 µg mycostatin. Virus was isolated from tracheal and cloacal swab samples by inoculation of embryonated chicken eggs.

Hemagglutination tests: Hemagglutination assays (HA) and hemagglutination-inhibition (HI) assays were performed in microtiter systems as previously described with sera treated with receptor destroying enzyme.4

Vaccination procedures: Fifty-six Spafas 10-week-old chickens were vaccinated intratracheally each with 0.5 ml of influenza A/turkey-Oregon/71 virus containing 4.6 log10 embryo infective doses (EID50). Two weeks later the chickens were again inoculated intratracheally with 5.9 log10 EID50 of the same virus. The chickens were housed in one isolation room on the floor. In addition, 26 nonvaccinated control chickens were held in another isolation room.

Immunity challenge procedures: Three weeks after the second vaccination with influenza A/turkey/Oregon/71, the vaccinated and control chickens were separated each into 5 groups for virus challenge as shown in Table 1.

Each group was confined in a large dog cage in separate rooms to promote contact transmission of the challenge virus. All chickens except those serving as contact transmission controls, were inoculated intratracheally with 1.0 ml diluted AAF containing 5.0 - 6.7 log10 embryo lethal doses of the immunity challenge viruses. The chickens were examined for clinical disease signs daily for 2 weeks after challenge.

RESULTS

Vaccination results: Influenza A/turkey/Oregon/71 virus was recovered from tracheal swabs for 4 days after the second vaccination. Only a few isolates were made after the second day.

Serum samples collected 16 days after the second vaccination had HI titers of 8 to 256; only two chickens had no HI titers. All control chickens had HI titers of less than 2 prior to immunity challenge exposure.

Immunity challenge exposure: Vaccinated chickens were completely protected (11/11) against the immunity challenge with A/FPV/Alexandria/45 virus, whereas all nonvaccinated, inoculated and contact transmission controls died (Table 1).

Complete protection did not occur against the other challenge viruses but ranged from 82-83% for the Brescia, Rostock and Dutch isolates of FPV to 91% for the A/turkey/England/63 virus.

One of the vaccinated chickens that died after the A/FPV/Rostock/34 challenge and the one chicken that died after challenge with
A/turkey/England/63 virus had prechallenge serum HI titers of less than 2.

One of the vaccinated birds that survived the A/FPV/Brescia/02 virus challenge still had this virus in its cloaca 14 days after challenge.

All nonvaccinated controls exposed either by inoculation or contact to the Brescia and Dutch isolates of FPV died. All 3 of the controls inoculated with A/FPV/Rostock/34 died, but 1 of 2 contact transmission controls survived. A similar result occurred following challenge with A/turkey/England/63 virus in that all inoculated controls died, but neither of the contact transmission controls was affected nor did they develop antibody by 14 days after the challenge inoculation.

DISCUSSION

Earlier reports (2,3) have shown influenza A/turkey/Oregon/71 virus to afford 100% protection to chickens against influenza A/FPV/Dutch/27 virus. Although numbers of chickens in groups in the present study were small, 100% protection was not afforded to immunity challenge except with influenza A/FPV/Alexandria/45 virus. However, in two vaccinated birds that died, one following challenge inoculation with A/FPV/-Rostock/34 virus, and the other with A/turkey/England/63 virus, vaccination did not stimulate an HI antibody response. Furthermore, other vaccinated birds that died following challenge inoculation had HI titers of 32 or less.

Contact transmission studies confirmed the findings of Alexander et al.1 in that influenza A/FPV/Dutch/27 virus killed all chickens placed in contact with challenged chickens, while influenza A/FPV/Rostock/34 virus killed 7 of 10 chickens placed in contact with challenged chickens.

The observations that influenza A/FPV/Brescia/02 virus could be isolated from the cloaca of influenza A/turkey/Oregon/71 virus vaccinated chickens 14 days after challenge indicates that the immune chicken may become a virus carrier and thus a potential source of infection for nonimmune replacement birds. Based on this premise, eradication rather than vaccination would be the route to follow in control of avian influenza.
REFERENCES


ACKNOWLEDGMENTS

The authors thank Mr. E.V. Kramer, Jr. for technical assistance and Mrs. Clara Begley for assistance with the manuscript.
Table 1. Results of immunity challenge exposure of chickens vaccinated with influenza A/turkey/Oregon/71 virus and subsequently exposed to fowl plague viruses.

<table>
<thead>
<tr>
<th>Immunity challenge exposure virus</th>
<th>Vaccinated and challenged chickens</th>
<th>Nonvaccinated and challenged control chickens</th>
<th>Contact FPV transmission control chickens</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPV/Alexandria/45</td>
<td>0/11*</td>
<td>3/3 (3-4 dac)</td>
<td>2/2 (6 dac)</td>
</tr>
<tr>
<td>FPV/Brescia/02</td>
<td>2/11 (4 &amp; 6 dac)**</td>
<td>4/4 (2-4 dac)</td>
<td>1/1 (6 dac)</td>
</tr>
<tr>
<td>FPV/Dutch/27</td>
<td>2/12 (4 &amp; 6 dac)</td>
<td>4/4 (3-6 dac)</td>
<td>2/2 (3 &amp; 8 dac)</td>
</tr>
<tr>
<td>FPV/Rostock/34</td>
<td>2/11 (3 &amp; 6 dac)</td>
<td>3/3 (2 dac)</td>
<td>1/2 (4 dac)</td>
</tr>
<tr>
<td>turkey/England/63</td>
<td>1/11 (4 dac)</td>
<td>3/3 (2-4 dac)</td>
<td>0/2</td>
</tr>
</tbody>
</table>

*Number dead/total number chickens in group.

**dac = day after challenge that chickens succumbed.
IDENTIFICATION OF NONAVID INFLUENZA A VIRUSES CONTAINING HUMAN SUBTYPES OF HEMAGGLUTININ AND NEURAMINIDASE ISOLATED FROM POULTRY IN HONG KONG

W. K. Butterfield,1 C. H. Campbell,1 & K. F. Shortridge2

SUMMARY

Three influenza A viruses isolated from domestic poultry in Hong Kong had nonavid hemagglutinins and were identified after antiserum to the isolates was produced and after the antisera were tested in hemagglutination-inhibition tests with the known prototype influenza A viruses.

Two of the isolates were identified as HON1 or Hsw1N1 viruses under the classification scheme of the World Health Organization (8). The third isolate had a swine subtype hemagglutinin (Hsw1) and a human subtype neuraminidase (N2). This is the first isolation of an Hsw1N2 virus and may further indicate that avian species are a potential source of recombination of influenza A viruses that may cause future pandemics.

The World Health Organization (WHO) and its many cooperating laboratories have coordinated efforts for surveillance of influenza viruses in mammals and birds as possible sources of pandemic strains of influenza virus. A surveillance study of domestic poultry in Hong Kong has revealed a large number of influenza A viruses that contain combinations of hemagglutinin and neuraminidase surface antigens not previously described (6).

The isolation of swine influenza virus from man (A/New Jersey/8/76) and a duck (A/duck/HK/36/76) in 1976 and the reappearance of H1N1 virus in the U.S.S.R.-China area in 1977, emphasize the importance of animal surveillance for detecting possible reservoirs of pandemic strains of influenza virus (2,4).

The first phase of the surveillance study on poultry originating from Hong Kong (HK) and the People's Republic of China (PRC) resulted in the isolation of influenza A viruses that fail to react with antiserum produced to the known prototype influenza A viruses. Antisera to the viruses from HK and PRC however, reacted with one or more of the prototype viruses, thus showing that the isolates were nonavid. This study was undertaken to identify 3 nonavid viruses isolated from a duck, a goose, and a chicken during this surveillance.

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2Reader, Department of Microbiology, University of Hong Kong, Pathology Building, Queen Mary Hospital Compound, Hong Kong.

Use of trade names is for identification and does not constitute endorsement by the U.S. Department of Agriculture.
MATERIALS AND METHODS

Virus isolation

The origin of the 3 nonavid influenza A isolates is as follows: A/duck/HK/193/77 isolated from the trachea of a duck from the PRC in November 1977; A/goose/HK/8/76 isolated from the cloaca of a goose from the PRC in September 1976; and A/chicken/HK/14/76 isolated from the cloaca of a chicken from HK in September 1976. Ten-day-old embryonated chicken eggs were inoculated with the isolates via the chorioallantoic sac and incubated at 37°C. Combined amniotic and allantoic fluids (AAF) were harvested 48 h after inoculation and tested individually for hemagglutination activity.

Antisera

Monospecific antisera to segregated hemagglutinin and neuraminidase surface antigens and to specific ribonucleoprotein (rnp) for influenza A and B viruses were prepared in goats (7) and provided by Dr. R.G. Webster, St. Jude Children's Research Hospital, Memphis, TN, USA. Antisera to purified, whole influenza A viruses were prepared in guinea pigs (3). Antisera to nonavid influenza A isolates were prepared by intravenous inoculation of chickens. (5). The nonavid viruses were contained in AAF from the second embryo passage at limiting dilutions.

Prototype influenza A viruses

All known WHO viruses were obtained from the Plum Island virus repository (Table 1). Other influenza A viruses with HON1 and H1N1 surface antigens were provided by Drs. Walter R. Dowdle and Alan P. Kendal of the WHO Collaborating Center for Influenza, Center for Disease Control, Atlanta, GA, USA.

Serological tests

Sera treated with receptor-destroying enzyme were used in microtiter systems for hemagglutination-inhibition tests (5). Neuraminidase-inhibition tests were done with fetuin as substrate (5).

Group specific rnp antigens were identified by single radial immunodiffusion (SRID) assays with specific antisera to rnp of influenza A and B viruses (5).

RESULTS

Virus isolation

Three hemagglutinating isolates were determined to be influenza A viruses by SRID tests with specific influenza A rnp antiserum.

Antigenic analysis of isolates

The 3 isolates were nonavid when tested for HI with antisera to all known prototype influenza A viruses from human, avian, equine, and porcine sources.

The neuraminidase of the 3 isolates were inhibited by antiserum to human subtype 1 (N1) or subtype 2 (N2) neuraminidase. Influenza
A/duck/HK/193/77 was a N2 subtype; A/chicken/HK/14/76 and A/goose/HK/8/76 were N1 subtypes (Table 2).

Antiserum to the second limiting dilution passage of A/duck/HK/193/77 and A/chicken/HK/14/76 inhibited hemagglutination of both prototype influenza A viruses and homologous viruses (Table 3). Antiserum to the 2 isolates also inhibited hemagglutination of influenza A/goose/HK/8/76. Hemagglutination by HO and Hsw1 subtypes was inhibited by these antisera. Antiserum to influenza A/duck/HK/193/77 reacted with WSN/33 virus, WS/33 and most of the swine influenza virus strains, but did not inhibit hemagglutination of PR/8 virus or other viruses with HO hemagglutinin. Influenza A/chicken/HK/14/76 inhibited WSN/33, WS/33, PR/8/34, CAM/46, and DSP/43 viruses with HO subtype hemagglutinin as well as with all isolates of swine influenza virus.

DISCUSSION

Three influenza A viruses isolated from domestic poultry in Hong Kong were nonavid when tested in HI tests against antisera produced to all known prototype influenza A viruses. However, the viruses were subtyped by producing antisera to the isolates in chickens and back-testing the antisera with the known prototype viruses.

Influenza A/chicken/HK/14/76 has a human subtype (N1) neuraminidase. Antiserum to the isolate inhibited hemagglutination of HO and Hsw1 influenza virus. The antiserum did not inhibit hemagglutination of FM/1 or other viruses with subtype 1 hemagglutinin. The antiserum to A/chicken/HK/14/76 completely cross-reacted with another nonavid isolate — A/goose/HK/8/76. The latter isolate also had a human subtype 1 neuraminidase.

Influenza A/duck/HK/193/77 has a human subtype 2 neuraminidase (N2) and antiserum to this isolate inhibited hemagglutination of WSN and WS (HO) viruses and most of the Hsw1 viruses tested. However, this antiserum did not inhibit hemagglutination of other HO or any H1 viruses.

Under the system devised by the WHO Expert Committee on Influenza (8), influenza A/chicken/HK/14/76 would be classified as a HON1 or Hsw1N1 virus. An HON1 virus has not been isolated from man or animal since the appearance of H1N1 virus in 1947.

Influenza A/duck/HK/193/77 would be classified by the WHO system as an HON2 or Hsw1N2 virus, neither of which have been previously reported.

A recent classification of influenza A viruses by Beveridge (1) states that the subtype in man until 1947 was designated HO, but recent research indicates that all isolates from man and swine up to 1957 (HO, H1, Hsw1) belong to the same subtype which should be designated H1. However, antisera to influenza A/duck/HK/193/77 or A/chicken/HK/14/76 did not inhibit any of the H1N1 viruses tested.

As influenza surveillance studies have increased over the past two decades, it is quite apparent that the greatest number of different influenza viruses are being isolated from avian species, especially avian
species from Southeast Asia. Continuing surveillance for influenza A viruses may keep us aware of new influenza recombinants that may possibly cause pandemic influenza.

ACKNOWLEDGEMENTS

The authors acknowledge E.V. Kramer, Jr. for technical assistance; C. Begley for manuscript preparation; Dr. R.G. Webster for manuscript review and suggestions; and Drs. W.R. Dowdle and A.P. Kendal for advice on the resolution of hemagglutinin subtypes.

REFERENCES

Table 1. Prototype influenza A viruses

<table>
<thead>
<tr>
<th>Influenza A virus</th>
<th>Surface antigens</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/FPV/Dutch/27</td>
<td>Hav1Neq1</td>
</tr>
<tr>
<td>A/chicken/ Germany &quot;N&quot;/49</td>
<td>Hav2Neq1</td>
</tr>
<tr>
<td>A/duck/England/56</td>
<td>Hav3Nav1</td>
</tr>
<tr>
<td>A/duck/Czech/56</td>
<td>Hav4Nav1</td>
</tr>
<tr>
<td>A/tern/S.Africa/61</td>
<td>Hav5Nav2</td>
</tr>
<tr>
<td>A/shearwater/ E.Australia/1/72</td>
<td>Hav6Nav5</td>
</tr>
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<td>A/turkey/Mass./65</td>
<td>Hav6N2</td>
</tr>
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<td>A/duck/Ukraine/1/63</td>
<td>Hav7Neq2</td>
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<td>A/turkey/Ontario/6118/68</td>
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</tr>
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</tr>
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<td>A/swine/Iowa/15/30</td>
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<td>A/Hong Kong/68</td>
<td>H3N2</td>
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Table 2. Neuraminidase-inhibition (NI) test results with influenza A virus isolates from domestic poultry in Hong Kong (HK)

<table>
<thead>
<tr>
<th>Influenza A isolate</th>
<th>NI titer&lt;sup&gt;a&lt;/sup&gt;</th>
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<tbody>
<tr>
<td></td>
<td>Antiserum</td>
</tr>
<tr>
<td></td>
<td>N1</td>
</tr>
<tr>
<td>A/chicken/HK/14/76</td>
<td>1660</td>
</tr>
<tr>
<td>A/goose/HK/8/76</td>
<td>1515</td>
</tr>
<tr>
<td>A/duck/HK/193/77</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>a</sup>Figures represent reciprocals of serum dilution causing 50% neuraminidase inhibition.
Table 3. Hemagglutination-inhibition (HI) test results with influenza A viruses and antisera produced to influenza A/duck/Hong Kong/193/77 and A/chicken/Hong Kong/14/76 viruses

<table>
<thead>
<tr>
<th>Influenza A virus</th>
<th>Surface antigens</th>
<th>HI titer&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Antiserum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A/duck/HK/193/77</td>
<td>A/chicken/HK/14/76</td>
</tr>
<tr>
<td>All avian subtypes</td>
<td>Hav1 - Hav9</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Equine subtypes</td>
<td>Heq1 - Heq2</td>
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<tr>
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<td>HON1</td>
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<td>40</td>
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<tr>
<td>MS/N33</td>
<td>HON1</td>
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<tr>
<td>PR/8/34</td>
<td>HON1</td>
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<td>80</td>
</tr>
<tr>
<td>Bel/42</td>
<td>HON1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DSP/43</td>
<td>HON1</td>
<td>-</td>
<td>40</td>
</tr>
<tr>
<td>CAM/46</td>
<td>HON1</td>
<td>-</td>
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<tr>
<td>FN/1/47</td>
<td>H1N1</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>H1N1</td>
<td>-</td>
<td>-</td>
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<tr>
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<td>H1N1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>H1N1</td>
<td>-</td>
<td>-</td>
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<tr>
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<td>H1N1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
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<td>Hsw1N1</td>
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<td>80</td>
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<tr>
<td>NJ/8/76</td>
<td>Hsw1N1</td>
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<tr>
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<td>Hsw1Neq1</td>
<td>40</td>
<td>80</td>
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<tr>
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<td>H2N2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Aichi/2/68</td>
<td>H3N2</td>
<td>-</td>
<td>-</td>
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<td>H3N2</td>
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<tr>
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<td>320</td>
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<tr>
<td>Goose/HK/8/76</td>
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<td>320</td>
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</tr>
</tbody>
</table>

<sup>a</sup>Reciprocal of serum dilution inhibiting 4 hemagglutinating units of the influenza A virus.

<sup>b</sup>Indicates no inhibition at serum dilution of 1/20.
ISOLATION OF A VIRUS INDISTINGUISHABLE FROM ADENOVIRUS 127 FROM CHICKENS IN THE UNITED STATES

G.M. Schloer,¹ A.H. Dardiri,¹ W.K. Butterfield,¹ V. Yates² and S.S. Breese, Jr.¹

SUMMARY

A serological survey was made for the presence of antibody to adenovirus 127, the virus associated with the egg drop syndrome (EDS) of 1976. A standard hemagglutination-inhibition (H.I.) assay was used to detect antibody to the virus. Over 1900 chicken sera from 11 states, which were taken primarily from progeny chickens hatched from eggs imported from Europe, were examined for antibody to adenovirus 127. Over 200 sera from domestic ducks were also tested, since the virus was reputed to be of duck origin.

Low levels of H.I. antibody, with titers ranging from 2 to 16, were found in three flocks on a farm in North Carolina. Only 1.7% of the affected flocks showed evidence of antibody to adenovirus 127. There was no increase in titer or frequency of positives upon subsequent bleeding of the chicken from these flocks. In contrast, sera from 5 out of 7 duck flocks tested were H.I. positive with titers ranging from 2 to 4096. Negative sera were from two special breeding duck flocks.

Isolation of a virus morphologically and serologically indistinguishable from adenovirus 127 was made from 3 chickens in the flock in North Carolina. Two of the chickens had low H.I. titer to adenovirus 127.

INTRODUCTION

A new avian adenovirus has been isolated independently by McFerran, et al. in Ireland⁵ and Baxendale in England¹ from chickens in flocks having an egg drop syndrome (EDS). This syndrome originally described by the Dutch¹ was first evident in 1976 and is associated with a drop of egg production to 45% of the expected level. The drop in egg production may vary greatly in affected flocks. McFerran, et al.⁵ reported a drop of 10 to 30%. The epizootiology of this virus has not been established. There appears to be limited lateral spread so that vertical transmission has been postulated but not documented.¹ ³ ⁴ It is hypothesized that chickens may have become infected after the injection of a vaccine contaminated with the virus.¹ The presence of high hemagglutination inhibition titer

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ADENOVIRUS 127

(H.I.) to adenovirus 127 has led to the suggestion that this virus is normally found in ducks.1,2 The Irish 127 and the English BC14 isolates are the only adenoviruses known to hemagglutinate chicken erythrocytes. These two viruses appear to be serologically identical,2 but are not related to the 11 prototype avian adenovirus serotypes by serum neutralization tests.8 Upon examination in the electron microscope, the adenovirus 127 appears to be somewhat different from the prototype avian adenoviruses.4

The new adenovirus appears to have caused an epidemic of depressed egg production in Ireland in 1976.8 The egg drop dyndrome (EDS) is one of the most important problems affecting poultry in Europe and Britain.2 Antibody to the new adenovirus was detected in many chicken flocks in Europe, which experienced a drop in egg production (3). A number of chicken flocks have imported hatching eggs from Europe to the USA in the past few years. As a result, a serological survey for the presence of antibody to adenovirus 127 was initiated by the Animal Plant and Health Inspection Service (APHIS) of the U.S. Department of Agriculture (USDA). Most of the sera examined were from progeny flocks hatched from fertile eggs imported from Europe. In addition, sera from several duck flocks were examined as well as sera from certain chicken flocks with a decline in egg production. This report concerns the results of the serum survey conducted at Plum Island Animal Disease Center (PIADC) and the isolation from chickens in the USA of a virus which is serologically and morphologically similar to adenovirus 127.

METHODS AND MATERIALS

Virus

Adenovirus 127 and homologous serum was obtained from J.B. McFerran.3 Virus was propagated in chick kidney cultures prepared from day-old Spafas chickens.9 Five days post-inoculation (DPI) amnioticallantoic fluids (a.a.f.i) were collected, centrifuged at 2,000 RPM on an International Centrifuge at 4C and the supernatant fluids saved. Virus aliquots were stored at -70C in 1 ml ampoules.

Virus isolations were made in embryonated duck eggs. Inoculation was made into the allantoic sac of 12 to 14 day old embryonated duck eggs. Eggs were removed 4 to 5 days p.i., fluids were harvested and processed as described above. Virus titrations were done in duck embryos using 3 eggs per dilution and tenfold dilutions of virus. Eggs were individually tested for HA activity. The 50% endpoints were determined and expressed as egg infectious doses (EID50).8

Antisera

Antisera to adenovirus 127 were prepared in 1-year-old Spafas

8Dept. of Agriculture, Veterinary Research Laboratories, Stormont, Belfast, Northern Ireland.
roosters. Chickens were inoculated intranasally with approximately 10^6EID_50 virus and were bled prior to inoculation and 10 dpi.

**Hemagglutination (HA) and hemagglutination-inhibition (HI) assays**

The HA and HI tests were done in microtiter plates and were similar to the standard methods used for influenza virus by the Center for Disease Control. The HA assay used serial twofold dilutions of virus suspended in 0.05 ml of buffered saline, to which was added 0.05 ml of 0.5% chicken red blood cells. After incubation for 30 minutes at room temperature (R.T.), the test was read and the results were expressed as the reciprocal of the highest dilution of virus showing complete agglutination of the red cells.

The HI test employed serial twofold dilutions of serum diluted in 0.025ml of saline, to which was added 4 HA units of antigen in 0.025 ml. The antigen and antisera mixtures were incubated for 30 minutes at 37°C. Thereafter, 0.05 ml of 0.5% chicken red blood cells was added to each well and incubated for 30 minutes at R.T. The titer was expressed as the reciprocal of the serum dilution producing 100% inhibition of the HA activity. Positive and negative control sera were used with all of the tests.

None of the sera including the positive and negative control sera used in the survey were heat inactivated, since the small size of the samples made this impractical. All were tested in a standard H.I. test for presence of antibody to adenovirus 127. Those sera with a positive reaction were retested and serum controls were done with each serum. Some sera showed a high frequency of non-specific reactions, as evidenced by reactions with red cells alone. Only those sera which showed inhibition greater than that found in the controls and which reacted in a tilt test routinely used for influenza virus H.I. tests were considered positive.

**Serum neutralization (S.N.) assay**

A standard S.N. test was done in 12 to 14-day-old embryonated duck eggs. Serial twofold dilutions of antiserum were made in phosphate buffered saline (PBS). An equal amount of antigen containing 100 EID_50 of virus was added to the diluted sera. A single 1:20 dilution of control serum with an equal volume of virus was used in each test. Embryos were inoculated with 0.2 ml of the mixture. They were incubated for 5 days at 37°C and chilled. Amniotic allantoic fluids were harvested and tested for HA activity. Titers were expressed as the reciprocal of the dilution producing 50% inhibition of virus replication.

**Procedure for virus isolation**

The following tissues were taken from chickens at necropsy, trachea, liver, spleen, ovary, oviduct and rectum. Cloacal, tracheal and ocular swabs were taken and suspended in 2.0 ml of PBS. A portion of each tissue was weighed, ground in a Ten Broeck grinder and diluted 1:3 on a wt. vol. basis with PBS. Swabs and tissues were stored at -70°C before use.

Embryonated duck eggs were supplied by the USDA, SEA, FR,
Poultry Laboratory at East Lansing, Michigan, and were used for all isolation attempts. The supply flock was found to be free of antibody to adenovirus 127. Embryonated duck eggs were inoculated with 0.2 ml of tissue or swab suspension. Embryos were earlier stated 12 to 14 days of age, and three eggs were inoculated per sample. After 5 days of incubation at 37°C eggs were chilled, the aaf was removed and tested for HA activity. An H.I. test was done on all HA positive fluids using anti-adenovirus 127 serum as well as normal control serum. Where necessary, a second passage of HA positive fluids was done to increase the virus titer.

**Electron micrographs**

Virus for examination in the electron microscope (E.M.) was harvested from embryonated duck eggs. Infected aaf was centrifuged at 2,000 RPM for 10 minutes at 5°C in an International Centrifuge. Supernatant fluids were layered on top of a 30% sucrose cushion and centrifuged for 2 hours at 25,000 RPM in a SW 27 Beckman rotor 5°C. Virus pellets were suspended in minimal amount of PBS. Virus was negatively stained with phosphotungstic acid (PTA) and examined in the electron microscope.

**RESULTS**

**Serological survey**

Over 1900 chicken sera were examined for evidence of H.I. antibody to adenovirus 127, Fig. 1. The survey considered primarily flocks from progeny hatched from embryonated eggs imported from Europe. In addition, some flocks with an egg drop problem were examined from California, Massachusetts and Pennsylvania. Only a single farm in North Carolina showed evidence of antibody to adenovirus 127. In contrast, 5 of the 7 duck flocks had H.I. antibody to the virus, Fig. 2. Two flocks, one in Michigan and Indiana respectively, had no demonstrable H.I. titer. Both flocks were special breeding stock.

Table 1 lists the frequency and distribution of H.I. titers to adenovirus 127. For purposes of the survey, serum with an H.I. titer of 2 or greater was considered H.I. positive. McFerran et al. has recorded a titer of 4 or greater. The range of titers in the case of the chicken sera is low, ranging from 2 to 16. The most frequent titer is 8. The range of titers is considerably greater in the case of the duck sera, ranging from 2 to 4096. However, the most frequent titer is 16 with the highest incidence of HI titers ranging from 4 to 64. Despite the prevalence of antibody to adenovirus in ducks, little serological evidence for the presence of the virus was found in chickens.

**Serological response of chickens to adenovirus 127 from a farm in North Carolina**

The initial survey of the North Carolina farm showed only two sera out of 220 with an H.I. titer of 16, Table 2. Eighty sera from houses 2 and 3 were examined; only a single serum in each house showed evidence of H.I. antibody. Chickens at that initial bleeding were 21 weeks of age. Subsequently, a greater number of sera from houses 1, 2 and 3 were examined for antibody to adenovirus 127. At subsequent bleedings, when
the birds were 26 and 30 weeks of age, 0.9 to 3.1 percentage of chickens had positive sera. A total of 1280 sera were examined. The overall percentage positive was 1.7%.

As a result of the suspicious serology, 22 chickens with both positive and negative serology were shipped to Plum Island. Five of the chickens were dead upon arrival. They were transferred to a room free of exposure to virus and necropsied. Extensive hemorrhage was seen in all visceral organs. Birds appeared to have died of suffocation or stress. The remaining birds were placed in an isolated room. They were bled, and tracheal and cloacal swabs were taken at about 10 day intervals. No evidence of H.I. antibody was seen in chickens, which were H.I. negative upon entrance into the laboratory. Those chickens with low H.I. titers showed some persistence, and in a few cases, a drop in H.I. titer.

Two months after the chickens were placed in isolation, they were divided into two groups of four chickens. Group I had some evidence of previous H.I. titer, while H.I. titer was not detectable in Group II. Both groups of chickens were inoculated with approximately 10^6 EID_50 doses of adenovirus 127. The antibody response of both groups of chickens is found in Table 3. Only 2 of the 4 chickens in Group I still had residual H.I. titer at day 0. Both of those chickens, 70076 and 70122, showed both S.N. and H.I. titers at 3 dpi. The other two chickens in Group I and the 4 in Group II showed no rise in antibody at 3 dpi. All birds had high H.I. and S.N. titers at 8 dpi. The two chickens, 70076 and 70122 with persistent antibody, showed evidence of anamestic response to adenovirus 127.

Isolation and identification of virus from chickens in North Carolina

Seven swabs and 26 tissues from the 5 dead birds shipped to our laboratory were examined for evidence of adenovirus 127. In addition, pairs of tracheal and cloacal swabs were taken in North Carolina and shipped frozen to the laboratory. A total of 13, 46 and 10 pairs of swabs from houses 1, 2 and 3 respectively were examined for virus.

Positive isolates were made on samples from three chickens, all originating from house 3. The isolate from chicken 70692 was made from a cloacal swab sent from North Carolina. In addition, virus isolates were obtained from two chickens, which were dead upon arrival at our laboratory. Virus was isolated from the kidney of bird 70748, while three separate isolations were made from the tracheal and ocular swabs, as well as from the ground tracheal tissue of bird 70618. A confirmation of the tracheal isolate was made in a separate laboratory, which never had prior exposure to adenovirus 127. Virus was isolated from a separate portion of the intact trachea which had been stored at -70°C. In the latter case, virus was not detected upon first passage in embryonated duck eggs, but was recovered at the second passage. No virus was evident by direct examination in the electron microscope of a suspension of the ground trachea, from which the initial isolation was made.

Serological identification of the viral isolates

The isolates were serologically identified by both H.I. and S.N. titrations using anti-adenovirus 127 sera as well as control sera. The
titers of the three isolates as well as the adenovirus 127 was shown in Table 4. The H.I. and S.N. titers of the 3 isolates varied from 64 to 128 and 320 to 640 respectively. The control adenovirus 127 also had 64 and 320 H.I. and S.N. titer respectively. The slightly higher titer of the 70748 kidney isolates is not significant, since it is only a two fold difference. The isolates from the tracheal and ocular swabs of bird 70618 had H.I. titers with adenovirus 127 antiserum identical to the 70618 tracheal isolate and were not included in the table. Thus, these isolates from the three birds in house 3 are serologically similar to adenovirus 127.

**Electron Microscope (E.M.) examination**

The three isolates as well as the 127 adenovirus were compared in the E.M. All of the viruses were morphologically indistinguishable from adenovirus 127. Fig. 3 shows the micrographs of 127 and the 70618 isolate from the trachea. Both viruses had icosahedral symmetry and are similar in size to adenoviruses. The characteristic fibers which normally project from the vertices of adenoviruses were not seen in both of the viruses examined. This finding for adenovirus 127 was reported previously.

**DISCUSSION**

Three separate isolations were made of a hemagglutinating virus which was morphologically and serologically similar to adenovirus 127. The isolations were made from a flock in which only 1.7% of the chickens showed evidence of antibody to the 127 virus. The flock showed no evidence of viral spread or increase in H.I. titer, after serial bleedings of chickens in this flock. Moreover, no drop in egg production was reported in this flock. Chickens were 21 weeks old at the time of the initial survey. No increase in number and frequency of positive sera were seen in the flock tested at 26 and 30 weeks of age. This is in contrast to the experience with this virus reported by others.

Previous work by both McFerran’s and Baxendale’s group had shown that positive serology to the 127 virus was correlated with a drop in egg production. In the initial report by McFerran et al., most of the flocks had high H.I. titers ranging from 32 up to 512. However, 2 of the 10 flocks had geometric mean H.I. titers of 8, with a range of 4 to 32 in one flock. The other flock showed only 20% of the flock with positive serology. Both flocks showed a 10 to 25% drop in egg production. The mean titers of the 2 positive flocks reported by McFerran et al are not too different from the titers in the North Carolina flock, but the 1.7% positive serology is far lower than that found in previous work.

The epizootiology of this disease has not been documented. There appears to be some lateral spread with the possibility of vertical spread via the semen or the egg. However, there is no experimental evidence of vertical transmission in chickens. The only pathology reported in this disease has been confined to microscopic lesions in the uterus. Previous isolations have been obtained from nasal and pharyngeal tissues as well as from the faeces and oviduct. Isolations from the buffy coats have been obtained during active disease. All of the previous isolations were from flocks showing EDS. Our isolates were
from birds without any evidence of EDS. The isolations suggest that the virus may be carried latently in a small number of birds, a situation previously postulated by Baxendale et al.\(^3\) Latency is typically found in adenovirus infections. It is not presently known whether the isolates will cause the egg drop syndrome.

The role of ducks in the transmission of the virus is at present unknown. Positive H.I. titers shown in this report have been reported by others.\(^1\)\(^3\)\(^4\) A virus serologically similar to adenovirus 127 has been isolated by Dr. S. Kleven (University of Georgia, Athens, GA) from a flock of ducks showing antibody to adenovirus 127; (personal communication). The role of wild ducks in the epizootiology of the virus is under investigation.

REFERENCES

Table 1. Frequency distribution of hemagglutination inhibition (H.I.) titers of chicken and duck sera to adenovirus 127

<table>
<thead>
<tr>
<th>Type of sera</th>
<th>Total number</th>
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<td>156</td>
<td>7 15 27 37 28 23 9 6 .2 1 1</td>
</tr>
</tbody>
</table>

<sup>a</sup> In this table, sera were considered positive if the H.I. titer was 2 or greater.
Table 2. Frequency and range of hemagglutination inhibition (H.I.) titers of chicken sera from a farm in North Carolina to adenovirus 127

<table>
<thead>
<tr>
<th>Age of chickens in weeks</th>
<th>Number tested</th>
<th>Percent&lt;sup&gt;a&lt;/sup&gt; positive</th>
<th>H.I. titer</th>
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<tr>
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<td>26</td>
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<tr>
<td>30</td>
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<tr>
<td><strong>Total</strong></td>
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<td>1.7</td>
<td>5</td>
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</table>

<sup>a</sup> In this table sera were considered positive if the H.I. titer was 2 or greater.

<sup>b</sup> Sera from five groups of chickens were examined. Only house 2 and 3, consisting of 40 samples per house, showed evidence of H.I. titer.

<sup>c</sup> Sera came from house 1, 2 and 3.
Table 3. Hemagglutination inhibition (H.I.) and serum neutralization (S.N.) titers of two groups of chickens after intranasal inoculation of adenovirus 127

**Group I.** Chickens with low previous H.I. titer to adenovirus 127

<table>
<thead>
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<th>0</th>
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<th>8</th>
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<td>H.I.</td>
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<td>70076</td>
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<tr>
<td>70264</td>
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<td>70122</td>
<td>4</td>
<td>&lt;4</td>
<td>8</td>
</tr>
<tr>
<td>70485</td>
<td>&lt;2</td>
<td>&lt;4</td>
<td>&lt;2</td>
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</table>

**Group II.** Chickens with no previous antibody to adenovirus 127

<table>
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<th>Chicken</th>
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<td>H.I.</td>
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<td>&lt;4</td>
<td>&lt;2</td>
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<tr>
<td>9488</td>
<td>&lt;2</td>
<td>&lt;4</td>
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Table 4. A comparison of the hemagglutination inhibition (H.I.) and serum neutralization (S.N.) titers of the adenovirus isolates with adenovirus 127 using adenovirus 127 antiserum

<table>
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<th>Source of virus</th>
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<tr>
<td></td>
<td></td>
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<tr>
<td>Chicken</td>
<td></td>
</tr>
<tr>
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<td>trachea</td>
</tr>
<tr>
<td>70748</td>
<td>kidney</td>
</tr>
<tr>
<td>70692</td>
<td>cloaca</td>
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<tr>
<td>Control</td>
<td>adenovirus 127</td>
</tr>
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</table>

a S.N. titer is the reciprocal of the dilution of serum showing 50% neutralization.
DUCK SERA WITH H.I. ANTIBODIES TO AVIAN ADENOVIRUS 127

TOTAL 156/277
ADENOVIRUS 127
REPORT OF THE COMMITTEE ON
TRANSMISSIBLE DISEASE OF POULTRY

Chairman: R. A. Bankowski, Davis, Calif.
Co-Chairman: W. K. Butterfield, Plum Island, N. Y.

E. S. Bryant, F. G. Buzzell, H. E. Goldstein, L. C. Grumbles, P. Halbert,
Merritt, H. E. Nadler, W. C. Patterson, I. L. Peterson, B. S. Pomeroy, J.
B. Roberts, T. B. Ryan, J. Smiley, H. W. Towers

NEWCASTLE DISEASE

There were no reported cases of velogenic viscerotropic Newcastle
disease (VVND) in commercial poultry, backyard flocks, captive or wild
game birds in the continental United States in 1978. The increased ef-
fectiveness of surveillance activities, especially those associated with
border inspection and import facilities, has accounted for this period of
success.

Puerto Rico remains under Federal quarantine for VVND, USDA
inspects passenger hand baggage and luggage for all air flights from
Puerto Rico to the United States to remove live poultry and poultry
products. Pit-hold baggage is inspected at the San Juan airport on flights
originating in the Virgin Islands destined for the United States.

MYCOPLASMOSIS

Veterinary Service is continuing to distribute mycoplasma diagnostic
reference antigens and serums.

Dr. E. T. Mallinson reported studies conducted on the relative merits
of MG free and F-strain MG inoculated layers over naturally infected
layers. Additionally, the studies are focused on the possible utility of
artificial exposure in MG eradication.

Comparisons between 36 flocks reveal statistically significant, but
modest, increases in total hen housed egg production in inoculated flocks
over naturally infected flocks. Comparisons between 10 MG free layer
flocks and naturally infected or F-strain inoculated flocks revealed im-
pressive differences in total hen housed egg production in favor of MG
free layers.

Results in 2 large and 1 medium sized multiple age table egg pro-
duction operations have revealed promising results in using MG
inoculation as a practical tool in converting the status of these operations
from MG positive to MG negative. Horizontal spread of F-strain MG was
found to be minimal six weeks post-inoculation.

ORNITHOSIS

Ornithosis in turkey flocks in Texas has subsided considerably since
the outbreak of the disease that last occurred in June of 1976. The
Federal and State surveillance program was therefore discontinued as of August 1, 1978.

ADENOVIRUS

Dr. D. King presented a status report on adenovirus 127. Fertile eggs for hatching have been imported from Europe where the condition called "Egg Drop Syndrome-76" is known to exist. A survey was conducted on 45 flocks originating from imported hatching eggs. A low level of antibody was determined in one breeding flock during this survey. Birds with positive serum titers were sent to the Plum Island Animal Disease Center and the Veterinary Services Laboratory. A virus similar to adenovirus 127 was isolated at Plum Island. No clinical signs have been noted in the flock in question.

The breeding flock in question was destroyed following a normal laying season on September 26, 1978. No virus isolation or antibody recovery were found at time of processing. Progeny of this flock have been sampled. From approximately 4,000 birds, 842 sera were collected and found to be negative for adenovirus 127 antibodies. A report by Dr. G. Schloer on the isolation of the virus and other studies conducted at Plum Island is published elsewhere in the proceedings.

A survey of ducks for antibodies to the 127 isolate indicates that the adenovirus seems to be widespread in the U.S.

CERTIFIED VVND NEGATIVE FLOCKS

The report of the VVND-Negative Flock certification program subcommittee meeting which was held in Las Vegas, June 6, 1978, which recommended the committee of transmissible Diseases of Poultry endorsement of the document "California Proposal for Turkey Breeder Surveillance for Exclusion of Exotic Newcastle Disease as amended 6/28/78" (California Proposal) was distributed and reviewed. The objectives of the proposal were summarized in the proceedings of the committees' report for 1977.

Veterinary Services position paper (November 1978) agreeing with the concept of the "California Proposal" was as follows:

Veterinary Services (VS) is in agreement with the concept of certification of breeding flocks in quarantined areas under certain prescribed conditions as being free of a specific disease (e.g., velogenic viscerotrophic Newcastle Disease-VVND) and developing a program to allow the movement of hatching eggs from such flock(s) to areas outside of the quarantined area:

Once a quarantinable disease has been diagnosed in an area and a quarantine has been established, specific parameters including type of tests, testing frequency, testing intervals, record evaluation, security procedures, etc., for certification of a flock for movement of product may need to be modified. For example, the proximity of the flock to be certified to the disease focus would influence the approval of certification if
it is established that undue risk of disease transmission to the poultry industry would result. Veterinary Services, taking into consideration recommendations of State poultry health officials, poultry industry officials and selected poultry disease authorities, will approve these changes in certification procedures. The final decision to certify a particular flock, however, must be the responsibility of the State and Federal regulatory agencies based on recommendations of the regional poultry and other task force epidemiologists and criteria established by the regulatory agencies. It is important to note that once a quarantine has been established, this certification program will then only apply to movement of poultry hatching eggs from the quarantined area.

VS, along with the States, must retain the ability to establish a quarantine ("stop movement" or "hold order") on all products from all flocks in the quarantine area until epidemiological evaluation and assessment of the outbreak can be made. VS, along with the States, must retain the ability to establish surveillance procedures on a premises or in an area under quarantine so that the extent of the disease can be determined.

VS believes that the revised California proposal does not conflict with VS program procedures concerning VVND outbreaks.

The National Turkey Federation (October 20, 1978) and the Pacific Egg and Poultry Association (October 4, 1978) are on record of endorsing the proposal (California Proposal). The Committee on Transmissible Diseases of Poultry unanimously approved the Subcommittee Report, endorsed the “California Proposal” and charged the Subcommittee to:

1.) Develop a similar certification program for chicken breeder flocks and:

2.) Recommend a program for salvage of VVND infected pedigree breeding stock.

A resolution recommending USDA and State Animal Health Regulatory Agency adoption and a VVND-negative flock certification program for turkey primary breeding as outlined in the “California Proposal” was unanimously approved and sent to the Resolution Committee.

PROBLEMS OF AVICULTURE

The problems of Aviculture were presented before the committee by Dr. R. E. Baer, President of the American Federation of Aviculture. Among the points emphasized, Dr. Baer stated that the industry not only consists of commercial importers, the dealer and the manufacturers of pet and aviary products, but reaches out to the Veterinary profession which provides the medical care and to agriculture which produces the grain for feed. As an industry, aviculture is valued at over 500 million dollars.
Dr. Baer concluded that the USAHA can provide a forum necessary from which to work out many of aviculture's problems; a forum where aviculture and industry, both pet and poultry, can meet with regulatory officials, Federal and State, and other interested parties to resolve differences; USAHA could help establish that liaison which is needed for the intelligent development of preventive animal disease programs and concepts as pertain to cage and aviary birds, the control of exotic avian diseases, and the fostering of research into avian disease problems. To pursue this goal, a subcommittee on cage and aviary birds was formed to study these problems and to report to the Committee on Transmissible Diseases of Poultry at the next year's meeting. This committee consists of industry, technical, regulatory personnel and aviculturists.

QUARANTINE STATIONS

A report of the status of bird import quarantine facilities was made by Dr. G. Pierson. There are 82 approved quarantine facilities located at 11 ports of entry. This is an increase of 34 since the beginning of this fiscal year. Most of the facilities are located in California with 39, followed by Florida with 15. Upwards of 70% of the birds imported enter through these two States. Detection of Newcastle Disease remains at a similar level as in the past year. Twelve lots containing about 25,000 birds were found to be infected with velogenic viscerotropic Newcastle Disease during FY 1978. This compares to 16 (FY 1977), 13 (1976), 19 (1975), and 6 (1974).

Pacheco's (psittacine herpes virus) disease was diagnosed on several occasions in birds shortly after their release from quarantine.

Mortality rates in birds handled at private quarantine facilities remained similar to previous years. For calendar year it was 13.2, for 1977 it was 13.9%.

The cost of the bird import program has risen to over $2 million per year. Commodity Credit Corporation (CCC) funds have been used for this program. Early this year it was anticipated that CCC funds would not be available for the bird import program in FY 1979. The budget request for FY 1979 included $2.412 million for bird imports. This request was denied by Congress. A "user free" system, effective October 1, 1978, was established.

INFLUENZA

Avian influenza (AI) did not appear to be as serious a problem in the U.S. as in the past years except for some outbreaks in turkeys in Minnesota. Three outbreaks in late 1977 involved approximately ½ million birds. In one outbreak involving 14 flocks, losses were complicated by Colibacillosis.

A survey between 1974 and 1976 of wild duck populations in the Agassiz National Wildlife refuge and the Roseau River Wildlife area in
Minnesota resulted in isolation of 60 influenza A viruses with a great variety of serotypes.

Dr. James Pearson, of the National Veterinary Services Laboratory, Ames, Iowa, submitted information regarding influenza A virus and Newcastle Disease virus isolations from birds at import quarantine stations. The results were as follows:

<table>
<thead>
<tr>
<th></th>
<th>1977</th>
<th>Jan.-May 1978</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. Samples</td>
<td>26,552</td>
<td>12,417</td>
</tr>
<tr>
<td>Total No. Lots</td>
<td>218</td>
<td>118</td>
</tr>
<tr>
<td>Avg. Samples/Lot</td>
<td>121.8</td>
<td>—</td>
</tr>
<tr>
<td>Lots VVNDV Positive</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Lots HA + NDV-</td>
<td>53</td>
<td>18</td>
</tr>
<tr>
<td>No. HA + Samples</td>
<td>640</td>
<td>571</td>
</tr>
</tbody>
</table>

Dr. Pearson reported that Dr. R. VanDeusen conducted studies to characterize hemagglutinating isolates, other than NDV. One isolate proved to be pathogenic for chickens and resulted in the death of two out of eight inoculated chickens. The isolate was typed as avian influenza, antigenic type Hav4Neq 2. The envelope antigens found in this isolate were the same type as those which caused the high mortalities in chickens in Alabama in 1975.

MISCELLANEOUS

There has been a national continuing trend toward reducing emphasis on instruction in avian medicine in Colleges of Veterinary Medicine. This Committee expresses concern about this trend in Veterinary medical education because future ability to prevent, control and eradicate infectious diseases of poultry depends on an adequate supply of research, regulatory and technical support personnel who are well trained in avian medicine. We urge all colleges of Veterinary medicine to include more adequate instruction in this area.

THE FOLLOWING SUBCOMMITTEES WERE FORMED:


U.S. POULTRY HEALTH ADVISORY COMMITTEE TO APHIS: E. Bryant, H. Goldstein, R. Hogue, I. Peterson, B. Pomeroy, T. Ryan and R. McCapes, Chairman.


WHERE ARE WE IN CONTROLLING SALMONELLOSIS?

H. Graham Purchase

U.S. Department of Agriculture, Science and Education Administration, Agricultural Research, National Program Staff, Livestock and Veterinary Sciences, Beltsville, Maryland 20705.

Parts of this paper were presented at the annual meetings of the American Public Health Association, Washing, D.C., October 30-November 3, 1977 and the American Veterinary Medical Association, Dallas, Texas, July 17-20, 1978.

SUMMARY

Specific Salmonella infections of man (typhoid) and of poultry (fowl typhoid and pullorum disease) have been largely controlled in developed countries. However, control of other species of Salmonella is difficult because of the complexity of the cycle of infection of the organism, the exceedingly large number of sources of the organism and the large number of persons, groups, and agencies involved in research and regulation. Also, there is a gap between available basic technology to destroy or prevent contamination with Salmonella and technology that is acceptable, inexpensive and applicable on a large scale. Research effort to develop new technologies is small—it amounts to about $2.7 million. There are Salmonella control programs for certain feeds and for the production, processing, further processing and cooking of food. With current technology, an eradication program would likely cost far more to the consumer than the benefits the consumer would derive from such eradication. Nevertheless, practical Salmonella control can be achieved through progressive application of new technology developed through research.

INTRODUCTION

In this paper, I will emphasize salmonellosis control in poultry. Also, I will exclude discussions of human typhoid caused by Salmonella typhi and will mention only briefly fowl typhoid caused by Salmonella gallinarum and pullorum disease caused by Salmonella pullorum. These are specific organisms that have been largely controlled in developed countries.

The veterinary and medical professions have been interested in salmonellosis almost since the turn of the century. However, in the last two decades, interest has intensified with a proliferation of publications, reports, task forces, advisory committees and regional, national and international meetings (1-6). A discussion of Salmonella control programs is very timely as the roots of the problem are defined and opportunities for better control emerge.
The control of most zoonotic diseases is far easier than the control of salmonellosis for the following reasons: (a) the complexity of the cycle of infection of salmonellosis; (b) the exceedingly large number of sources of Salmonella; and (c) the large number of persons and groups interested in salmonellosis.

The complex cycle of infection needs little elaboration. Briefly, Salmonella organisms are transmitted: (a) through the feed, processing plant, rendering plant, blending plant, feed cycle; (b) from parent to offspring through egg contamination and hatchery dissemination; and (c) from one flock to another, both temporally and spatially, through a contaminated environment. Almost everything touched or eaten by animals and man can be contaminated with Salmonella. Thus, the sources of the organism are so diverse that controlling all of those sources is very difficult.

Persons interested in Salmonella contamination during feed and food production and consumption include the importer, renderer, blender, hatchery, grower, producer, transporter, processor, further processor, wholesaler, retailer, housewife and restaurateur. Interest groups may be integrated and represent more than one of these persons. Also, various associations formed by these persons and by consumers must be included; e.g., poultry-producing associations, consumer safety groups.

Groups interested in and performing research are: the National Institutes of Health, Center for Disease Control and Food and Drug Administration of the Public Health Service of the U.S. Department of Health, Education, and Welfare; the Science and Education Administration, the Food Safety and Quality Service, Animal and Plant Health Inspection Service and Foreign Agricultural Service of the U.S. Department of Agriculture; the Fish and Wildlife Service of the U.S. Department of the Interior; the National Science Foundation; the state agricultural experiment stations and universities; other non-profit organizations and private industry.

Groups with regulatory jurisdiction over some aspects of the Salmonella cycle include the National Institutes of Health, Center for Disease Control and Food and Drug Administration of the Public Health Service; the Science and Education Administration, Agricultural Marketing Service, Animal and Plant Health Inspection Service and Food Safety and Quality Service of the U.S. Department of Agriculture; the National Oceanic and Atmospheric Administration of the Department of the Interior; the Environmental Protection Agency; and agricultural and health departments of state and local governments.

With the large number of interested persons, sufficient unanimity in a democratic society to obtain action is difficult to find. Each party blames the other or considers the other responsible for the Salmonella contamination. For example, renderers and feed blenders say that control at
their level is useless if vertical transmission of the organisms cannot be prevented and if contaminated poultry houses cannot be cleaned up. Conversely, poultry breeders are unable to eliminate the organism from breeding flocks without Salmonella-free feed. Certainly, in the production and consumption area, each group considers its area the least important in causing Salmonella contamination and expects the other groups to take action.

GAP BETWEEN BASIC AND APPLIED TECHNOLOGY

We have the technology to destroy or prevent most of the contamination of our feed and foodstuffs with Salmonella. However, implementation of the technology is either unacceptable or too expensive. Let me give you a few examples.

We know most of the sources of contamination during animal production, but we do not know which are the most common and the most important. Some people say feed is most important, and others say environment or egg transmission. We know how to kill the organism with heat, but we do not know how to consistently inactivate the organism during pelleting of feed. We know how to kill the organisms with formalin, but we do not know how to free contaminated fertile eggs of the organism and we do not know how to clean up the growing houses consistently. We know how to pasteurize eggs, but we do not know how to pasteurize meat. We know how to perform aseptic surgery, but we do not know how to process and cut up meat and consistently avoid contaminating it. We know how to produce sterile broth by autoclaving, but we do not know how to consistently produce sterile cooked meat in every home. We know how to detect human carriers, but we do not know how to consistently prevent contamination of food by humans.

Most of the time, the basic technology we have to eliminate organisms or prevent contamination of our food (e.g., heat sterilization or aseptic surgery) cannot be applied because it is either unacceptable (e.g., sale of sterile meat) or too expensive (e.g., aseptic or sterile processing and cut up). Thus, we need technology that is acceptable, inexpensive and applicable on a large scale.

EFFORTS OF U.S. DEPARTMENT OF AGRICULTURE IN SALMONELLA RESEARCH

To tabulate the effort of the U.S. Department of Agriculture (USDA) in Salmonella research, a computer printout from the Current Research Information System (CRIS) was obtained. All projects conducted in the Science and Education Administration (SEA), Federal Research (FR) (formerly the Agricultural Research Service) and in the State Agricultural Experiment Stations (SAES) system are entered into the CRIS computer. Research conducted by private foundations and industry is not included. Each project was examined, and the total effort (funds and scientist years (SY's) expended) was apportioned among the various
functions of and hosts found in the Salmonella cycle and among agricultural agencies performing research (Table 1). The procedure was repeated, and the effort was apportioned among commodities involved (Table 2).

Certain deficiencies in poultry salmonellosis research are obvious (Table 1). In particular, no research is being performed in SEA, AR and little in SAES on salmonellosis in poultry feed, including rendering and sampling of the feed and water. Little research is being performed on breeding flocks, hatcheries, vertical transmission or sampling of dead embryos and infertile eggs. The total effort on salmonellosis in poultry is fewer than 13 SY's, or the equivalent of fewer than 13 full-time scientists' research effort, in SEA and fewer than 7 SY's in SAES. This number is an exceedingly small proportion of the approximately 11,000 scientists working in these Federal and State research agencies. An even smaller effort is devoted to research on mammalian salmonellosis; i.e., fewer than 8 SY's in each agency (Table 1). Although the effort appears to be more evenly distributed, there are again gaps, particularly in the farm production area as opposed to slaughter, processing, and further processing. The distribution of research among animal commodities is in Table 2. Eggs and poultry meat have the largest effort, and the effort in mammalian salmonellosis is small.

With the low level of Salmonella research, ongoing additional research effort is needed. Some of the major areas needing immediate attention have been outlined in the various research studies and committee deliberations (1-7). More research is needed: (a) to determine the base line of infection and epizootiology of the agent in animals; (b) to study factors that influence the level of infection in animals; (c) to develop methods to eliminate, prevent or reduce infection in animals; (d) to develop ways to break the cycle of infection; and (e) to develop methods to control disease in animals and man. The research community needs enough support from consumers and from other interest groups to obtain, through the usual budgetary processes, additional funds and scientists to study these problems. The logical place to study the human disease aspect is in the Public Health Service (PHS), and the logical place to study the animal aspect is the USDA. Both of these areas of research need to be increased.

CURRENT AND RECENT SALMONELLA CONTROL PROGRAMS

Federal, State and local government sanitary programs reduce bacterial levels in meat and poultry operations. These programs naturally impact on Salmonella. Thus, the regulatory agencies in the United States have already reduced and are continuing to reduce the Salmonella level in meats and poultry. With few exceptions, the agencies do not have Salmonella testing programs per se because Salmonella is but one of the many potential bacterial contaminants of our meat and poultry. The bacterial contamination problem is attacked from an overall sanitation approach. The following are brief descriptions of these programs.
WHERE ARE WE IN CONTROLLING SALMONELLOSIS? 355

Animal feed.

A cooperative Federal-State program for the certification of rendering plants was begun in 1968 (8). Its purposes were (a) to define Salmonella contamination problems in animal and marine protein plants and in the general area of animal feed and (b) to develop and test techniques for decontamination of contaminated animal and marine protein plants and feed mills.

In an initial survey, blender plants and, more specifically, the animal protein sources from rendering plants were identified as the major problem. Of the samples tested, 43% were from blender plants, 15% from livestock slaughter plants, 12% from poultry slaughter plants, 14% from independent plants, 14% of the marine samples and 1% of the feather meal were positive. Different surveys have indicated different parts of the cycle to be more important. However, in this initial survey, efforts were concentrated on the rendering plants. The program costs Federal and State agencies $1.5 million annually. By the end of the program in 1972, the success in cleaning up rendering plants had been considerable. Of the 741 plants involved in the program, 196 (26%) were in full compliance with requirements of the program and 519 (70%) were in the process of cleaning up (8).

Because of a lack of funds and because of other emergency situations that required attention, the Animal and Plant Health Inspection Service, USDA, was unable to continue this program. The program was transferred to the Food and Drug Administration (FDA). A study task force from the FDA (7) reached the following conclusions, among others: "A costly but successful program in eliminating Salmonella from rendered animal and marine by-products would not in itself result in a significantly lower incidence of salmonellosis in animals and man." Also, "Any program to eliminate Salmonella from rendered animal and marine by-products would result in higher prices for the feed industry and ultimately for the consumer. The promulgation of any program would involve unacceptably high expenditure of resources." The FDA decided not to continue the program. Thus, the program came to an end in 1972. Since then, we do not know how many rendering plants have remained free of infection.

Recently the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service began a voluntary Salmonella inspection process for fishmeal plants in the United States. The program is paid for by the industry and to date involves 18 plants that supply 65% of the fishmeal in the United States.

Animal production.

The program of the National Poultry Improvement Plan (NPIP; see 7 United States Code 429) for the control of pullorum disease and fowl typhoid incorporates many sanitary procedures that affect all Salmonella spp. For example, strict egg sanitation standards including preincubation
fumigation of hatching eggs, reduction of personnel movement between premises and control of rodents, birds and wild animals, all reduce the level of Salmonella contamination or the chance of Salmonella introduction. In addition, chickens are tested serologically for antibody to Salmonella groups, and litter is monitored for Salmonella in many poultry operations.

The NPIP program for control of typhimurium in turkeys was started in 1965 and continued until 1974 by which time many flocks were free of this organism. A similar program was started a little later in chickens and continued until about 1976 by which time about one-quarter of the industry had complied with the testing requirements of the plan. However, these programs were discontinued because only one Salmonella sp. was being attacked and a more general sanitation program was sought. In 1976, the General Conference Committee of the NPIP adopted a “sanitation monitored” program. For certification in this program, breeding flocks must comply with a long series of sanitation procedures and must have acceptably low levels of contaminating organisms when monitored. Regular monitoring of the sanitation program is required; and if the isolation of organisms has increased, additional strict sanitation requirements are put into effect.

Many additional procedures for control of bacterial contamination, such as washing of market eggs in germicides, are in practice in much of the industry.

Animal processing and further processing.

The Food Safety and Quality Service, USDA, has general requirements for hygiene in processing and further processing plants. The quality of the sanitation is continually monitored. Included in the programs are water potability checks and requirements for plant facility and equipment, basic plant sanitation, sewage disposal, temperature and plant operating practices and inspection. Clean-up requirements are designed to be strict enough to prevent the carryover of Salmonella from one day’s operation to the next.

Pasteurization of processed liquid egg products was required by the Agricultural Marketing Service, USDA, and FDA in 1966. Mandatory inspection was instituted in 1972. In addition to pasteurization, other requirements such as prohibition of shipment of cracked and broken eggs, washing of eggs before breaking, machinery and air flow requirements in the plant have successfully eliminated Salmonella as a problem in egg products. Unless recontaminated, egg products can be considered free of Salmonella.

Food processing and restaurants.

The PHS and State and local health authorities have clean-up and sanitation requirements for all food services establishments. The FDA provides model ordinances that are used by most authorities. In these programs, progress has been made towards Salmonella control because
more and more restaurants are complying with sanitation regulations. No reports of the effectiveness of these programs are in the literature and no benefit/cost data have been developed.

**Home cooking.**

Although no regulations are concerned with home cooking, the effort to acquaint the consumer with the dangers of Salmonella contamination and recontamination of food has been considerable. This effort is geared to those who prepare food at home. The task of preventing salmonellosis from home-prepared foods by consumer education is enormous, and current expenditures do not do justice to the problem; for example, more effort is needed in magazine and cookbook recipes.

**Other sources.**

Occasionally, a Salmonella problem is associated with a non-food item; for example, pet turtles. Relevant agencies may take action. The American public has been saved an estimated 300,000 cases of salmonellosis each year by the enactment of regulations prohibiting the interstate shipment and importation of pet turtles (6).

**ARE WE WILLING TO PAY FOR ERADICATION?**

Workers in Canada have estimated that the annual cost of complete Salmonella eradication from poultry in that country would be about $300 million, and the benefits obtained would be $23 million (9). Cost of eradication included: cost of testing and monitoring; cost of more hygienic production of feed; cost of improved sanitation in hatcheries, broiler operations, packaging; cost of destroyed flocks and products; cost of education of consumer, meat manager and restaurateur; and cost of prosecution. Benefits included reductions in forgone wages, in medical and hospitalization costs, in human lives lost, in loss of productivity and in banning of product. These workers conservatively estimate that Canada would spent $12.68 for each $1.00 benefit obtained. Most of this would be on a continuing annual basis. When we remember that the annual value of United States poultry production is more than $7 billion (10), a similar cost would represent about 5% of the value of poultry products. However, because the industry in the United States is about 10 times larger than that in Canada, conceivably, the costs could represent a considerably greater proportion (even as high as 50%) of the value of annual industry production. The consumer will not likely be willing to pay from 5 to 50% more for his poultry products to insure that they are Salmonella free.

On the other hand, recent estimates of medical costs that American consumers pay as a result of salmonellosis is $1.2 billion per year (4). If the consumer could be assured that all these and other losses could be prevented, an eradication program might be worthwhile.
CONCLUSIONS

Great progress has been made in developed countries in the control of specific Salmonella infections. The remaining human health problem is the multitude of Salmonella that may contaminate and recontaminate food in the food chain and so lead to food poisoning in man. Poultry are major contributors to the human health problem. Salmonellosis is also an economic problem in domestic animal production, particularly turkey production.

We already have a Salmonella control program in the United States. Current technology applied under optimal conditions has the potential to prevent Salmonella infection of poultry at the production level. However, the application of some of this technology may not be feasible at the present time. Current technology can prevent salmonellosis by correct food-handling procedures at the consumer level. However, current technology can only reduce the level of Salmonella organisms on carcasses during processing and marketing. In practice, we have no consensus on the level of control of Salmonella obtainable in the entire food chain. The following are prerequisites for a significant level of control: (a) workers must realize that control procedures at all levels will be quantitative until the organism is completely eradicated from animal production systems; (b) persons involved in each part of the feed and food chain must be convinced to do their part in the control of the organism; and (c) some incentive must be provided to produce, process and market clean meat. This incentive may be financial or regulatory. On the basis of today's standards, the benefits derived from complete eradication will not likely exceed the costs. Nevertheless, through the practical application of research findings and progressive use of control technology, Salmonella control will improve at minimal cost to the producer and the consumer.

REFERENCES


Table 1. Effort (funds and scientist year (SY)) in agriculture devoted to Salmonella research.

<table>
<thead>
<tr>
<th>Part of Salmonella cycle</th>
<th>Poultry salmonellosis research</th>
<th>Mammalian salmonellosis research</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SEA,FR State universities</td>
<td>SEA,FR State universities</td>
</tr>
<tr>
<td></td>
<td>$ Thousand SY</td>
<td>$ Thousand SY</td>
</tr>
<tr>
<td>Detection, identification, properties</td>
<td>235 3.4 79 0.6</td>
<td>88 1.5 176 2.6</td>
</tr>
<tr>
<td>Feed, rendering, water</td>
<td>0 0.0 55 0.5</td>
<td>42 0.6 73 0.6</td>
</tr>
<tr>
<td>Breeder, hatchery, vertical transmission</td>
<td>0 0.0 56 1.3</td>
<td>0 0.0 0 0.0</td>
</tr>
<tr>
<td>Grower, house, litter, serology</td>
<td>220 2.1 57 0.7</td>
<td>26 0.4 211 2.3</td>
</tr>
<tr>
<td>Slaughter, egg washing, serology</td>
<td>267 3.6 81 0.6</td>
<td>0 0.0 34 0.4</td>
</tr>
<tr>
<td>Further processing, egg breaking, marketing</td>
<td>236 3.4 159 2.0</td>
<td>98 1.7 63 0.8</td>
</tr>
<tr>
<td>Therapy, disinfection</td>
<td>20 0.2 40 0.3</td>
<td>3 0.0 15 0.2</td>
</tr>
<tr>
<td>Animal waste, environment</td>
<td>0 0.0 26 0.1</td>
<td>301 3.4 42 0.4</td>
</tr>
<tr>
<td>Other Salmonella research</td>
<td>0 0.0 14 0.1</td>
<td>0 0.0 14 0.2</td>
</tr>
<tr>
<td>Total</td>
<td>978 12.7 567 6.3</td>
<td>558 7.7 629 7.3</td>
</tr>
</tbody>
</table>

*SEA,FR = Science and Education Administration, Federal Research (formerly Agricultural Research Service). SY = Equivalent of one scientist working on the project for 1 year. Due to rounding off, figures do not necessarily add up exactly.
Table 2. Effort (funds and scientist year (SY)) in agriculture devoted to Salmonella research (by commodity).

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Effort $ Thousand</th>
<th>SY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Poultry</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat-type chickens</td>
<td>538</td>
<td>5.8</td>
</tr>
<tr>
<td>Egg-type chickens</td>
<td>569</td>
<td>7.6</td>
</tr>
<tr>
<td>Turkeys</td>
<td>271</td>
<td>3.4</td>
</tr>
<tr>
<td>Waterfowl</td>
<td>38</td>
<td>0.4</td>
</tr>
<tr>
<td>Other*</td>
<td>128</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,544</td>
<td>19.0</td>
</tr>
<tr>
<td><strong>Livestock</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ruminants</td>
<td>292</td>
<td>4.4</td>
</tr>
<tr>
<td>Porcine</td>
<td>188</td>
<td>2.4</td>
</tr>
<tr>
<td>Man</td>
<td>277</td>
<td>2.8</td>
</tr>
<tr>
<td>Other*</td>
<td>430</td>
<td>5.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1,187</td>
<td>15.0</td>
</tr>
<tr>
<td><strong>Total commodities</strong></td>
<td>2,729</td>
<td>34.0</td>
</tr>
</tbody>
</table>

*Includes effort that cannot be identified more precisely by commodity. SY = Equivalent of one scientist working on the project for 1 year. Due to rounding off, figures do not necessarily add up exactly.
WHAT'S NEW IN THE REGULATION OF HEALTH HAZARDS

Fred W. Clayton
Occupational Safety and Health Administration
Washington, D.C.

In May of 1977, the Consumer Product Safety Commission (CPSC), Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) announced a proposed joint interagency regulatory action to ban certain chlorofluorocarbons when used in aerosols for non-essential purposes. This interagency approach resulted in consistent regulatory policy and eliminated any possible duplication of effort among the agencies. The agency heads decided that similar efficiencies might be achieved by working together on other projects. Several breakfast meetings were held between Douglas Costle, the Administrator of EPA, Donald Kennedy, the Commissioner of FDA, John Byington, then the Chairman of CPSC, (Susan King became Chairwoman on June 29, 1978), and Eula Bingham, Assistant Secretary in the Department of Labor for Occupational Safety and Health Administration (OSHA). The heads of the four agencies promised to seriously examine the common requirements and functions of their agencies as they pertained to lessening the potential hazards from toxic substances, and to begin a process through which, together, they could lessen redundant administrative burdens on regulated industries, the public, and the agencies themselves, while conducting their business in a more coordinated and cost-effective manner.

Investigation revealed that 45 ongoing interagency efforts involved at least 2 of the 4 agencies. In August, 1977, the principals of the four agencies agreed to cooperate on a formal basis and to call the consortium the Interagency Regulatory Liaison Group (IRLG).

Although the four Federal agencies responsible for controlling chemicals function separately, they have much in common. They are all regulatory agencies working to protect the public health.

The Consumer Product Safety Commission (CPSC)

Under the Consumer Product Safety Act, CPSC has the responsibility to protect the public from the unreasonable risk of injury associated with consumer products. These products may be chemical as well as non-chemical. In addition, the CPSC is responsible for the Federal Hazardous Substances Act, the Poison Prevention Packaging Act of 1970, as well as some other laws less closely related to toxic substances.

The Environmental Protection Agency (EPA)

Established in 1970, the EPA administers eight laws to control and reduce contamination of our air, water and land systems throughout the natural environment. Two EPA laws deal specifically with
chemicals: The Toxic Substances Control Act, and the Federal Insecticide, Fungicide and Rodenticide Act. Others, for example, the Clean Air Act and the Clean Water Act, also are concerned with chemical contamination.

**The Food and Drug Administration (FDA)**

The FDA is an arm of the Department of Health, Education, and Welfare. The Food, Drug and Cosmetic Act, the primary law under which FDA operates, is intended to assure that foods are pure and wholesome, safe to eat, and produced under sanitary conditions; that drugs and medical devices are safe and effective; that cosmetics are safe and properly labeled; and that packaging and labeling of these products is truthful and informative.

**The Occupational Safety and Health Administration (OSHA)**

OSHA was created within the Department of Labor by the Occupational Safety and Health Act of 1970. OSHA is mandated to assure as far as possible that all employees have a safe and healthful place of employment. OSHA has responsibility for setting permissible levels of exposure for toxic substances in the workplace.

In summary, FDA and CPSC focus on the production of goods for the marketplace, OSHA is focused on the workplace, and EPA on the surrounding community and natural environment.

How do these agencies go about the tough job of controlling thousands of toxic substances? While each agency has its own distinct way of combatting the problem, the major enforcement role of all four agencies comes from their authority to issue and enforce standards or regulations that identify dangerous chemicals and specify how the public is to be protected.

These standards and regulations are based primarily (though not exclusively) on scientific data relating to the health effects certain materials or substances may have on consumers, workers or life support systems. These agencies also gather additional data through extensive public hearings; and then evaluate the potential risks involved, weighing these risks against the benefits gained before taking final action.

Table 1 illustrates the cooperative action theme of the IRLG. Eight initiatives were identified as interagency efforts to meet the goals of the IRLG. These initiatives became work groups as follows: 1) Compliance and Enforcement (Table 2); 2) Education and Communications (Table 3); 3) Epidemiology (Table 4); 4) Information Exchange (Table 5); 5) Regulatory Development (Table 6); 6) Research Planning (Table 7); 7) Risk Assessment (Table 8); and 8) Testing Standards and Guidelines (Tables 9a-b).

These work groups were composed of representatives from all four agencies and each of the four agency principals assumed responsibility for two of the work groups. Each work group elected a chairperson, developed work plans (see Tables 2-9b), which were published in the
Federal Register, and each held public meetings early in 1978 to explain their objectives and receive comments.

Each of these substances was the subject of a team representing all four agencies with the name and telephone number of the team leader. Tables 10a-d list the laws administered by each agency and the actions authorized by each law. The two Venn diagrams on Tables 11 and 12 illustrate the dominance when two laws overlap. The IRLG is developing a computerized file of laws affecting the four agencies.

I would like to call your attention to the Resource Conservation and Recovery Act (see Table 10c), which was passed at the same time as the Toxic Substances Control Act (see Table 10d), but was overshadowed by the latter. There have been a series of events that illustrated the problem associated with disposal of toxic materials. Table 13 diagrams product problems; while Table 14 diagrams pollutant problems.

Among the many instances of catastrophe following disposal of toxic materials, the following examples are offered.

1. Polychlorinated Biphenyls (PCBs), used commercially for about 50 years, were identified as a problem in 1971. The General Electric Company was fined several million dollars for discharging them into the Hudson River. **PCBs are the only individual class of chemicals to be subjected to legal banning.**

2. Since we are meeting within 20 miles of the Love Canal tragedy, I feel compelled to mention it briefly. In the early 1890's, an industrialist named William Love proposed to develop an industrial complex by diverting water around Niagara Falls to produce electricity. At that time electricity had to be used where it was generated. He obtained permission from the legislature of the State of New York, secured financial backing, and began digging a canal which was named after him. However, two events defeated him: a) the development of alternating current which permitted electricity to be transmitted long distances economically; and b) a recession which caused his financial backing to disappear. The partially excavated canal remained unused for years and became a dumping ground for waste chemicals by the Hooker Chemical Company. In the 1950's it was purchased by the city and filled. Later homes and an elementary school were built on this location. Melting snow from recent blizzards and heavy rain caused the chemicals to come to the surface and vapors contaminated the basements of homes and the school. Multiple instances of birth defects, miscarriages and still births have been reported. Two hundred thirty (230) homes have been appraised and 35 families have sold their homes to the state of New York and moved. The other families are expected to sell to the state and move also. One family moved their home to another location. This tragedy is still under investigation and the final analysis is yet to come.
TABLE 1
INTERAGENCY REGULATORY LIAISON GROUP

WORK GROUPS

1. Compliance and Enforcement
2. Education and Communications
3. Epidemiology
4. Information Exchange
5. Regulatory Development
6. Research Planning
7. Risk Assessment
8. Testing Standards and Guidelines

TABLE 2
COMPLIANCE AND ENFORCEMENT WORK PLAN

1. Enforcement Response to Health and Environmental Emergencies
2. Personnel Exchange
3. Sharing Expertise
4. Coordination of Laboratory Facilities and Equipment
5. Cooperative Application of Compliance Sanctions
6. Compliance Training
7. Coordination of Compliance Monitoring and Enforcement Priorities
8. Coordination of Inspectional Resources
9. Establishing Common or Compatible Investigational Forms
TABLE 3
EDUCATION AND COMMUNICATIONS WORK PLAN

OBJECTIVES

1. To plan, develop, and evaluate a coordinated education program directed toward consumers;

2. To plan and develop a coordinated external training program for key consumer representatives who can produce a multiplier effect;

3. To recommend guidelines for promoting the implementation of an external coordinated education and training program;

4. To recommend a coordinated communication system for reaching the target populations to whom these education and training (external) programs are to be directed; and

5. To assess the effectiveness of labelling as an educational tool and a preventative strategy.

TABLE 4
EPIDEMIOLOGY WORK PLAN

GOALS

1. Identification of epidemiology programs and epidemiology programs and epidemiology resource personnel.

2. Guidelines for epidemiological studies.

3. Identification of legal authorities and requirements for epidemiologic studies.

4. Defining data bases of interest.
TABLE 5
INFORMATION EXCHANGE WORK PLAN

PROJECTS

1. Common Identification Codes
2. Confidential Information
3. Monograph Planning and Production
4. Coordination of Reporting Requirements
5. Regulated Chemicals System
6. Chronic Testing Support System
7. Management and Operational Support

TABLE 6
REGULATORY DEVELOPMENT WORK PLAN

PROJECTS

1. Coordinated Regulatory Action on 28 Items.
2. Implementation of an Alert System.
3. Funding of Public Participation in Regulatory Development.
4. Selection of Best Authority for a Given Situation.
5. Petition Response Coordination.
7. Evaluate Supplementary Approaches to Direct Regulation.
RESEARCH PLANNING WORK PLAN

OBJECTIVES

1. Document and coordinate existing (planned for FY 78 and 79) projects in the four agencies to eliminate undesirable duplication, maximize effectiveness and identify gaps in needed research.

2. Jointly plan and coordinate budgets for selected mutual interest programs/initiatives for inclusion in the President's FY 80 Budget Submission to Congress.

3. Develop a comprehensive action plan for more effectively utilizing non-regulatory research programs in regulatory decisionmaking.

TABLE 8
RISK ASSESSMENT WORK PLAN

OBJECTIVE

Develop procedures and criteria that can be uniformly applied by the four agencies for purposes of characterizing and quantifying human health risks associated with certain chemicals.
TABLE 9a

TESTING STANDARDS AND GUIDELINES

WORK PLAN

SHORT TERM GOALS

1. Review documents currently used by agencies as guidelines for testing.
2. Develop working definitions for tests the agencies now require.
3. Standardize guidelines for: a) acute tests related to assessment of health effects; b) tests related to assessment of ecological and environmental fate and effects.
4. Consider for adoption the FDA Good Laboratory Practices for related toxicology studies.
5. Consider for adoption the PHS Safe Practices for Handling of Carcinogens.

INTERMEDIATE TERM GOALS

1. Tests related to assessment of health effects.
2. Tests related to assessment of environmental hazard.

TABLE 9b

TESTING STANDARDS AND GUIDELINES WORK PLAN (CONTINUED)

LONG TERM GOALS

1. Tests related to assessment of health effects:
   a) mutagenicity tests, b) behavioral studies, c) neurological tests, d) short term in vitro tests.
2. Tests related to assessment of environmental hazard:
   a) aquatic invertebrate toxicity, b) fish toxicity, c) microcosm protocol for measuring ecosystem-level effects.
3. If necessary, propose legislative changes needed to permit development of additional uniform guidelines.
4. Data submission and review formats.
### IRLG REGULATORY ACTIONS

<table>
<thead>
<tr>
<th>ACT/AGENCY</th>
<th>ACTIONS AUTHORIZED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal Food, Drug and Cosmetic Act - FDA</td>
<td>1) Prohibits manufacture or distribution of the substance if FDA finds that a FFDCA substance is adulterated or misbranded.</td>
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<tr>
<td></td>
<td>2) FDA may restrict use of food additives, drugs, devices and cosmetics.</td>
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<tr>
<td></td>
<td>3) FDA may require labeling.</td>
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<tr>
<td></td>
<td>4) Requires premanufacture review of new drugs and devices.</td>
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<tr>
<td></td>
<td>5) FDA may seize adulterated and misbranded FFDCA substances.</td>
</tr>
<tr>
<td>Consumer Product Safety Act - CPSC</td>
<td>1) CPSC establishes consumer product safety standards (CPSS) for:</td>
</tr>
<tr>
<td></td>
<td>a) design, constructions, performance, contents, etc.</td>
</tr>
<tr>
<td></td>
<td>b) markings and warnings.</td>
</tr>
<tr>
<td></td>
<td>2) Agency may declare product &quot;banned hazardous substance&quot; if standard is not adequate to reduce risk.</td>
</tr>
<tr>
<td></td>
<td>3) Prohibition of manufacture and distribution of products not in conformity with CPSS's and &quot;banned hazardous substances&quot;. CPSC may seize these products.</td>
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## Regulation of Health Hazards

<table>
<thead>
<tr>
<th>ACT/AGENCY</th>
<th>ACTIONS AUTHORIZED</th>
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</table>
| Federal Hazardous Substances Act - CPSC | 1) CPSC may require hazardous substances to be packaged and labeled in a certain manner. Otherwise they are "misbranded hazardous substances".  
2) CPSC may declare a product to be a "banned hazardous substance" if labeling would not adequately reduce risk of injury. Manufacture and distribution of misbranded and banned hazardous substances are prohibited and may be seized. |
| Poison Prevention Packaging Act - CPSC | 1) CPSC may set special CPSC packaging standards. Substances which do not comply with packaging standards are "misbranded hazardous substances" within the meaning of the Federal Hazardous Substances Act. |
| Occupational Safety and Health Act - OSHA | OSHA may set occupational safety and health standards (conditions, practices, and equipment) to eliminate workplace hazards. |
| Clean Air Act - EPA | 1) EPA establishes ambient air quality standards.  
2) EPA approves State Implementation Plans to achieve ambient air quality.  
3) EPA establishes air emission standards for hazardous air pollutants, new stationary sources, and mobile sources (vehicles).  
4) EPA may seek to enjoin source of air pollution to comply.  
5) EPA may regulate any substance, practice, process, or activity affecting stratosphere. |
<table>
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<tr>
<th>ACT/AGENCY</th>
<th>ACTIONS AUTHORIZED</th>
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</table>
| Clean Water Act - EPA                                 | 1) EPA regulates and makes financial grants for municipal waste treatment works.  
2) EPA establishes water discharge standards for industry, toxic substances, and discharges to sewerage systems.  
3) EPA approves State ambient water quality standards.  
4) EPA issues permits for water discharges (delegated to some States).                                                                                 |
| Safe Drinking Water Act - EPA                        | 1) EPA establishes standards for public drinking water systems.  
2) EPA regulates underground drinking water sources.  
3) States are delegated primary enforcement duty.                                                                                                       |
| Marine Protection, Research and Sanctuaries Act - EPA | Ocean dumping permits.                                                                                                                                                                                               |
| Federal Insecticide, Fungicide, and Rodenticide Act - EPA | 1) EPA may prohibit the manufacture or distribution of a pesticide, restrict the use of a pesticide, and require labeling of a pesticide.  
2) EPA may seize pesticides which do not comply with regulations.  
3) Requires premanufacturing review of new pesticides.                                                                                                    |
REGULATION OF HEALTH HAZARDS

### TABLE 104

<table>
<thead>
<tr>
<th>ACT/AGENCY</th>
<th>ACTIONS AUTHORIZED</th>
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<tbody>
<tr>
<td>Toxic Substances Control Act - EPA</td>
<td>1) EPA may require testing of chemicals for health and environmental effects.</td>
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<td>2) Requires premanufacture review of new chemicals and significant new uses of chemicals.</td>
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<td></td>
<td>3) EPA may prohibit or limit manufacture, processing, or distribution of chemicals.</td>
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<td>4) EPA may regulate manner or method of commercial use or disposal of chemicals.</td>
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<td>5) EPA may require labeling of chemicals.</td>
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<td>6) EPA may impose quality control procedures.</td>
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<td>7) EPA may require submission of information.</td>
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TABLE 11

REGULATION OF PRODUCTS

- Soap
- Tobacco
- Firearms & Ammunition
- Nuclear Materials
- Motor Vehicles
- Meats & Poultry

FFDCA
Foods, Food Additives, Drugs, Cosmetics, & Devices

FIFRA
Pesticides

TSCA
Chemical Substances & Mixtures

OSHA
Workplace Hazards
TABLE 12
REGULATION OF POLLUTANTS

CAA
- Set Ambient Air Standards
- Auto Air Emissions
- Factory Air Emissions
- Product Use Air Emissions

CWA
- Water Standards
- Sewage Discharge
- Sewerage
- Factory Effluents
- Irrigation Return Flows

MPRSA
- Ocean Dumping

SDWA
- Drinking water Contamination

RCRA
- Solid Waste
- Disposal
- Activities

TSCA
- Chemical Substances
- Mixtures

OSHA
- Workplace Hazards
TABLE 13
PRODUCT PROBLEMS

- Is the Stratosphere Damaged?
  - Yes: CAA
  - No: Use vs. Disposal
    - Use
      - Food, Drug or Cosmetic?
        - Yes: FFDCA
        - No: Pesticide?
          - Yes: FIFRA
          - No: Users
            - Who/what is Injured?
              - Yes: Public Health or Environment
              - No: TSCA
                - Work: OSHA
                - Home: CPSA, FSHA, PPPA
    - Disposal: Pollutant Problem
TABLE 14

POLLUTANT PROBLEMS

Where do pollutants go?

AIR

CAA

WATER

CWA
SDWA
MPRSA

WORK PLACE

OSHA

GROUND

RCRA
3. The much publicized Kepone incident has several interesting aspects. Allied Chemical contracted with two ex-employees to produce this toxic pesticide and sell it to Allied. They ignored safety, health and good business practice and polluted the environment. As a result, more than 30 people were hospitalized, the James River was contaminated and its fishing industry was put out of business. The courts found that their small company, Life Science Products, had little financial backing and that Allied Chemical was at fault. According to a recent article in *Fortune Magazine*, Allied has paid out more than 20 million dollars and all the legal actions have not been settled.

4. Michigan is suing to recover $119 million that was spent by the State in the tragic polybrominated biphenyl contamination of livestock feed.

5. In North Carolina a contractor illegally dumped a solution of polychlorinated biphenyls along 270 miles of secondary roads. Dr. Martin Hines, who many of you know, estimated that it would cost the state $10 million to remove and dump this material.

6. In Louisville, Kentucky, a subcontractor illegally dumped a highly toxic chemical, hexachlorocyclopentadiene, into the city sewer system. The result was similar to the Kepone incident in Hopewell, Virginia. The city sewage disposal plant was rendered inoperable and plant workers were hospitalized. In both cases, damage amounting to millions of dollars resulted from illegal actions by irresponsible operators who are not financially able themselves or bonded to correct the damage they caused.

Industry produces an estimated 30 to 40 million tons of chemical wastes each year which have typically been disposed of in land fills or by dumping in rivers, lakes or oceans. To date, over 600 land fills are known to contain toxic and cancer causing chemicals. More than a thousand more have not been inspected and remain a question mark. The fixing of liability by the courts in the Kepone incident together with the R.C.R.A. Law, may cause industry to police their fellow members and take a responsible attitude in the disposal of toxic wastes.

With the Proposition 13 influence spreading this way from California, difficult decisions will be forced by such incidents, such as what state programs will be cut to pay for the clean up and who pays the innocent third party who has suffered physically or financially? In a recent study of state laws and capabilities to respond to such emergencies, it was noted that only two states were considered reasonably well prepared to react adequately. Several factors were considered, as follows: a) designated spill response teams; b) proper equipment and advanced training of such teams; c) adequate funding; d) statutes which permit levying penalties on the offending parties; e) financial compensation to
protect innocent parties who suffer damage; f) identification of approved disposal sites for toxic materials; and g) listing of approved contractors capable of cleanup operations.

I would encourage each of you to review the ability of your state to deal with environmental emergencies!

The Interagency Regulatory Liaison Group (IRLG) has demonstrated that interagency coordination and cooperation can improve efficiency, decrease costs, and lessen the burden of regulations. The Food Safety and Quality Service (FSQS) of the U.S. Department of Agriculture (USDA) recently became the fifth member of the IRLG.

Additional coordination has occurred through activities of the IRLG work groups, which have involved the following non-IRLG agencies: National Cancer Institute (NCI), National Institute of Environmental Health Sciences (NIEHS), National Institute of Occupational Safety and Health (NIOSH)—all of the Department of Health, Education, and Welfare (DHEW)—and the Department of Transportation (DOT).

Two other recent developments also relate to the regulation of health hazards. The creation of the Regulatory Council to provide a mechanism to assist the President to oversee the regulatory programs. Patterned after the IRLG, the Council will analyze goals, benefits, legal requirements and estimated costs for anticipated regulatory actions.

The other new development is the establishment of a National Toxicology Program (NTP) by the Department of Health, Education, and Welfare (DHEW). The broad goal of the NTP is to strengthen activities in the testing of chemicals and the development and validation of new and better test methods.

It is evident that the regulation of health hazards is a dynamic process and will continue to receive considerable attention.
PUBLIC HEALTH AND ENVIRONMENTAL QUALITY

Chairman: Richard L. Parker, Columbia, S.C.


The committee met at 1:30, October 31, 1978. In accordance with the committee's report of November 10, 1976, a study was made for the need for laws governing the quarantine of animals having infectious diseases or containing biological and/or chemical residues that are injurious to man and/or animals.

The committee found that the majority of States of our Nation do not have sufficient laws necessary for the control of animals and their products intended for human or animal foods that may contain infectious disease, biologic, or chemical residues that are harmful to man and animals.

A resolution was composed by the committee and submitted for consideration and approval of the Executive Committee recommending that States enact laws enabling the animal disease control authority to promulgate regulations for the quarantine of animals and animal products that are found to have or contain infectious disease, biological and/or chemical residues injurious to human or animal health.

The committee discussed the affects of pollution of livestock drinking water and pasturelands from industrial and domestic sources and the liability to animal owners. According to reports, livestock losses resulting from environmental pollutants has become a serious problem for losses incurred as a result of said pollution. It was proposed that a further study be made into losses occurring in animals resulting from pollution of animal environments and to determine what regulatory measures are needed by animal disease control officials in the various States for preventing this type of injury to the livestock industries.

This report is respectfully submitted to the Executive Committee for its consideration and acceptance.
PROBLEMS OF SHEEP AND GOATS

Address given to United States Animal Health Association meeting at Buffalo, New York, October 31, 1978, by Dr. Don E. Bailey, DVM, Health Committee Chairman, National Wool Growers Association.

I wish to extend greetings from the National Wool Growers Association and to thank the United States Animal Health Association for inviting me.

Enthusiasm is high in the sheep business. Prices are good and the future looks bright. The bottom in sheep number in the United States appears to have been reached and the upturn is appearing.

In listing problems of the Sheep Industry, the coyote still persists and is the number one problem. Since the ban on poisons, put on by the government, many sheep raisers have been forced out of business. Only recently has hope in coyote management been seen. The National Wool Growers were successful in promoting a four and one half million dollar budget item in the Department of Interior, Fish, and Wildlife for predator control. Some relaxation of controlled poisons is a sign that the general public is becoming aware that with the sheep gone, coyote predation in other domestic animals and wildlife is appearing.

During the last National Wool Growers convention, the Health Committee voted a list of health priorities. This resulted in a list of four animal health resolutions.

Foot Rot disease of sheep was listed as the number one problem. In many sheep-producing areas of the United States, foot rot prevents expansion of sheep numbers. Producers turn to cattle raising because foot rot is such a chronic and discouraging condition to put up with. The Department of Agriculture lists two research projects on foot rot on their 1978 budget. One project at Oregon State University is identification and culturing the causitive agents and the immune response of foot rot. This project is funded at $12,000 annually. Another project is listed at NADL, Iowa at $17,000. With a budget of $8,486,000 identified to sheep and goat research by the U.S.D.A., the $29,000 devoted to foot rot is too few dollars being spent on this number one problem.

The number two health problem is respiratory diseases of sheep. They propose to identify the scope and extent of pneumonia in sheep. They asked the Federal Meat Inspection Service for an impact report concerning condemnations in federal slaughter houses due to respiratory diseases categorized into specific pulmonary diseases, i.e., progressive pneumonia, enzootic pneumonia, vermenous, pleurisy, and others. The National Animal Disease Laboratory at Iowa has been working with progressive pneumonia and developing a test. The budget for their research is listed at $367,800 for 1978. The research with progressive pneumonia has reached about all that can be done on this type of
respiratory disease and the committee believes that NADL could expand into the other types of respiratory disease in sheep and maybe in conjunction with other domestic animal research.

The third problem is the availability of biologic and pharmaceuticals for the sheep and goat industries. Admittedly, the low volume of some products restricts the production. This is not the complete picture however. With F.D.A.'s licensing laws, many needed products are not available. Out of thirty-five applications for new products, only two were passed this last year.

Some the needed vaccines are EAE, vibriosis, and epididymides. Injectable wormers and anesthetics need approval for sheep and goats. New products such as fluke remedies and coccidiosis products are badly needed.

The last resolution and a very important problem in the west and south is blue tongue disease. The U.S.D.A. Denver laboratory and the University of California at Davis are doing extensive work on blue tongue research. The budgeted amount is $245,700. Besides this amount, APHIS has a budget of $1,200,000 being spent on a National Blue Tongue Survey. Some states are suffering from over 6% death losses due to blue tongue. The disease is complicated by the presence of four strains of the virus. Two states at the present time are developing their own vaccine for use within their state. This can lead to great problems because these vaccine producers do not have to show any tests for safety or efficiency of their products. The committee recommended a return to the temporary license for new vaccines and products so that all products, intra or inter-state, can be tested. The producer needs to know the product being used is safe and efficient and won't spread to other species through the vaccine.

The Dairy Goat and Mohair Goat Industries are active and growing prices for dairy goats and for mohair are very good. Dairy goats are very popular with small or backyard operations.

Health problems of the dairy goat industry were identified at a recent convention. In order of importance were; abscesses, mycoplasma infections, abortion, John's disease, and mastitis. No major research projects are being budgeted by the U.S.D.A. at the present time. Small projects are being carried out at some institutions. The goat people are very anxious to get needed research started.

The Angora or Mohair Industry has research going on in Kerrville, Texas on parasite and mohair with a total budget of $194,000.

The National Wool Growers appreciates the research programs carried out by the U.S.D.A., now, and over the years. They believe that these two species (sheep and goats) have been neglected in the research funding of the U.S.D.A. The new health research money the Congress recently appropriated (15 million) is a welcome move.
Producers are looking at present research projects of the U.S.D.A. with a closer eye. They understand the need for basic research and how slow it sometimes is. If a research project has not published results of their research within the last five years, then they question the need for that project continuing. There is more need for results geared to everyday production problems, after basic research is completed.

The National Wool Growers believes that research projects assigned to State Universities where Veterinary Schools are located or to State Experiment Stations where no Veterinary School exists results in "closer to the problem" research solutions with lower research costs.

In summary, the Sheep and Goat Industry is growing. They, like other livestock industries, have problems. They continue to look to you research leaders for continued help. The appointment of livestock advisory committees to the U.S.D.A. with their special expertise is a good move. It is important that each group listens to the other.
SELECTED MYCOPLASMOSIS OF GOATS IN THE UNITED STATES

H. E. Adler
Department of Epidemiology and Preventive Medicine
School of Veterinary Medicine
University of California
Davis, California

Six serotypes of mycoplasma, including all of the so-called "exotic" strains, have been isolated in the United States from goats with various pathological manifestations. These strains have been characterized by biochemical, serological, and biological means and designated as distinct species. The mycoplasmas with potential economic effect to the livestock industry are: *Mycoplasma mycoides* subsp. *mycoides*; *M. mycoides* subsp. *capri*; *M. agalactiae*; and *M. capricolum*. Of greatest concern is *M. mycoides* infection of goats, found in a few isolated instances in the U.S.A. These mycoplasma were originally identified as *M. capri*.

There have been other early reports, some of a conflicting serological relationship between *M. mycoides* and *M. capri* (Edward, 1953; Villemot and Provost, 1959; Lemcke, 1965). More recent studies, however, conducted with type strains of the two organisms (Al-Aubaidi et al, 1972; Tully et al, 1974) indicate no antigenic similarity between *M. mycoides* and *M. capri*.

Natural infection of goats with antigenically related organisms has been described by Cottew (1974). Of special interest in that report were nine mycoplasms, isolated from goats in Australia, that had the serologic characteristics of *M. mycoides* and biochemical reactions of *M. agalactiae*. Classification of those mycoplasmas awaits complete biological studies of the latter isolates.

Although serological and other laboratory criteria implicate a number of *M. capri* isolates to be *M. mycoides*, natural transmission of the latter mycoplasma from goats to cattle has not been demonstrated. That is not surprising since many attempts to reproduce respiratory disease in cattle with *M. mycoides* of bovine origin failed until procedures were devised that produced the disease regularly (Turner, 1959).

A few experiments were conducted to determine the pathogenicity for cattle of *M. mycoides* isolated from goats. The organisms were administered by subcutaneous, intramuscular, or intravenous inoculation. Those routes of infection ordinarily will not produce pulmonary disease. Calves infected intramuscularly with a United States' goat isolate (Barber and Yedloutshnig, 1970) developed cellulitis at the site of inoculation and marked fluid infiltration of the thoracic, peritoneal, and joint cavities. Inoculation of calves with *M. mycoides* by the intramuscular route can cause similar lesions (Lloyd and Trethewie, 1970). Hudson et al (1967) inoculated two calves intravenously with a culture of
M. mycoides of goat origin (Australia) suspended in pooled-egg fluids. The calves developed a local cellulitis and a septicemia that persisted for 15 days. Extensive synovitis and tendovaginitis were observed in one calf, and the second had two infected sequestra in the lungs at necropsy, 46 days after infection. Similar lesions were induced by intracaudal injection of V5 vaccine suspended in egg fluids (Hudson and Leaver, 1965) and by intravenous inoculation of agar-culture mixture (Daubney, 1935). Unfortunately, the first two experiments did not attempt to produce pneumonic lesions by intrabronchial intubation.

Until recently, there was no evidence that M. mycoides caused gross lesions in the lungs and pleura of goats. Laws (1956) recovered M. mycoides from the peritoneal exudate of a naturally infected goat with severe peritonitis and no lung involvement. Recovery of the mycoplasmas from the blood and nasal exudate tended to implicate airborne transmission even though pneumonia was absent. Experimental intratracheal inoculation of M. mycoides (Cottew et al, 1969) failed to induce infectious pleuropneumonia. With M. capri, however, the same procedure could reproduce classical lung disease. Ojo (1976) used a goat-adapted strain of M. mycoides administered by endobronchial inoculation and produced a disease with the gross and microscopic lesions of contagious pleuropneumonia.

M. capri is the major cause of contagious caprine pleuropneumonia (CCPP). The infection, transmitted primarily by cohabitation, is a natural disease of goats, whereas sheep must be inoculated to be infected. This disease has been observed in a number of European countries, Africa, Central Asia, and India. CCPP is the most devastating pneumonia of goats, being particularly important where the goat is the major source of milk and meat.

The exact etiology of CCPP has been clouded by the several serotypes of mycoplasma that were antigenically distinct from the M. capri prototype organism yet caused CCPP or were associated with it (Cottew et al, 1969; Provost et al, 1967; Ojo, 1976). Those reports pointed out some of the difficulties in diagnosing M. capri infection. A further complication in sorting out the taxonomic classification of an isolate is the requirement that the mycoplasma must be serologically related to the PG 3 strain for M. capri speciation.

M. capri has been recovered from goats in the United States. One isolation has been from goats reared in California. At necropsy, only one infected animal had obvious pneumonia. The histopathological lesions were not characteristic for a mycoplasmal pneumonia. M. capri was cultured from milk and infected joints. The anatomical sites of the various isolations may not be suspect for mycoplasma since descriptions of the disease are usually limited to pathological changes in the lungs. Aside from the usual expected hemorrhagic infarction and the red and gray variegation observed in the lungs, there may be muscle lesions characterized by edema of the lower jar and lumbar regions. In addition
to the lung and muscle lesions, a common sequela of septicemia is severe arthritis.

*M. agalactiae* infection causes an acute or chronic mastitis of sheep and goats. The disease has been described in Turkey, the Mediterranean countries, Switzerland, Africa, Yugoslavia, and Austria. Transmission is through contact or ingestion of exudates and milk. Infection of sheep and goats not only affects the mammary glands of lactating animals but frequently produces severe joint and eye lesions. The only recorded case of *M. agalactiae* in the United States was an isolation from the joint of a goat with arthritis, in 1969 (personal communication, Jasper).

*M. cupricolum* is a natural infection of goats, manifested by septicemia and polyarthritis. The mycoplasma has been described for infected goats from the United States (Cordy *et al.*, 1955), Australia (Cottew, 1974), and Turkey (Tully *et al.*, 1974). Transmission might have been by inhalation, since the organism was recovered from excreta and the respiratory tract. The major pattern of the disease in kids was septicemic signs rapidly followed by arthritis. In one outbreak during the kidding season, almost the entire kid crop was lost from the disease. Twenty percent mortality was observed in yearling and adult does in a herd of 70 female goats.

*M. capricolum* has many of the cultural characteristics of *M. capri* but differs serologically and in pathological manifestations. Pleuropneumonia is absent in natural and laboratory-induced disease. Although these observations were made in the original studies of the agent, it was not named *M. capricolum* until the complete serological investigations of Tully *et al.* (1974). Cottew (1974) then suggested that the Cal goat isolate (*M. capricolum*) was a strain of *Acholeplasma laidlawii*, on the basis of growth inhibition and biochemical tests. He used *A. laidlawii* PG8 (National Institutes of Health) as the type strain for that identification. The biological characteristics described for the organisms are not in accord with the original findings of Cordy *et al.* (1955) and the more detailed later studies of Tully *et al.* (1974). Those results and additional data acquired in the author's laboratory do not support the name *A. laidlawii* for the goat isolate.

Investigations to define the host range of *M. capricolum* infection provided interesting information (Cordy and Adler, 1960). A horse, calves, dogs, chickens, turkeys, and small laboratory animals were refractory to infection. Lambs were susceptible to parenteral injection by many different routes of exposure. In most instances, cellulitis developed at the site of inoculation, followed by septicemia, hyperthermia, and depression. If the animals survived beyond four days, infection progressed to the joints, with arthritis ensuing.

An unusual feature of *M. capricolum* is its pathogenicity for swine (Cordy *et al.*, 1958). Four pigs inoculated intravenously had fibrinous serositis of the pericardial, pleural, and peritoneal cavities. Cellulitis was
observed at the site of inoculation, and fibrinous arthritis was seen in the leg joints of three pigs, with one of them having synovitis. The visceral and joint lesions are almost identical to the pathological changes described in pigs from *M. hyorhinis* infection (Roberts et al., 1963; Roberts et al., 1963). There have been no serological comparisons of the pig and goat isolates.

This limited review of a few mycoplasma infections of goats reveals the need to isolate the organisms from tissues with or without typical lesions of a specific pathological entity. Serological identification must be on the basis of well-documented type strains.

**REFERENCES**


ISOLATION OF MYCOPLASMA AND UREAPLASMA FROM SHEEP AND GOATS IN WEST TEXAS (1970-78)

C. W. Livingston, Jr., DVM, PhD, and B. B. Gauer, BA, MT (ASCP)

SUMMARY

In one eight year period, beginning in 1970, 347 ovine and caprine specimens were cultured and mycoplasma isolated from 238 specimens or 68% of the total specimens examined. Mycoplasmas identified are Mycoplasma arginini, M. ovipneumoniae, and M. conjunctivae. Acholeplasmas were also isolated. Ureaplasmas were isolated from 104 of the 502 ovine and caprine specimens cultured or 20% of the specimens examined. All specimens were collected from naturally-infected sheep and goats.

INTRODUCTION

Identification of new species of mycoplasma with an increase in the frequency of isolation of mycoplasmas from sheep and goats has caused concern among research workers and certain leaders of the sheep and goat industry. Approximately 16 different species have been isolated from sheep and goats worldwide. With the exception of Mycoplasma mycoides subs. capri, Mycoplasma agalactiae and some unnamed species, all have been reported as occurring in livestock in the United States.

Arginine-hydrolyzing mycoplasmas isolated from sheep and goats were characterized and the name M. arginini proposed by Barile et al. in 1968. This mycoplasma was isolated from the joint cavities of sheep and goats, from a brain of a sheep, from lungs, pleural cavity, kidneys and eyes of sheep and goats and from the lungs of bighorn sheep.

Tully et al. proposed the name Mycoplasma capricolum for a mycoplasma isolated from a swollen leg joint of a kid goat in California. In addition to reproducing the disease conditions under experimental conditions, M. capricolum is pathogenic for sheep and pigs. Pneumonia was not produced by M. capricolum under these conditions.

Mycoplasma putrefaciens was isolated from the same goats with the original infection of M. capricolum. This species of mycoplasma does not appear to be pathogenic.

Carmichael et al. (1972) characterized a mycoplasma isolated from the respiratory tract of sheep and proposed the specific name Mycoplasma ovipneumoniae. Sullivan et al. described respiratory tract lesions resulting from the experimental inoculations of the Australian isolates of M. ovipneumoniae in neonatal lambs. In addition Perreau reported the isolation of M. dispar from goats in France and Africa.
Barile et al. (1972) proposed the specific name *Mycoplasma conjunctivae* for a mycoplasma regularly isolated from the eyes of sheep and goats with infectious keratoconjunctivitis. They characterized these isolates and found that the Australian and Canadian isolates were related to the isolates from the United States. Trotter et al. demonstrated the pathogenic effects of *M. conjunctivae* in goats under experimental conditions.

*Acholeplasma oculi* isolated from goats with keratoconjunctivitis was described and named by Al-Aubadi et al. (1973). *Acholeplasma oculi* was pathogenic for goats under experimental conditions.

Ureaplasmas have been isolated from sheep and goats. Ureaplasmas in these species have been associated with infertility, abortions, and vaginitis. Mastitis has been produced in sheep and goats experimentally with certain ureaplasmal isolates.

The first mycoplasmal isolate from sheep or goats in Texas was obtained in 1966 from the pleural cavity of a Spanish goat with pneumonic lesions. This isolate was identified later as *M. arginini*. The Texas A&M University Research and Extension Center was established at San Angelo in 1969 to serve the needs of the sheep and goat industry. This is a report of the mycoplasmal and ureaplasmal isolations from sheep and goats at this laboratory during an 8 year period.

Cultural methods.—The cultural methods utilized were described by Livingston. Hayflick medium was utilized with and without inhibitors [thallium acetate (1:5000) and penicillin (1000 u/ml).

Growth inhibition test.—The growth inhibition test was performed using paper discs as described by Clyde.

Biochemical tests.—The media and methods described by Aluotto et al. were employed except the procedure for the phosphatase test, which was that employed by Cottew.

Immunofluorescence.—The procedures employed were as described by Barile and DelGiudice.

Cultural material.—Specimens were obtained from local abattoirs, the experimental flocks of the Texas A&M University Research and Extension Center at San Angelo, and from sheep and goat flocks of producers in the Edwards Plateau region of Texas. Collections of specimens began in 1970 and were continued through 1978.

RESULTS

Beginning in 1970, pneumonic lesions from 107 ovine lungs were cultured and mycoplasmas were isolated from 104 of these lung specimens. Eleven lung specimens without gross lesions were cultured during the same period and one mycoplasmal isolate was obtained. Table 1.
Mycoplasmas were isolated from 10 of 17 pneumatic lesions in caprine lungs. Mycoplasmas were isolated from caprine vaginal swabs obtained after apparent abortions. One of five aborted caprine fetuses examined had positive mycoplasmal cultures from the abomasum and lungs. Table II.

Mycoplasmas were isolated from the lacrimal secretions of 41 of 49 sheep with infectious keratoconjunctivitis. Three isolations of mycoplasma were obtained from 5 sheep without signs of infectious keratoconjunctivitis. Two flocks (Flock A and Flock B) were examined in which sheep showed signs of infectious keratoconjunctivitis ranging from lacrimation to keratitis. In flock A lacrimal secretions cultured from 75 sheep resulted in positive mycoplasmal cultures in 33 sheep. In flock B lacrimal secretions from 42 sheep resulted in 23 mycoplasmal isolations. Lacrimal secretions from 26 goats with infectious keratoconjunctivitis were cultured and mycoplasmas were isolated from 15 goats. Table II.

Ureaplasmas occur naturally in sheep and goat flocks in Texas. Twenty-two isolations of ureaplasmas were made from 173 urine specimens from normal-appearing sheep. Table III. Thirty-two ureaplasma isolations were made from 115 vaginal or cervical swabs from ewes. Of 17 semen samples obtained from rams, eleven were positive for ureaplasmas. Preputial swabs obtained from 75 wether lambs and cultured for ureaplasmas, resulted in eight swabs being positive for ureaplasmas. Twelve urine specimens from goats were cultured and five specimens were positive for ureaplasmas. Table II. The uteruses of two does were cultured and both were positive for ureaplasma. The semen from one billy was cultured successfully for ureaplasma. Six caprine vaginal swabs were cultured unsuccessfully for ureaplasmas. Two preputial swabs from milk goats were cultured successfully for ureaplasmas.

Immunofluorescence, growth inhibition, metabolic inhibition and mycoplasmacidal tests were utilized in identifying selected isolates from sheep and goats as *M. conjunctivae*, *M. ovipneumoniae* and *M. arginini*. Acholeplasmas have been identified but not speciated.

The ureaplasmas of caprine and ovine origin appear to be species specific. At least 9 serotypes of caprine and ovine ureaplasmal isolates have been identified.14

DISCUSSION

Many of the isolates resulted from culturing normal-appearing flocks of sheep and goats in attempts to locate a flock free of ureaplasmal or mycoplasmal infection. A source of mycoplasma-free or ureaplasma-free sheep and goats is essential in order to do pathogenicity studies involving ureaplasmas or mycoplasmas as etiologic agents. To date we have not found a flock tested to be free of either ureaplasmal or mycoplasmal infections.
Approximately 50% of the mycoplasmal isolates originating from lacrimal secretions of sheep and goats were identified as *M. conjunctivae*. Several isolates similar to *M. conjunctivae* in biochemical and morphological characteristics apparently differ serologically.

Some of the arginine-hydrolyzing mycoplasmas isolated from eyes, respiratory and reproductive tracts differ serologically. Many have been identified as *M. arginini* but a few isolates differ from *M. arginini* in colonial morphology and biochemical characteristics as well as serological reactions.

*Mycoplasma ovipneumoniae* was identified in cultural material obtained from the respiratory and reproductive tracts of sheep and goats. Again mycoplasmal isolates were obtained that were similar in colonial morphology and biochemical characteristics, but differed serologically. Accurate identification of all types of mycoplasmal isolates is necessary before pathogenicity trials can be evaluated effectively.

Emphasis should be placed on the use of pure cultures of mycoplasmas and ureaplasmas employed in experimental procedures. In our experience most primary isolations of mycoplasmas and ureaplasmas represent mixed cultures, especially those obtained from the respiratory tract. Ovine and caprine ureaplasmas are serologically heterogenous and certain serotypes appear to be more useful as potential disease-producing agents. One specific ovine ureaplasmal serotype was isolated from the uteruses of several sheep in which the embryos died and were undergoing reabsorption shortly after fertilization. Serotyping procedures should be included in pathogenicity investigations involving ureaplasmas.

The incidence of mycoplasmal infections in Texas sheep and goat flocks under normal conditions appears to be approximately 10%. In lung tissue selected for pneumonic lesions in the abattoir, 89 of 90 lung cultures were positive for mycoplasma and *M. ovipneumoniae* was included in most of these isolates. The most frequently isolated mycoplasma from lung lesions in Texas is *M. ovipneumoniae*.

The overall incidence of ureaplasmal infections in sheep is approximately 10% under normal conditions. In older ewes and rams the incidence appears to be higher. In a flock of 100 aged ewes cervical swabs were cultured and 18 ureaplasmal isolates were obtained. The five rams that bred these ewes were electroejaculated and ureaplasmas were isolated from the semen of two of these rams. The isolation rate of ureaplasmas from wethers is approximately 10%. These results suggest that copulation may be an important factor in the transmission of ureaplasmas.

The ureaplasmas obtained from goats are more difficult to isolate and propagate than ureaplasmas of ovine or bovine origin. This is the main reason that the number of caprine ureaplasmal isolations in this report is less than that of sheep. However, the incidence of ureaplasmal infections appears to be similar to that of sheep. In a group of 10 Spanish does,
ureaplasmas were isolated from the urine of three does. Forty-five days later the does were killed and ureaplasmas were isolated from the same three does. This suggests that ureaplasmal infections can persist for long periods in individual goats without lateral transfer to contact does. A ureaplasma was isolated from the semen of the billy that had associated with the does prior to the first sampling date.

All isolations in this report were from naturally-infected sheep and goats under feedlot or range conditions representative of the Edwards Plateau region of Texas. Positive identification of isolates from a limited number of specimens received from other geographic areas of the United States adds to the evidence that mycoplasmas and ureaplasmas may be present in flocks throughout the United States.

REFERENCES


Table 1. Ovine Mycoplasmal Isolations

<table>
<thead>
<tr>
<th>Disease Condition</th>
<th>Number of Specimens Cultured</th>
<th>Number of Mycoplasmal Isolations</th>
<th>% Isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonic lesions</td>
<td>107</td>
<td>104</td>
<td>97.2</td>
</tr>
<tr>
<td>No visible pneumonic lesions</td>
<td>11</td>
<td>1</td>
<td>9.0</td>
</tr>
<tr>
<td>Keratoconjunctivitis</td>
<td>49</td>
<td>41</td>
<td>83.7</td>
</tr>
<tr>
<td>No keratoconjunctivitis</td>
<td>5</td>
<td>3</td>
<td>60.0</td>
</tr>
<tr>
<td>Lacrimal secretions Flock A</td>
<td>75</td>
<td>33</td>
<td>44.0</td>
</tr>
<tr>
<td>Lacrimal secretions Flock B</td>
<td>42</td>
<td>23</td>
<td>54.7</td>
</tr>
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</table>
Table II. Caprine Mycoplasmal Isolates

<table>
<thead>
<tr>
<th>Disease Condition</th>
<th># Specimens Cultured</th>
<th># Isolations</th>
<th>% Isolations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung lesions</td>
<td>17</td>
<td>10</td>
<td>59.1</td>
</tr>
<tr>
<td>Vaginal swabs from aborting does</td>
<td>10</td>
<td>7</td>
<td>70.0</td>
</tr>
<tr>
<td>Aborted fetuses</td>
<td>5</td>
<td>1</td>
<td>20.0</td>
</tr>
<tr>
<td>Keratoconjunctivitis</td>
<td>26</td>
<td>15</td>
<td>57.6</td>
</tr>
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</table>
Table III. Ovine Ureaplasmal Isolations

<table>
<thead>
<tr>
<th>Disease Condition</th>
<th># Specimens Cultured</th>
<th># Isolations</th>
<th>% Isolations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal urine</td>
<td>173</td>
<td>22</td>
<td>12.7</td>
</tr>
<tr>
<td>Nonpregnant uterus</td>
<td>65</td>
<td>8</td>
<td>12.3</td>
</tr>
<tr>
<td>Normal vaginal &amp; cervical swabs</td>
<td>115</td>
<td>32</td>
<td>27.8</td>
</tr>
<tr>
<td>Semen (electroejaculates)</td>
<td>17</td>
<td>11</td>
<td>64.7</td>
</tr>
<tr>
<td>Preputial swabs (wethers)</td>
<td>75</td>
<td>8</td>
<td>10.6</td>
</tr>
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</table>
Table IV. Caprine Ureaplasmal Isolates

<table>
<thead>
<tr>
<th>Disease Condition</th>
<th># Specimens Cultured</th>
<th># Isolations</th>
<th>% Isolations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal urine</td>
<td>34</td>
<td>13</td>
<td>38.2</td>
</tr>
<tr>
<td>Uterine swabs from aborting does</td>
<td>2</td>
<td>2</td>
<td>100.0</td>
</tr>
<tr>
<td>Semen (electroejaculates)</td>
<td>1</td>
<td>1</td>
<td>100.0</td>
</tr>
<tr>
<td>Vaginal swabs from normal does</td>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Preputial swabs</td>
<td>2</td>
<td>2</td>
<td>100.0</td>
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</table>

*All specimens were obtained from Texas Agricultural Experiment Station flocks.*
INTRODUCTION

Pearson et al.,* described the first documented case of mycoplasmosis in goats in Arizona. This outbreak involved the loss of eleven 2-to 10-week-old kids over a period of five days. Since this time a number of disease outbreaks in goat herds in Arizona have been studied and mycoplasmosis appears to be the major goat disease in the state.

During the period of April 1977 to June 1978, 20 cases of mycoplasmosis were diagnosed in goats. Several of these involved fewer than six animals from so-called "mini-farms" in the greater Phoenix area. It is the purpose of this paper to summarize the clinical, necropsy and laboratory findings of these cases, and to describe in detail an outbreak of mycoplasmosis that occurred in a small herd of goats assembled for pathogenesis studies of Corynebacterium psuedotuberculosis infection.

Breed - Age - Sex

The breeds involved in this study were Alpine, La Mancha, Nubian, Saanen and Toggenberg. The percentage incidence of this disease was highest and almost equal in the Alpine, La Mancha and Nubian breeds. The Nubian is the most popular goat breed in Arizona.

The age range of affected goats was 4 days - 20 weeks. There was no significant sex difference in the incidence of affected goats in this study.

Clinical Signs

The prominent clinical signs reported by owners and veterinarians were swollen joints with or without lameness, increased body temperature and dyspnea. In one case a marked swelling was observed ante-mortem on the right side of the face, especially in the mandibular area, anterior cervical region and the poll. In another case, slight scours was reported accompanying respiratory and joint problems. The clinical course of the acute disease ranged from 36 hours - 22 days.

Gross Lesions

Respiratory System — Lesions of pneumonia were prominent in these cases of mycoplasmosis. The right side of the lungs was involved in 92% of the pneumonias with total lung involvement in 8%. The apical lobes were the most frequently involved, followed by the cardiac lobes, and only occasional involvement of the diaphragmatic lobes. The affected tissue was red-purple with increased consistency and edema of the interlobular septa. In 21% of all pneumonias, single or multiple focal abscesses were observed. Pleural exudates usually consisted of large accumulations of soft fibrin lightly adhering to the serosal surface.

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The content of the trachea and bronchial tree varied from froth to thick purulent exudate. The appearance of the mucosa of the trachea and major bronchi was grossly normal with hyperemia occurring in the mucosa of the smaller airways.

Depending on the stage of the disease process, cut sections of affected lung would vary from dark reddish-purple homogeneous tissue to a variegated color pattern of hepatized to necrotic lobules separated by interlobular edema or fibrosis. Abscesses were well defined by fibrous tissue. Bronchial and mediastinal lymph nodes were generally enlarged and on cut section very moist.

Musculo-Skeletal System

The major diarthrodial joints were most often affected in these cases. The inflammatory reaction varied from increased cloudy joint fluid with fibrin clots to marked erosions of articular cartilage with fibrosis of the joint capsule. Periarticular tissues in acute cases were often edematous and congested, with extensive fibrosis occurring in chronic cases. Villus hypertrophy of the synovial membranes was a very consistent finding, and in at least 50% of the cases focal necrosis of these membranes could be observed. In the case involving cellulitis of the face and neck, edema was present in subcutaneous tissues which were congested with diffuse petechial and ecchymotic hemorrhages. In addition, a yellow-white rather gelatinous exudate was present in the atlanto-occipital and atlanto-axial joints and in "pockets" of the cervical musculature contiguous to these joints.

Microbiology

_Pasteurella hemolytica_ was isolated from lung tissue from one goat; _Corynebacterium pyogenes_ from a pulmonary abscess and joint fluid in two cases. These were the only isolations made in addition to mycoplasmas which were isolated from at least one primary lesion in each case. Mycoplasma organisms were isolated from the mandibular lymph node, cervical musculature and anterior cervical joints of the goat with cellulitis.

Histopathology

Lung — Acute lesions were characterized by congestion of the alveolar capillaries with increased numbers of neutrophiles. Fibrin was often present in the alveolar lumen with some neutrophiles interspersed. As the disease process proceeded, increasing numbers of inflammatory cells were found in the alveolar and bronchial lumens. Peribronchial and occasional perivascular accumulations of lymphocytes and neutrophiles could be seen. Necrosis of lung parenchyma was a prominent feature in the more advanced disease and these necrotic foci were usually well circumscribed by a layer of inflammatory cells and nuclear debris which in more chronic lesions was replaced by fibrosis.

Joints — Hyperplasia of the synovial membrane was evident forming villus projections with slight to moderate infiltrations of lymphocytes in
MYCOPLASMOSIS IN ARIZONA GOATS

the sub surface tissue. Necrosis of the villi as well as deeper tissues was often observed.

Case Report

A herd of 22 baby (6-14 day) goats were assembled at the University of Arizona Research Farm, Mesa, Arizona, in mid-March, 1977. On April 2, 1977 the first kid became sick, showing signs of depression, anorexia and hyperthermia (106 - 108°F). Over the next several days, seven more animals developed these same signs and the remainder were either clinically normal or had only mild listlessness, anorexia and slight elevation of body temperature. All the seriously affected goats developed joint swellings, with the carpal and stifle joints being most often involved, and resulting in severe lameness. From the group with mild clinical signs, two animals developed some joint swelling with moderate lameness.

Pneumonia and arthritis occurred singly or in combination in 70%, pleuritis in 8%, and pericarditis in 2% of acutely affected goats. Mycoplasma sp. were isolated from joint fluid in all cases of arthritis, and from 40% of the pneumonias in this acute disease group. Pasteurella hemolytica was isolated from only one of the pneumonic lungs.

In 70% of the surviving group, chronic or healed lung lesions were found when these animals were necropsied a year later as part of another research project. The morbidity in this outbreak of mycoplasmosis was 70% and the mortality, 36%.

Pneumonia, pleuritis, pericarditis and edema-cellulitis were the prominent lesions found in goat mycoplasmosis in Arizona. The gross and histopathologic features of these lesions were consistent with those described by Cottew and Lloyd¹ and Longley². Jonas and Barber² described five distinct clinical entities in goats caused by Mycoplasma sp., namely contagious caprine pleuropneumonia, caprine agalactia, infectious peritonitis, edema-cellulitis and polyarthritis. In Arizona three of these conditions have been observed in field outbreaks.

Several of the Arizona isolates were sent to the Plum Island Animal Disease Center for characterization and at least one has been reported to be Mycoplasma mycoides var. mycoides. We feel that it is important to determine whether goat isolates of Mycoplasma mycoides var. mycoides will produce disease in the bovine as well as in the goat. There is a continuing increase in the number of small back-yard as well as commercial goat herds in Arizona, which increases the potential of disease spread from goats to cattle.

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ISOLATION OF MYCOPLASMA FROM PNEUMONIC LUNGS OF SHEEP AND GOATS IN MEXICO

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Escuela Nacional de Estudios Profesionales “Cuautitlán”

INTRODUCTION

Pneumonia in sheep and goats in Mexico is a very common and costly disease. In a study of 12,000 animals slaughtered in 5 slaughterhouses around Mexico City, 12-15% of the animals had pneumonic lesions (Pijoan and Ramirez - unpublished results).

In these animals, mycoplasma are found to be important agents in the ethiology of pneumonia. The more common species in goats' lungs are *M. mycoides var capri* and *M. arginini* (Yedloutschnig et. al. 1971; Al-Aubaidi et. al., 1972; Ojo, 1976). Other species, such as *M. agalactiae* are of enormous importance, but are not primary pneumonia producers.

In sheep, the most important species of the respiratory tract is *M. ovipneumoniae* (Carmichael et. al., 1972; Stipkourts et. al., 1975).

In Mexico, only *M. mycoides var capri* has been isolated from goats (Solana, 1967) following a preliminary diagnosis by Dr. Aluja (1964). However, most of the pneumonic lesions found at slaughterhouses in Mexico, are not of the pleuropneumonic type, but rather, they are usually of the grey consolidation type, similar to those found in Enzootic Pneumonia of pigs.

Because of this, it was decided to investigate the occurrence of mycoplasma in sheep and goats' pneumonia.

MATERIAL AND METHODS

140 pneumonic lungs were studied (20 from sheep and 120 from goats). The lungs were obtained at local slaughterhouses and transported immediately to the laboratory.

The isolation procedure consisted of the dilution method, up to $10^4$ of the original tissue. For primary isolation, Eaton's liquid medium was used (Roberts y Pijoan, 1971). All samples were given 3 blind passages at 5 days' interval, before being discarded. When the media showed a change in pH, they were plated in Eaton’s solid medium, solidified with 0.5% Noble agar.

Mycoplasma like colonies were subjected to cloning three times. After that they were tested in the following tests: Liquoid and Digitonin sensibility; glucose and arginine utilization; film and spots formation and hydrogen peroxide production.

All strains isolated were tested against the antisera shown in table 1 (Kindly provided by Dr. H. Erno) by the growth-inhibition and the indirect FAT test. All the strains were sent for confirmation of results to the FAO/WHO Collaborating Centre for Animal Mycoplasmas, Aarhus,
RESULTS

In all, 17 Mycoplasmas were isolated, 13 from goats, (10.8%) and 4 from sheep (20% - table 2).

The results of the biochemical tests are shown on tables 3, 4 and 5. All the strains isolated were sensitive to 5% liquoid and 1.5% digitonin, and were therefore typed as Mycoplasma. Twelve strains were arginine hydrolase positive, 4 were glucose positive, and 1 was negative to both tests. None of the strains produced \( \text{H}_2\text{O}_2 \) of “film and spots.”

The results of the serological tests are shown on table 6. Ten strains were positive by the FAT test to \( M. \) \( \text{arginini} \) antiserum. Two strains were positive against \( M. \) \( \text{ovipneumoniae} \) antiserum. However, 5 strains were not typable with the antisera used. These strains included 2 arginine positive, 2 glucose positive and 1 negative to both tests. Table 7 shows the origin of the isolates. All \( M. \) \( \text{ovipneumoniae} \) strains were isolated from goats, whereas \( M. \) \( \text{arginini} \) was isolated from both animal species.

DISCUSSION

The results agree with those of other authors (Jones et. al. 1978; Alley et. al., 1975) which have isolated \( M. \) \( \text{arginini} \) and \( M. \) \( \text{ovipneumoniae} \) from sheep. However, these species had not been isolated in Mexico, although they have been reported in the United States.

On the other hand, we have been unable to find a previous report on the isolation of \( M. \) \( \text{ovipneumoniae} \) from goats, and this may be the first report of the occurrence of this species in goats.

It would seem surprising the failure to isolate \( M. \) \( \text{mycoides var capri} \), as this species has been previously reported in Mexico. However, a slaughterhouse survey usually misses highly pathogenic organisms such as \( M. \) \( \text{mycoides var capri} \) and tends to find more chronic types of organisms such as \( M. \) \( \text{ovipneumoniae} \).

At this moment, it is not known the importance of \( M. \) \( \text{ovipneumoniae} \) in goats as a disease-producing agent, nor have the “untypable” strains isolated been tried with antisera against species from origin other than sheep and goats. However, these problems are currently under research at our laboratory.

REFERENCES


Table 1

<table>
<thead>
<tr>
<th>Antisera used for identification in the indirect fat and the growth-inhibition test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mycoplasma agalactiae PG 2 capricolum CALIF-KID</td>
</tr>
<tr>
<td>dispar 462/2</td>
</tr>
<tr>
<td>mycoides subsp. capri PG3</td>
</tr>
<tr>
<td>ovipneumoniae Y-98</td>
</tr>
<tr>
<td>OVINE SEROGROUP 5 GOAT 145</td>
</tr>
<tr>
<td>OVINE SEROGROUP 7 AL 343</td>
</tr>
<tr>
<td>OVINE SEROGROUP 11.2 D</td>
</tr>
<tr>
<td>OVINE SEROGROUP 6 GOAT 189</td>
</tr>
<tr>
<td>OVINE SEROGROUP 8 Y-GOAT</td>
</tr>
</tbody>
</table>
Table 2
Total Mycoplasm Isolated

<table>
<thead>
<tr>
<th>No. of isolations</th>
<th>Species</th>
<th>Organ</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Goats</td>
<td>Pneumonic Lung</td>
</tr>
<tr>
<td>4</td>
<td>Sheep</td>
<td>Pneumonic Lung</td>
</tr>
</tbody>
</table>

17

Table 3
Sterol Requirement Test

<table>
<thead>
<tr>
<th>No.</th>
<th>Liquoid 5%</th>
<th>Digitonin 1.5%</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>+ + +</td>
<td>+ + +</td>
<td>Mycoplasma</td>
</tr>
<tr>
<td>5</td>
<td>+ +</td>
<td>+ + +</td>
<td>Mycoplasma</td>
</tr>
<tr>
<td>3</td>
<td>+ +</td>
<td>+ +</td>
<td>Mycoplasma</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td>+ + +</td>
<td>Mycoplasma</td>
</tr>
<tr>
<td>2</td>
<td>+ +</td>
<td>+</td>
<td>Mycoplasma</td>
</tr>
<tr>
<td>1</td>
<td>+</td>
<td>+</td>
<td>Mycoplasma</td>
</tr>
</tbody>
</table>

17

Table 4
Tests for Glucose or Arginine Metabolism

<table>
<thead>
<tr>
<th>No.</th>
<th>Arginine</th>
<th>Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Positive</td>
<td>Negative</td>
</tr>
<tr>
<td>4</td>
<td>Negative</td>
<td>Positive</td>
</tr>
<tr>
<td>1</td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>

17
Table 5
Tests for the Production of $\text{H}_2\text{O}_2$ and "Film and Spots"

<table>
<thead>
<tr>
<th>No.</th>
<th>$\text{H}_2\text{O}_2$</th>
<th>Film and Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>

Table 6
Results of the Serological Tests

<table>
<thead>
<tr>
<th>Antiserum</th>
<th>No. of Mycoplasmas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td>M. agalactiae</td>
<td>-</td>
</tr>
<tr>
<td>M. arginini</td>
<td>+</td>
</tr>
<tr>
<td>M. capricolum</td>
<td>-</td>
</tr>
<tr>
<td>M. conjuntivae</td>
<td>-</td>
</tr>
<tr>
<td>M. dispar</td>
<td>-</td>
</tr>
<tr>
<td>M. gallinarum</td>
<td>-</td>
</tr>
<tr>
<td>M. mycoides-capri</td>
<td>-</td>
</tr>
<tr>
<td>M. mycoides-mycoides</td>
<td>-</td>
</tr>
<tr>
<td>M. ovipneumoniae</td>
<td>-</td>
</tr>
<tr>
<td>M. putrefaciens</td>
<td>-</td>
</tr>
<tr>
<td>Ovine serogroup 5</td>
<td>-</td>
</tr>
<tr>
<td>Ovine serogroup 6</td>
<td>-</td>
</tr>
<tr>
<td>Ovine serogroup 7</td>
<td>-</td>
</tr>
<tr>
<td>Ovine serogroup 8</td>
<td>-</td>
</tr>
<tr>
<td>Ovine serogroup 11</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 7
Species of Mycoplasma Isolated from Sheep and Goats

<table>
<thead>
<tr>
<th>Animal Species</th>
<th>Total Isolations</th>
<th>Mycoplasma Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>4</td>
<td>3 M. arginini</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 Untyped</td>
</tr>
<tr>
<td>Goats</td>
<td>12</td>
<td>7 M. arginini</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 M. ovipneumoniae</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 Untyped</td>
</tr>
</tbody>
</table>
During fiscal year 1978, bluetongue (BT) was confirmed by virus isolation in five cattle herds; one in Iowa and four in California, and in 26 sheep flocks; 24 in California and two in Oregon.

There are presently 20 International Serotypes (Onderstepoort, South Africa classification) of BT virus recognized in the world. International Serotype 20 was isolated from a Culicoides pool collected in March 1975, in the northern territory of Australia. The virus was isolated in November 1976, but not identified as BT until October 1977. Four of the International Serotypes (10, 11, 13, and 17) have been identified in the United States. All four serotypes have been isolated from cattle and sheep in the United States; 13 and 17 have been isolated from wildlife.

In addition, during fiscal year 1978, some 42,210 modified direct complement-fixation (MDCF) tests were run at National Veterinary Services Laboratories (NVSL), Ames, Iowa, and at 20 approved laboratories with the following results:

<table>
<thead>
<tr>
<th></th>
<th>Total Tested</th>
<th>Negative</th>
<th>Suspicious</th>
<th>Positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle</td>
<td>36,151</td>
<td>32,190</td>
<td>3,149</td>
<td>812</td>
</tr>
<tr>
<td>Goats</td>
<td>901</td>
<td>873</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>Sheep</td>
<td>2,188</td>
<td>2,096</td>
<td>52</td>
<td>40</td>
</tr>
<tr>
<td>Wildlife</td>
<td>1,633</td>
<td>1,493</td>
<td>69</td>
<td>71</td>
</tr>
<tr>
<td>Unknown</td>
<td>1,337</td>
<td>1,202</td>
<td>101</td>
<td>34</td>
</tr>
<tr>
<td>TOTAL</td>
<td>42,210</td>
<td>37,854</td>
<td>3,390</td>
<td>966</td>
</tr>
</tbody>
</table>

Positive MDCF samples were collected from the following 32 States: Arizona, California, Colorado, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Minnesota, Missouri, Montana, Nebraska, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, South Carolina, South Dakota, Texas, Utah, Virginia, Washington, and Wisconsin.

A summary of accumulative MDCF test results on some 316,524 samples for fiscal year 1972 to fiscal year 1978, is shown in Figure 1 (see attached).

BT Surveillance Program

Veterinary Services, in an effort to determine the distribution and incidence of BT, conducted a serological survey of market cattle samples in the United States. Preliminary results from the survey reveal an overall reaction of about 18 percent. The results of the survey are being analyzed and will be reported later.
Veterinary Services also initiated cooperative projects with various State institutions to study BT with the following objectives: (1) establish a BT-free bull-stud to produce BT-free semen; (2) determine the epidemiology, ecology, entomology, and environmental factors of BT in high and low incidence areas, and (3) determine those factors responsible for the variation in BT incidence. These studies are showing promise and will be continued in fiscal year 1979. It is hoped the results of these studies will provide information useful to the certification of livestock for export, and for control or eradication efforts of BT.

Dr. Hugh Metcalf
### UNITED STATES BLUETONGUE SEROLOGICAL MDCF TESTING RESULTS
FY 1972 - FY 1978

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>SAMPLES</th>
<th>A-C</th>
<th>NEGATIVE</th>
<th>SUSPICIOUS</th>
<th>POSITIVE</th>
<th>SUSPICIOUS</th>
<th>POSITIVE</th>
<th>TOTALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATTLE</td>
<td>274,475</td>
<td>5,691</td>
<td>245,711</td>
<td>18,657</td>
<td>4,416</td>
<td>6.9</td>
<td>1.6</td>
<td>8.6</td>
</tr>
<tr>
<td>GOATS</td>
<td>5,238</td>
<td>142</td>
<td>4,803</td>
<td>222</td>
<td>71</td>
<td>4.4</td>
<td>1.4</td>
<td>5.7</td>
</tr>
<tr>
<td>SHEEP</td>
<td>11,229</td>
<td>955</td>
<td>9,084</td>
<td>837</td>
<td>353</td>
<td>8.1</td>
<td>3.4</td>
<td>11.6</td>
</tr>
<tr>
<td>WILDLIFE</td>
<td>4,279</td>
<td>447</td>
<td>3,381</td>
<td>258</td>
<td>193</td>
<td>6.7</td>
<td>5.0</td>
<td>11.8</td>
</tr>
<tr>
<td>UNKNOWN</td>
<td>21,303</td>
<td>352</td>
<td>20,355</td>
<td>505</td>
<td>91</td>
<td>2.4</td>
<td>0.4</td>
<td>2.8</td>
</tr>
<tr>
<td>TOTALS</td>
<td>316,524</td>
<td>7,587</td>
<td>238,334</td>
<td>20,479</td>
<td>5,124</td>
<td>6.6</td>
<td>1.7</td>
<td>8.3</td>
</tr>
</tbody>
</table>

#### TEST RESULTS:

**CATTLE:**
Cattle tested in 49 States. Reactors or suspicious animals disclosed in 46 States.
Ninety-four percent reacting cattle found west of Mississippi.
Ninety-one percent suspicious cattle found west of Mississippi.

**SHEEP:**
Sheep tested in 44 States. Reactors or suspicious animals disclosed in 32 States.
Eighty-four percent reacting sheep found west of Mississippi.
Eighty-three percent suspicious sheep found west of Mississippi.

**GOATS:**
Goats tested in 38 States. Reactors or suspicious animals disclosed in 17 States.
Fifty-three percent reacting goats found west of Mississippi.
Thirty-seven percent suspicious goats found west of Mississippi.

**WILDLIFE:**
Wildlife tested in 43 States. Reactors or suspicious animals disclosed in 21 States.
Sixty-six percent reacting wildlife found west of Mississippi.
Seventy-four percent suspicious wildlife found west of Mississippi.
Scrapie was reported in one flock in North Carolina during fiscal year 1978. The outbreak occurred in a Suffolk flock in Durham County. There were three outbreaks reported in fiscal year 1971, four in 1972, two each in 1973, 1974, and 1975, six in 1976, and three in 1977. There are 197 flocks under surveillance and it is expected that this number will increase when tracing has been completed on pending flocks.

The North Carolina outbreak was reported by the attending veterinarian in charge of the flock. The infected flock has been slaughtered. A preliminary investigation indicates that the source of the North Carolina outbreak was a Washington County, Virginia flock. The Virginia source flock has been dispersed and regulatory officials are endeavoring to locate and slaughter exposed sheep sold from the flock.

Effective August 31, 1976, a portion of LaSalle County, Illinois, was placed under Federal quarantine due to a source flock being located there. A Suffolk ewe from this flock was showing clinical signs of scrapie in an Oklahoma flock 2 months after being moved from the flock. The affected ewe was destroyed 3 months and 6 days after leaving the source flock, and scrapie was confirmed by histopathological examination. The Illinois source flock has been appraised and destroyed and the quarantine will be released.

Scrapie outbreaks have been reported at low levels in the United States since 1971. However, the six outbreaks in 1976, three in 1977, and the one in 1978, demonstrates that scrapie virus is active in the United States and we must not let down in promptly carrying out all program procedures if we are to eradicate this disease. Resistance to the program had developed in a segment of the industry. Inequities of appraisal and inadequate indemnity payments are a significant reason for this resistance.

The amendment to 9 CFR, Part 54, effective September 15, 1978, which provides for appraisal of animals destroyed because of scrapie by qualified appraisers, and increased Federal compensation for animals destroyed of two-thirds the appraisal value up to $300 per head, will, we believe improve cooperation by the industry and the Scrapie Eradication Program will move forward.

Scrapie Field Trial, Mission, Texas

The Scrapie Field Trial has been underway since November 1964 (165 months). During this period, scrapie has been confirmed by histopathological study or by mouse inoculation in 376 animals. The 376 cases
have occurred on infected premises No. 3 in the following category of animals taken to Mission or born on that premises:

1. Scrapie bloodline exposed sheep 252
2. Field suspects held for observation 12
3. Nonbloodline exposed sheep 57
4. Nonbloodline exposed goats 55
TOTAL 376

The findings at the Scrapie Field Trial study have demonstrated that bloodline animals exposed or infected and source flock premises will continue to develop scrapie and losses will continue to occur in succeeding generations at higher rates than observed in the original animals.

The work at Mission has confirmed that scrapie can be transmitted to previously unexposed nonbloodline sheep and goats placed on infected premises with scrapie-affected sheep and goats. Scrapie has been transmitted naturally to Hampshire, Rambouillet, Suffolk, and Targhee sheep; and to Angora, Nubian, Angora X, Nubian X, Toggenburg, Nubian X, Toggenburg X, and mixed breed dairy goats.

Goats, Suffolk, Rambouillet, and Targhee sheep developed scrapie if born on infected premises and removed from exposure at the following ages: goats—6, 9, and 10 months; Suffolk—at birth, 4, 9, and 20 months; Rambouillet—at birth, 4, 9 and 20 months; and, Targhees—at birth and 20 months.

This study demonstrates that animals sold from infected flocks at birth to 20 months of age may harbor the scrapie virus and progress to clinical scrapie. Therefore, they must be destroyed if we are to eradicate this disease.

Scrapie has not been directly linked to human disease. However, the evidence continues to draw closer and closer the possibility of the human health hazard. Scrapie virus inoculated into Capuchin, Cynomolagus, Rhesus, Spider, or Squirrel monkey produces a disease with similar symptoms and brain damage as that produced by the viruses of transmissible mink encephalopathy (TME) and of the human diseases of kuru and Creutzfeldt-Jakob Disease (when inoculated into monkeys).
During 1978, Oregon sheep producers experienced an unusually high lamb death loss due to abortion, stillbirth or perinatal deaths. A retrospective serologic study was initiated by the OSU Veterinary Diagnostic Laboratory to determine possible causes of the problem. Blood samples were collected from ewes in 19 flocks that had experienced high rates of abortion, stillbirth or perinatal death of lambs. The blood samples were identified as to the reproductive status of the ewe, that is, whether she had delivered a normal live lamb or had experienced abortion, stillbirth or perinatal death of her lamb. This study was initiated late in the lambing season, hence, in some flocks the blood samples were collected up to 2 months after lambing or abortion. A complete history of flock management and previous reproductive status was obtained also.

The number of blood (serum) samples collected from each flock ranged from 10 to 20 for a total of 314 samples. Each serum was tested for leptospirosis by the microscopic agglutination test, bovine virus diarrhea by the serum neutralization test, toxoplasmosis by the indirect hemagglutination test, and bluetongue and Brucella ovis by the complement-fixation test. The leptospiral serovars tested were: L. hardjo, L. grippotyphosa, L. pomona, L. icterohemorrhagiae and L. mini scwajizak.

The results of these tests are presented on Tables I and II. Not all of the tests have yet been completed on each of the serum samples.
TABLE I. RESULTS OF THE SEROLOGICAL TESTS ON SHEEP FROM FLOCKS EXPERIENCING ABORTIONS, STILLBIRTHS, OR PERINATAL DEATH OF LAMBS.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluetongue</td>
<td>278</td>
<td>1</td>
<td>0.36%</td>
<td>19</td>
<td>1</td>
<td>5.2%</td>
</tr>
<tr>
<td><em>Brucella ovis</em></td>
<td>314</td>
<td>8</td>
<td>2.5%</td>
<td>19</td>
<td>4</td>
<td>21%</td>
</tr>
<tr>
<td>Toxoplasmosis</td>
<td>204</td>
<td>90</td>
<td>44%</td>
<td>13</td>
<td>13</td>
<td>100%</td>
</tr>
<tr>
<td>Bovine Virus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diarrhea</td>
<td>80</td>
<td>2</td>
<td>2.5%</td>
<td>5</td>
<td>2</td>
<td>40%</td>
</tr>
<tr>
<td>Leptospirosis</td>
<td>314</td>
<td>140</td>
<td>45%</td>
<td>19</td>
<td>16</td>
<td>84%</td>
</tr>
</tbody>
</table>

* = titer of 1:64 or greater considered positive

TABLE II. DISTRIBUTION OF LEPTOSPIRA SEROVARS IN THE SHEEP WITH POSITIVE TESTS

<table>
<thead>
<tr>
<th>Leptospira Serovar</th>
<th>No. Sheep Pos.</th>
<th>% of Lepto Pos. Sheep</th>
<th>No. Flocks Pos.</th>
<th>% of Lepto Pos. Flocks</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>L. hardjo</em> (monovalent infection)</td>
<td>57</td>
<td>41%</td>
<td>4</td>
<td>25%</td>
</tr>
<tr>
<td><em>L. grippotyphosa</em> (monovalent infection)</td>
<td>52</td>
<td>37%</td>
<td>3</td>
<td>19%</td>
</tr>
<tr>
<td><em>L. pomona</em> (monovalent infection)</td>
<td>4</td>
<td>3%</td>
<td>1</td>
<td>6%</td>
</tr>
<tr>
<td><em>L. hardjo &amp; L. grippotyphosa</em> (dual infection)</td>
<td>27</td>
<td>19%</td>
<td>8</td>
<td>50%</td>
</tr>
</tbody>
</table>
a = titer of 1:100 positive for *L. grippotyphosa* and *L. pomona*,
    titer of 1:50 positive for *L. hardjo*

b = total of 140 sheep positive for leptospirosis

c = total of 16 flocks positive for leptospirosis

While the serologic tests on these sheep are not yet complete, results thus far indicate a greater rate of leptospiral infection in these flocks than expected. It is reasonable that at least some of the reproductive problems in these flocks were due to leptospirosos. These results indicate that only *L. hardjo*, *L. grippotyphosa* and to a lesser extent *L. pomona*, were active in these flocks.

Overall this study suggests that leptospirosis may be a greater problem in sheep than has been generally acknowledged.

The high reactor rate for toxoplasmosis was surprising and at this time the significance of these results and of this disease is not known.
REPORT OF THE COMMITTEE ON SHEEP AND GOATS

Chairman: F. James Schoenfeld
Co-Chairman: M. E. Macheak


There were 12 committee members present and 16 guests—a total of 28 present.

The committee met as requested by the President of U.S.A.H.A. to consider the business of the committee and submits the following report:

Dr. Blaine McGowan Jr., School of Veterinary Medicine, University of California at Davis, gave an update on Blue Tongue research in which the following agencies are cooperating in the project: APHIS, Veterinary Services, California Bureau of Animal Industry, California Department of Fish and Game, California School of Veterinary Medicine, The Extension Service and the Department of Entomology. This study involves cattle, sheep and goats, wildlife such as deer, elk, and antelope, zoo animals and game birds.

Mr. Bert Eller of the National Cattlemen's Association and Mr. John Neimi of the committee presented a Resolution on Blue Tongue which the committee gave support as presented by them.

A Mycoplasma Seminar of sheep and goats, as correlated by Dr. J. J. Callis, Director of Plum Island Disease Laboratory. The seminar was directed by Dr. H. E. Adler from the University of California. Dr. Adler gave a paper on "Selected Mycoplasmosis of Goats in the United States." (1). Dr. C. W. Livingston gave a paper on "Isolation of Mycoplasma and Ureaplasma from Sheep and Goats in West Texas (1970-78)" (2). Dr. C. J. Maré, of the Department of Veterinary Science, University of Arizona spoke on "Mycoplasmosis in American Goats" (3). Dr. Carlos Pijoan, of the University of Mexico, spoke to the subject of "Isolation of Mycoplasma from Pneumonic Lungs of Sheep and Goats" (4). Dr. Ronald Yedloutschnig of PIADC, SEA, USDA discussed the various mycoplasma isolates which have been typed at the center for the past 10 years" (5). The entirety of these papers is included in this report.

A summary of this seminar as furnished by Dr. Adler:

Goat and Sheep Mycoplasma

During the discussion on mycoplasmal infections of goats and sheep greatest concern was expressed on Mycoplasma mycoides subspecies mycoides infection of goats found in several eastern states. It was apparent that the taxonomic classification of the isolates was complicated by the different biologic characteristics of the strains. Similar diagnostic problems were posed in the identification of M. mycoides subspecies
capri. Since these so-called exotic mycoplasmas are a potential threat to the livestock industry, the investigators felt it would be of value of have available a source of specific antisera and antigens for mass-screening and diagnosis of these infections.

The scrapie report was submitted by Dr. A. L. Klingsporn, Chief Staff Veterinarian, VS (6).

Dr. Hugh E. Metcalf, USDA, APHIS, VS reported on Blue Tongue (7). These two reports are submitted as a committee report.

Dr. T. B. Snodgrass of FDA, and a member of the committee, and Dr. Linda Carpenter, USDA, VS, reported on biologic problems as to the production, interstate movements and proper license application for vaccines. It was noted concerning the new Virus and Serum Act.

Dr. Guy P. Reynolds, Oregon State University, gave a preliminary report on ewe abortions, added information was given by Dr. John A. Schmitz. A summary report is submitted by Dr. Reynolds and is included in this report (8).

The committee approved and accepted the reports as given.

Resolutions were submitted by Dr. T. Lyn Barber, USDA, SEAFR concerning mycoplasma. Mr. Olin H. Timm, member of the committee and stablizer of this committee, presented the resolutions on Foot Rot and Blue Tongue.

The business of the committee being completed was adjourned at 5 P.M.
The United States was declared officially free of hog cholera January 31, 1978, by Secretary Bergland. This was the result of 16 years of State-Federal regulatory, research and industry cooperation. The last diagnosed positive case of hog cholera was on August 1, 1976. A longstanding recommendation of the former Secretary's Advisory Committee on Hog Cholera Eradication has been to maintain a high level of surveillance for 3 years following the official declaration. Funds and manpower have been reduced as the domestic risk lessened. Recent occurrences have emphasized the need for indefinite surveillance to prevent and detect the introduction or reintroduction of African swine fever, hog cholera, foot-and-mouth disease, swine vesicular disease, and vesicular exanthema of swine.

1976 TASK FORCE AREAS

As FY 1978 progressed without incidence of hog cholera in the New England and New Jersey outbreak areas, permanent and temporary personnel were reduced. The two headquarters offices were closed and remaining personnel placed into the field organizations of the various States. Slaughter serum collections continued in small packing plants in the Northeast. Swine brucellosis serum collections are also titered for hog cholera.

It was anticipated that all surveillance in New England and New Jersey would be performed by regular, permanent employees; however, the outbreak of African swine fever in Brazil and the Dominican Republic, raised the threat of a foreign swine disease being introduced into States through U.S. air and sea ports of entry. So, again, temporary people have been employed to help maintain surveillance for this fiscal year.

UNITED STATES-MEXICAN BORDER

Personnel have had to be reduced in the interior United States in order to fund the coastal States and the U.S.-Mexican border. This calendar year two known outbreaks of hog cholera, confirmed by Mexican authorities, have occurred just over the border, one at Ciudad Miguel Alleman near Falcon Dam south of Texas in April and another in May at Tijuana south of San Diego, California.
Slaughter serum samples are collected in Texas plants that receive swine from the lower Rio Grande Valley. Suspicious titers are traced and herds sampled. In the areas of Texas most heavily populated with swine (Brownsville and to the west) a constant detail of veterinarians and animal health technicians is maintained for market and swine herd inspections.

The area of California above Mexico, for the most part, is very rugged mountains and arid desert. The total swine population is small and swine-owning premises are few. These are regularly inspected by State and Federal personnel. The Customs Service and the Immigration and Naturalization Service also patrol the area. Food items carried by illegal aliens are seized and destroyed. Border crossing sites are inspected by Customs Service, Immigration and Naturalization Service, Plant Protection and Quarantine, and Veterinary Services personnel.

PUERTO RICO

Due to historic and ethnic ties with Spain and Portugal, South America and the Caribbean islands have threatened swine populations. Temporary and permanent personnel have been increased in both State and Federal regulatory field forces in Puerto Rico. The rate of inspection of all swine has been doubled and the rate of laboratory submissions for African swine fever-hog cholera analysis increased.

OVERALL SURVEILLANCE

Diagnostic capability is maintained in all States. State diagnostic laboratories are urged to continue fluorescent antibody testing of swine tissues submitted to them for diagnosis. Through State and Federal cooperation, a minimum of once-per-month garbage inspections is to be maintained nationally.

Swine tissue specimens submitted to the National Veterinary Services Laboratories for hog cholera are also analyzed for African swine fever. Samples involving herds suspected to have African swine fever are submitted directly to the Plum Island Animal Disease Center, as are serum samples which are to be titered for African swine fever antibodies.

Hog cholera has been diagnosed in South and Central America and the Caribbean islands from samples collected for African swine fever analysis. This can cause confusion in the differential diagnosis of these two diseases and once again points out the nearness of the threat of the reintroduction of hog cholera.
The United States was declared free of hog cholera on January 31, 1978. The last known positive case of hog cholera was on August 1, 1976. Our intent is to maintain a high level of domestic hog cholera surveillance through 1980 and then to a lesser degree indefinitely due to its worldwide distribution.

The FY 1979 budget is approximately 40 percent of FY 1978. It had been planned to have all surveillance work, including that in former task force areas, performed by permanent personnel in FY 1979.

Veterinary Services appropriations in FY 1979 are for swine disease surveillance including monitoring for African swine fever. Outbreaks of African swine fever in Brazil and the Dominican Republic have generated the hiring of temporary personnel to bolster efforts in the New England-New Jersey areas and Puerto Rico. A budget redirection is in motion to support these people, the additional work of permanent personnel, and diagnostic laboratory expense at the National Veterinary Services Laboratories, Ames, Iowa, in an endeavor to maintain a reasonable level of surveillance.

The laboratory submissions of tissues for African swine fever in infected and neighboring countries of the Caribbean, South and Central America, have demonstrated the presence of hog cholera. In addition, two known confirmed cases of hog cholera have occurred in Mexico near the U.S. border in April at Ciudad Miguel Alleman and in May at Tijuana, reminding us that we must keep up our guard. Market approval and inspections are to continue as are monthly inspections of waste food operations in cooperation with the various States. Trained diagnosticians (210 Federal, 52 State) are present in every State, many also trained as foreign animal diseases diagnosticians. Sick swine investigations and tissue submissions are encouraged on a national basis as geographical borders are not sufficient deterrents to rapid spread should African swine fever or hog cholera be introduced or reintroduced.
FY 1979 - 31 DIRECT FIELD MY
SHADABLE--HIGH SURVEILLANCE 1/MONTH GARBAGE INSPECTION
UNSHADABLE--4/YEAR GARBAGE INSPECTION

NORTHERN REGION
SOUTHWEST region
SOUTHERN CENTRAL
WESTERN

GARAGE FEEDING PROHIBITED

* PUERTO RICO
** GARDEN ISL.

A. H. NW. B. M. I. N. W. A. M. N. W. A. M. N.
A. H. NW. B. M. I. N. W. A. M. N. W. A. M. N.
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### HOG CHOLERA SURVEILLANCE

**Surveillance FY 1976 vs Surveillance FY 1977 vs Surveillance FY 1978**

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<td><strong>FA Screening</strong></td>
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<tr>
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<td><strong>On Farm Inspections</strong></td>
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<tr>
<td>1/2&quot; = 1 million</td>
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<td>7,568,925 swine</td>
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<td>11,725,794 swine</td>
<td>13,039,245 swine</td>
<td>13,154,990 swine</td>
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**Prepared: October 23, 1978**
HOG CHOLERA SLAUGHTER SERUM'S SURVEY

1974 - 6,544 SERUM SAMPLES

52 or .79% POSITIVE AT 1/16 OR GREATER
43/52 or 83% HOG CHOLERA TITER OR HOG CHOLERA TITER GREATER THAN BVD
9/52 or 17% BVD EQUAL TO OR GREATER THAN HOG CHOLERA

1977 - 6,418 SERUM SAMPLES

11 or .17% POSITIVE AT 1/16 OR GREATER
4/11 or 36% HOG CHOLERA GREATER THAN BVD (1), INSUFFICIENT SERUM FOR BVD (3)
7/11 or 62% BVD EQUAL TO OR GREATER THAN HOG CHOLERA
REPORT OF THE COMMITTEE ON
NATIONWIDE ERADICATION OF HOG CHOLERA

Chairman: Lowell W. Hinchman, DVM, Glenwood, Ind.
Co-Chairman: J. B. Taylor, DVM, Montgomery, Alabama

Ralph L. Hosker, Don G. Brothers, Sam Young, H. A. Sibley, George B. Estes, Marvin Garner, R. E. Hall, Paul L. Spencer, John Villari, Milton J. Tillery

The optimism indicated by this committee in 1977 that the United States would be declared "hog cholera free" was rewarded with the ceremonies in Washington, D.C., at which Secretary of Agriculture Robert Bergland on January 31, 1978 made that declaration.

Dr. Ralph Hosker of Veterinary Services described the current status of hog cholera surveillance and his comments are included.

It is with great satisfaction to the members of this committee that they have been able to contribute to the accomplishment of their original charge. The members, however, would be remiss, not to compliment all persons who have diligently served on allied Hog Cholera Committees and given innumerable hours of dedicated service to achieve this goal. These service-oriented personnel include those who served on the National Advisory Committee, state and federal regulatory personnel, state advisory committees and other allied animal health organizations.

The committee reaffirms its support of the 1977 recommendations and suggests that the first four points be continued as guidelines for the continued success of the program. In an extended discussion of the future status of the committee, it was their unanimous recommendation that the committee status as a standing committee of the United States Animal Health Association be terminated.

It was also recommended that due to the parallel relationship in the surveillance for African Swine Fever, that the responsibilities originally assigned to the committee be transferred to the Foreign Disease Committee.

The chairman has consulted with the President of the USAHA and the chairman of the Foreign Disease Committee concerning this recommended transfer of responsibilities and they have concurred.
IMMUNIZATION OF SWINE WITH A MODIFIED LIVE-VIRUS PSEUDORABIES VACCINE


Research and Development Division, Norden Laboratories, Lincoln, NE 68501

In June, 1977, Norden Laboratories introduced the first licensed pseudorabies vaccine available in the United States. During more than a year of field use, this modified live-virus (MLV) vaccine has effectively protected pigs in endemic areas, and has proven to be of significant value in limiting losses in the face of active outbreaks. In addition, it has been shown to be uniformly safe in swine of all ages.

The vaccine is a live, attenuated strain of pseudorabies virus (PRV) grown in a porcine cell culture. It is administered intramuscularly in a single 1 ml. dose, and is indicated for use in pigs 3 days of age and older. Pigs nursing immune sows should be revaccinated at 3 to 8 weeks of age, when maternal antibody levels have declined. Semiannual vaccination is recommended for animals retained for breeding. Because safety of the vaccine has not been established in other species, it is indicated for use in swine only.

SAFETY AND EFFICACY

Prelicensing tests demonstrated conclusively that (1) the vaccine does not cause adverse reactions in swine, (2) horizontal transfer of vaccine virus does not occur, and (3) vaccination effectively protects pigs from severe challenge with PRV. Validity of these tests was assured by using a statistically significant number of young, susceptible test animals and an exceptionally virulent challenge virus. Because older swine are more resistant to pseudorabies, seronegative pigs less than 1 month of age were used in the safety and efficacy tests. The PRV challenge strain was obtained from a pseudorabies outbreak in Indiana.

Because virulence of PRV strains varies widely, severity of challenge should be considered when assessing the relative efficacy of pseudorabies vaccines. For example, in a challenge test to evaluate an inactivated pseudorabies vaccine, challenge virus killed only 58% and affected 89% of 19 nonvaccinated control pigs 6 weeks of age. When the same challenge virus was given to more resistant control pigs 5 months of age, only 3 of 5 were affected and 2 of 5 were killed. In contrast, the Indiana challenge virus used to evaluate the MLV vaccine killed 13 of 16 (81%) and produced disease in 100% of nonvaccinated control pigs less than 6 weeks of age. When administered to nonvaccinated control pigs 6 to 7 months of age, it killed 5 of 8 and affected all 8.

a'PR-Vac', Norden Laboratories, Lincoln, NE 68501.
In prelicensing tests of the MLV vaccine, young, susceptible pigs vaccinated with as much as 1,400 times the normal field dose remained consistently normal with no increase in temperature. PRV could not be isolated from tonsil or fecal swabs taken on a daily basis following vaccination, indicating that intramuscular administration does not result in shedding of the vaccine virus. Nonvaccinated control pigs in continuous contact with vaccinates remained seronegative and susceptible to PRV challenge, indicating that horizontal transfer of vaccine virus did not occur. Seronegative pigs were also vaccinated intranasally without adverse reactions or an increase in temperature. Although definitive safety tests in pregnant sows have not been performed, experimental vaccination of limited numbers of pregnant sows did not result in adverse reactions, abortions, or stillbirths.

Vaccine safety was conclusively demonstrated by administration of more than 12 times the normal field dose to immunosuppressed pigs. Five seronegative pigs were treated daily with 100 mg. of cortisone 3 days prior to vaccination and 3 days postvaccination. Vaccine virus was not isolated from tonsil swabs taken daily for 28 days postvaccination, nor was PRV isolated from the brain or tonsils of 2 of the pigs sacrificed 16 days postvaccination. The immunosuppressed pigs remained free from signs of pseudorabies following vaccination, and contact control pigs remained seronegative throughout the test period. The test demonstrated that even in susceptible, immunosuppressed pigs the vaccine does not produce disease or adverse reactions, nor is it shed to contact animals. In addition, the immunosuppressed pigs developed postvaccination SN titers equivalent to those in a group of 5 nontreated vaccinates of the same age.

Vaccine efficacy was demonstrated in various vaccination-and-challenge tests. Susceptible pigs consistently seroconverted within 7 days following vaccination with a single dose. All 67 experimentally vaccinated pigs were protected from signs of pseudorabies following challenge that killed more than 80% of the nonvaccinated controls and affected 100%.

Duration of immunity was evaluated in 33 pigs vaccinated at 1 to 6 weeks of age. Vaccinates remained in continuous contact with 8 control pigs of the same age. The controls remained seronegative throughout the test period, indicating that postvaccination exposure did not occur. Six months postvaccination, all pigs were challenged with virulent PRV. All vaccinates were protected from signs of pseudorabies, although some had elevated temperatures 2 to 4 days postchallenge. All 8 controls were affected by challenge, and 5 died. In another duration of immunity test, 33 pigs were challenged 13 months postvaccination. All survived without showing signs of pseudorabies, but they had elevated temperatures, went off feed, and had a mean weight loss of 19 lbs. (Nonvaccinated controls were more severely affected, with a higher mean temperature and a mean weight loss of 34 lbs. following challenge.) Based on these
results, we recommend that breeding stock be revaccinated every 6 months for maximum protection.

In another prelicensing test, the length of time maternal antibodies persist in immune sows was evaluated. Two sows vaccinated 7 weeks previously had SN titers of 1:8 and 1:4, respectively, at farrowing. Their litters were serologically tested at birth and at weekly intervals for 23 weeks thereafter. The pigs had mean SN titers of 1:8 at birth, 1:4 at 3 weeks of age and less than 1:2 at 8 weeks of age. At 12 weeks all pigs were seronegative. When 17 pigs from the immune sows were vaccinated at 3 to 4 weeks of age, all survived challenge. When pigs from the same litters were vaccinated at 2 weeks of age and then challenged, only 8 of 11 survived. This indicates that pigs with maternal antibodies may be successfully immunized as early as 3 weeks of age.

CLINICAL HISTORY

Results of the experimental studies were reviewed by the USDA's Animal and Plant Health Inspection Service (APHIS), which authorized implementation of vaccine field trials. The field trials were conducted under the supervision of 6 licensed veterinarians in Indiana and Nebraska. A total of 3,468 vaccinated swine and 1,577 nonvaccinated control swine were evaluated. The basic test design was to vaccinate two-thirds of the animals in a given group, and leave the remainder as controls. Blood samples were taken from vaccinates and controls at the time of vaccination and 3 to 4 weeks later. Of the 20 groups where vaccination was conducted, 18 had a history of pseudorabies and 2 of those were experiencing active outbreaks when the trial was implemented. Serologic evaluations indicated the remaining 2 field trial groups were noninfected.

Adverse reactions or side effects due to vaccination were not reported in any of the field trial herds. The test animals included pigs of all ages and pregnant sows. In the 2 noninfected herds, the vaccinates consistently seroconverted and all control animals remained seronegative. This indicated that horizontal transfer of vaccine virus did not occur. In addition, vaccinates in the actively infected herds experienced a significant reduction in morbidity and mortality due to pseudorabies compared with nonvaccinated controls in the same herds.

The field trial experience on one farm in Nebraska illustrates the value of vaccination in the face of an outbreak. A confirmed pseudorabies outbreak occurred on the farm on December 24, 1976. Field trial vaccination was initiated on January 12, 1977. By that time, approximately 200 suckling pigs in the farrowing houses had died. Following vaccination of 248 sows and piglets, 27% were affected within 4 days postvaccination. Virulent PRV was later isolated from several of the vaccinated pigs that died, indicating they were incubating disease at the time of vaccination. Nonvaccinated controls in the same facility were affected to a much greater degree. Sixty-four (43%) of 150 control sows and pigs died, and disease continued to occur in controls for 12 days after the trial was initiated.
The nursery on this same farm contained 415 feeder and grower pigs weighing 30 to 150 lbs. each. None of the 285 vaccinates in this facility showed signs of disease during the test period. On February 3, a confirmed pseudorabies outbreak occurred in nonvaccinated control animals in the nursery, and within 7 days 100% of the controls were affected.

The gestation floor held adult sows in various stages of gestation, and boars and gilts waiting to be bred. All 130 vaccinates remained normal, but 100% of the controls developed pseudorabies. This pattern was repeated in a barn where all 25 vaccinated gilts and boars remained normal, but all 90 nonvaccinated gilts and butcher hogs were affected.

Considering that control pigs showed signs of disease as early as 7 days after vaccinates were inoculated, and that pseudorabies has an incubation period of about 4 days, it appears that protection develops 3 to 4 days following vaccination. This was the length of time required for the outbreak in the farrowing houses to subside in vaccinated pigs. This herd history indicates that within 4 days, vaccinated swine develop immunity that protected them from contact exposure, and that vaccination can effectively control an active pseudorabies outbreak.

Since the MLV vaccine was licensed, Norden Laboratories has received no reports of adverse reactions in vaccinated swine or failure of the vaccine to protect when used according to label recommendations. Producers have stated the vaccine has been of particular benefit in breeding operations. Not only has the producer's investment been protected from disease outbreaks, but conception rates have improved following vaccination. The value of vaccination in limiting the effects of active outbreaks has also been affirmed. Vaccination has been shown to be of significant benefit in feeder pigs. Although mortality in these older animals is much lower than in young pigs, subclinical or clinical pseudorabies definitely affects rate of gain and susceptibility to secondary respiratory disease. Vaccinated feeder pigs in endemic areas have been shown to finish earlier and require less feed and medical care. Of course, vaccine efficacy can be compromised if label recommendations are not adhered to. If administered to affected swine or to newborn pigs from immune sows (i.e., with protective levels of maternal antibodies), it will be of no benefit.

ROLE OF VACCINATION IN DISEASE CONTROL

Although pseudorabies is endemic in those states where a majority of our hog production occurs, only a small percentage of the swine population is vaccinated at any given time (Table 1). This is because regulations in some states prohibit or limit interstate shipment of swine seropositive for PRV (i.e., vaccinated or naturally infected animals). Restricted movement of vaccinated hogs is not based on whether or not the vaccine used contains a live virus, but only on its ability to produce a serologic response. It has been implied that an inactivated vaccine is to be preferred over an MLV vaccine because the latter contains a live
virus. However, no state restricts vaccination or movement of vaccinated hogs because the immunizing agent contains a live antigen.

Unreasonable restrictions on pseudorabies vaccination may have an adverse effect on disease eradication. South Dakota, for example, had 20 reported outbreaks in 1977, and 30 outbreaks in the first quarter of 1978 (Table 1). Despite this marked increase in a state with more than 1,700,000 hogs, only 12,100 doses of the MLV vaccine (representing 0.7% of the state's swine population) have been used. Georgia has experienced 135 outbreaks since 1977, but only 4,120 doses of vaccine (representing 0.3% of the state's hog population) have been used. Ohio has had 16 reported outbreaks during the first 3 months of 1978, equal to the total number reported during all of 1977, but has used only 640 doses of vaccine. These 3 states show a pattern of increasing outbreaks and limited immunization. In Iowa, however, liberal vaccination is permitted. During the first 3 months of 1978, Iowa reported 110 outbreaks, a 29% reduction in the rate of a year ago. In Nebraska, where a relatively high percentage of the hog population is vaccinated, only 3 outbreaks have been reported in 1978, an 82% reduction from the 1977 rate.

The chief animal health official in Iowa has stated, "The proper use of vaccine has been our greatest aid in controlling the spread of pseudorabies." To maximize the benefits of vaccination, pseudorabies regulations in Iowa have been revised to establish a Pseudorabies Controlled Vaccinated Herd. In such herds, swine older than 6 months must be seronegative to PRV (based on tests of 25% of the herd older than 4 months), and then vaccinated within 15 days after the test. All additions to the herd must be similarly tested and vaccinated and then added to the herd within 30 days after the test. Progeny of vaccinated animals will not be under quarantine after they become serologically negative. Vaccinated animals will not be under quarantine provided they originate from a herd that has been disease-free during the preceding year. The Iowa regulations are a useful model for incorporating vaccination into a program for pseudorabies control.

Under the federal pseudorabies program proposed by APHIS, vaccination would no doubt be conducted on a selective basis as an aid in eventual eradication of the disease. Should limited vaccination fail to produce a reduction in the number of outbreaks, routine immunization of all susceptible swine may be a more feasible approach to eradication. Vaccination not only protects susceptible swine but reduces the length of time natural virus is shed following exposure. For these reasons, a program of continuous, widespread vaccination may be a necessary transition phase leading to eventual eradication.

ACKNOWLEDGMENT

Appreciation is expressed to Mr. R. M. Dana for preparing the manuscript.
IMMUNIZATION OF SWINE

REFERENCES


Table 1. Swine Population, Vaccine Sales, and Reported Pseudorabies Outbreaks by State

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REPORT OF THE COMMITTEE ON
TRANSMISSIBLE DISEASES OF SWINE

Chairman: E. A. Butler, Council Bluffs, Iowa
Co-Chairman: M. W. Vorhies, Brookings, SD

N. Black; E. H. Bohl; C. E. Boyd; D. Brothers; J. E. Fox; R. D. Glock; D. P. Gustafson; E. A. Haelterman; R. E. Hall; H. Hill; L. Hinchman; J. P. Kluge; D. L. Kruger; M. Lange; D. L. Larson; Tom Powell; M. Ristic; W. C. Stewart; J. W. Walker; F. D. Wertman.

The Committee on Transmissible Diseases of Swine and colleagues met Wednesday, November 1, 1978.

Reports of the sub-committees on T.G.E., Swine Dysentery and the Pseudorabies were received and will be reported in the 82nd annual proceedings.

Discussion lead by Doctors Paul Doby and Merle Lang regarding a motion in the Brucellosis Committee that swine brucellosis be transferred to the Committee on Transmissible Diseases of Swine led to the following resolution which was submitted to the Resolutions Committee:

(Motion by Dr. Fred Wertman, 2nd by Dr. Merle Lang—Unanimous Approval)

WHEREAS, the Brucellosis Committee of the USAHA has recommended that swine brucellosis attention be shifted to the Committee on Transmissible Diseases of Swine;

NOW THEREFORE BE IT RESOLVED, by the Committee on Transmissible Diseases of Swine that a standing committee of USAHA on swine brucellosis be formed, or a subcommittee on that disease be created within the Committee on Transmissible Diseases of Swine.

Discussion of the Transmissible Gastroenteritis subcommittee report highlights the continued endemic incidence in continuous farrowing swine units. This is apparently due to the carrier state of the virus in sows and appears to be an important cause of weanling diarrhea in such herds. Concern continues about the possibility that a virulent virus used as vaccines could revert to virulence by pig-to-pig passage as has been demonstrated experimentally.

The subcommittee on Swine Dysentery presented the following recommendations:

1. USDA-APHIS-Veterinary Services should obtain funding for training of laboratory diagnosticians in standardized techniques for isolation of Treponema hyodysenteriae and the serological diagnosis of swine dysentery.

2. All diagnoses of swine dysentery should be confirmed by culture for Treponema hyodysenteriae.
3. Breeding swine and feeder pigs should not be sold from herds in which pathogenic *Treponema hyodysenteriae* has been isolated.

4. An infected herd may resume the sale of breeding swine or feeder pigs if no clinical symptoms of swine dysentery have occurred during a 3-6 month period during which no medications for the prevention of swine dysentery have been used. After this 3-6 month period, a fecal sampling of 75-100% of weaned pigs should also be culture negative for pathogenic *T. hyodysenteriae*.

Discussion of the P.R.V. subcommittee report reviewed the progress of the proposed P.R.V. federal regulations which have been sent to O.G.C. (Oct., 1978). If proposed changes are not considered to be substantial by O.G.C., the federal regulations will become law in 90 days. Dr. Downard-APHIS stated that the department P.R.V. field trials have not progressed long enough to allow interpretation. Review of these results will be used to develop future control or eradication procedures.

Doctor Donald Gustafson recommended that intradermal skin P.R.V. testing be used to evaluate P.R.V. status of swine herds as a field screen test. The procedure is considered to have no false positives. The test limitation is the sensitivity to identify low level positive serum neutralization animals. (20% of 1:4; 50% of 1:8 positive MSVN). Because of this limitation, individual animals should not be allowed to move on the skin test.

Doctor Howard Hill reported that a standardized protocol for the Micro-immunodiffusion test for detecting P.R.V. antibody has been accepted by AAVLD Executive Committee and will be published in the 21st annual proceedings.

The AAVLD Pseudorabies Diagnostic Standardization Committee recommended that the micro-immunodiffusion (MID) test be accepted as a standard method for the detection of P.R.V. antibody. It is not intended that the M.I.D. test replace the microtitration serum-virus neutralization (MSVN) test. Experimental data has demonstrated that the M.I.D. test is slightly less sensitive than M.S.V.N. Therefore, it appears that the M.I.D. test has its greatest application as a test to demonstrate P.R.V. antibody on a herd basis.

African Swine Fever outbreaks in the Americas were discussed by Dr. Robert E. Reichard. His formal discussion from Thursday AM, November 2, will be published in the 82nd annual proceedings. It was recommended that data and auto-visual material be developed regarding A.S.F. and distributed to colleges of veterinary medicine, State and Extension Veterinarians and State Veterinary Associations so that the swine industry can be better assisted in early recognition and detection if the disease should spread to the United States.

A recognition of sincere appreciation of Chairman E. A. Butler's leadership to the Transmissible Disease of Swine Committee was moved by Neal Black and passed by acclamation.
Transmissible gastroenteritis (TGE) continues to be a major disease problem of swine raisers. There is a continuing increase in the number and size of large swine herds in which continuous or near continuous farrowing is practiced and these conditions are conducive to endemic TGE infection. Most sows in endemically infected herds are immune to TGE. Pigs suckling these sows are protected by lactogenic immunity and do not become infected until after weaning. TGE is not usually fatal in pigs of this age but it appears that this virus may be an important cause of weanling diarrhea in such herds. Such continuously infected herds could provide a means for interepidemic survival of TGE virus.

The carrier state of TGE virus in swine is under continued study. It has been shown that the virus may persist in the respiratory tract or in the intestine for as long as 2 or 3 months but these persistently infected pigs do not shed virus regularly if at all after the first week or 2 after infection.

Research is continuing on the development of safe and effective means of immunizing newborn pigs against TGE. Most of this is centered about immunizing sows in order to deliver immunity to their pigs through colostrum and milk. Work with TGE indicates that an immunologic receptor system of the intestine must be stimulated in order to cause production of TGE-specific IgA in the milk. Thus an important problem centers upon immunologic stimulation of the gut without causing infection severe enough to produce disease in the sow or in pigs through inadvertent infection. A small plague variant TGE virus which appears to stimulate IgA production in sows and is avirulent in piglets has been reported recently by workers at the National Animal Disease Center. It has been shown that sows may deliver immunity to their pigs for 1½ years after immunization. Researchers are concerned with the possibility that avirulent virus used as vaccine could revert to virulence by pig-to-pig passage as has been demonstrated experimentally or that partially attenuated TGE virus could produce diarrheal disease which, although not highly fatal, could add another factor to the troublesome complex of diarrheal disease in young pigs.

Respectfully submitted,
E. O. Haelterman
L. G. Morehouse

PSEUDORABIES SUBCOMMITTEE

The meeting was convened at 1:30 P.M. October 31, 1978 with 45 people in attendance.

Dr. Kluge (Iowa State U., Ames, Iowa) presented a summary of his
recent consultations for APHIS with workers in the Netherlands, Denmark, Yugoslavia, Hungary, England, Ireland and Northern Ireland.

Dr. D. Gutekunst (National Animal Disease Center, Ames, Iowa) summarized USDA extramural research projects at nine universities and intramural projects at the National Animal Disease Center. He discussed the level of funding for the current fiscal year ($300,000) and pointed out that pseudorabies is one of the diseases mentioned specifically in the Animal Health Research Bill ($10,000,000).

Dr. Downard (APHIS, Hyattsville, Maryland) reported that the national incidence is now 4%. This is a rise of 0.5% over last year. There were 867 new outbreaks during the first six months in 1978 compared to 706 during the same period last year. He stated that the proposed federal regulations are now at OGC. If the proposed changes are not considered to be substantial the regulations will become law 90 days after publication. He discussed current and future budgets and pointed out that they will be dependent on the success of a small pilot eradication program during 1979 and industry support for the program. APHIS is currently developing an educational film on pseudorabies.

Drs. E. Bass (Norden Laboratories, Lincoln Nebraska) and J. Cecil (Salsbury Laboratories, Charles City, Iowa) reported on research and field experience with the vaccines manufactured by their respective companies. Discussion ensued concerning usage of the products under varying field circumstances.

Dr. D. Gustafson requested that the intradermal skin test be considered for limited usage as a field screening test and as an aid to evaluate the status of animals when attempting to establish a pseudorabies free herd.

Dr. H. Hill and others requested that future APHIS disease incidence questionnaires differentiate between clinical diagnoses, virus isolations and positive serological results.

John P. Kluge, DVM
Chairman

SUBCOMMITTEE ON SWINE DYSENTERY

The subcommittee held an open meeting on October 30, 1978 with 15 people in attendance. It was announced that additional members would be added representing state and federal regulatory agencies and producer groups.

Dr. D. L. Harris reviewed current research being conducted on etiology, vaccine development, and diagnosis. The results of a survey conducted by Dr. Songer were presented. This survey indicated that 9 of 19 state diagnostic laboratories and 1 federal laboratory were routinely
using selective culture for *Treponema hyodysenteriae* to diagnose swine dysentery. The basis for establishing a quarantined herd was discussed. Due to the danger of misdiagnoses, it was agreed that quarantines should not be placed without confirmation by selective culture. Dr. Harris reported that *T. hyodysenteriae* was being successfully eliminated from infected herds by medication and prevention of environmental survival.

Following the open meeting, the subcommittee met to develop recommendations for consideration by the Committee on Transmissible Diseases of Swine.

D. L. Harris, Chairman  
H. J. Olander  
J. Glenn Songer  
Robert Rainier  
C. J. Farho  
C. R. Miller  
Rube Harrington, Jr.  
S. C. Whipp

**RECOMMENDATIONS FROM THE SUBCOMMITTEE ON SWINE DYSENTERY**

1. USDA-APHIS-Veterinary Services should obtain funding for training of laboratory diagnosticians in standardized techniques for isolation of *Treponema hyodysenteriae* and the serological diagnosis of swine dysentery.

2. All diagnoses of swine dysentery should be confirmed by culture for *Treponema hyodysenteriae*.

3. Breeding swine and feeder pigs should not be sold from herds in which pathogenic *Treponema hyodysenteriae* has been isolated.

4. An infected herd may resume the sale of breeding swine or feeder pigs if no clinical symptoms of swine dysentery have occurred during a 3-6 month period during which no medications for the prevention of swine dysentery have been used. After this 3-6 month period, a fecal sampling of 75-100% of weaned pigs should also be culture negative for pathogenic *T. hyodysenteriae*. 
Chairman, ladies and gentlemen:

I am pleased to have the opportunity to discuss with you the Canadian Perspective on *Salmonella* Control in Poultry. As Canada purchases almost all of its broiler chicken breeding stock and a considerable amount of chicken meat from the United States, the concerns that I have are undoubtedly mutual to many on both sides of the border.

The Canadian Perspective however, may be a slightly misleading, or even distorted topic for this talk as I am speaking from the view point of an employee of the Department of National Health and Welfare. Although much of this perspective is also shared by colleagues in the Canada Department of Agriculture and by concerned scientists in both the agricultural and public health fields in industry, university and provincial governments, we are not always in accord. And to maintain my own perspective about the differences of opinion concerning *Salmonella* in poultry I think back to a favourite saying of a fellow salmonellologist in the Netherlands, Michael van Schothorst. Van Schothorst advises me that when two scientists agree on everything, they are no longer scientists. Hence I debate and argue with my scientific colleagues who are not in accord with my views with the expectation that this vexing problem will be resolved without rancor among us, and to the benefit of the consumer (Consumers' Association of Canada, 1976).

I wish to emphasize consumer because the consumer is the one who loses when salmonellae are indigenous to the food supply. If the breeders, growers or renderers were the losers in this matter, salmonellae would have been controlled decades ago. One only has to look back 30 or 40 years to the very great success story in controlling *Salmonella pullorum* and *Salmonella gallinarum* to realize that the industry has the expertise to successfully tackle and control infection by other salmonellae. And I sincerely believe that when the poultry industry realizes the important contribution it can make to public health, it will tackle this problem as effectively as it combatted pullorum disease.

The perspective from both sides of the fence, public health and agriculture, was succinctly described in the Nicholas Turkey News of August/September 1978. The Turkey News quotes Dr. Eugene Gangarosa of the Communicable Disease Centre in Atlanta: "The root issue is the vast reservoir in the animals man depends upon for food. We need to get
Salmonella out of the animal food chain: this is where the chain of transmission must be broken."

The Nicholas Turkey News, in commenting on Dr. Gangarosa's statement says, "The Communicable Disease Centre is giving us a golden opportunity—we can be part of the decision making group that works out the poultry requirements of the future. If our industry does not participate, the regulations will still be made by someone, only without our input."

In the remainder of my presentation, I will provide some facts, and perhaps speculate a little. The facts are concerned with: (1) human salmonellosis, (2) the cost of the disease in humans, (3) the relationship of Salmonella serotypes in poultry to those in humans, (4) the role of feed and breeding stock (5) some success stories in controlling Salmonella in poultry (6) some figures on the incidence of Salmonella contaminated poultry purchased by Canadian consumers and some estimates of the cost of decreasing this incidence.

In Canada we have about 5000 cases of salmonellosis per year that are sufficiently ill for laboratory analysis to be used in the diagnosis (Table 1). Although 5000 is not a large number, there is very good epidemiological evidence that for every laboratory confirmed case there are between 10 and 100 additional cases. Every fifth diagnosed case is hospitalized, and the average hospital stay is 13 days. In total we estimate somewhere between 50,000 and 500,000 cases per year.

The cost of salmonellosis in humans has been calculated and published within the past 3 months for four separate outbreaks in Canada and the USA (Cohen et al, 1978; Lavigne, 1978; Leclerc, 1978). In each study the average cost per case was about $500. I have estimated that human salmonellosis costs Canada not less than $25,000,000 per year and not more than $100,000,000. Estimates for costs of human salmonellosis in the USA are about $1,000,000,000 per year (Cohen et al, 1978).

I do not suggest that all salmonellosis is caused by poultry, but I do believe that a substantial amount results from spread of Salmonella from raw poultry to kitchen workers who become excreters, or by way of contaminated surfaces to cooked food. We do know that, year after year, 85-90% of human salmonellosis in Canada is caused by the same serotypes that we find in poultry, poultry barns, and some other poultry related materials (PPRM; Table 2) while these same serotypes account for only 20-40% of all the isolates from non-human sources (Table 3).

The sources of Salmonella in poultry are said to be many (Committee on Salmonella, 1969), and this fact often leads to the attitude that little can be done about controlling salmonellae in poultry (Figure 1). However, in Canada where chickens are almost universally housed in well designed barns, one could disregard almost all of the sources presented in this figure and concentrate on feed, breeding flocks and sanitation (Report, 1978). There is much evidence that rendered feed and infected breeder stock are the main problems.
Until recently there was suspicion that feed was not one of the main causes because *S. typhimurium* is not commonly found in rendered material although it is the most common *Salmonella* in human and other animals. However, a report this year from England (Harvey and Price, 1978) has shown that *S. typhimurium* is far more common in rendered material that hitherto suspected provided that one uses a newly-developed method for detecting *S. typhimurium* in rendered material. The Dillon Beach project (Dungan, 1978) supplies additional evidence; and finally, the spread of *S. agona* (Figure 2) throughout the world in contaminated fish meal and then to humans should convince even the most doubting sceptic of the role of feed in spreading salmonellae (Clark et al., 1973).

The extra cost of providing *Salmonella*-free rendered material to the feed industry has been estimated at $20.00 per ton of rendered material. With 10% rendered material in the feed, this would amount to $2.00 per ton of feed and, given the conversion rate of feed to meat, would add about one cent to the cost of a chicken carcass.

Breeder stock is also amenable to clean up and a lot more money could be put into preventing *Salmonella* infection in breeder stock at the cost of about one cent per meat carcass. Simple arithmetic indicates that one great-grandparent breeder is the forerunner of over 100,000 broiler meat carcasses. An increase of one cent per chicken broiler carcass would therefore provide $1,000 which could be used to decrease the incidence of *Salmonella* in the breeding stock.

Additional costs for improved sanitation, testing, etc., would probably add two cents per carcass for a total cost of about four cents per broiler. This is my estimate for Canada, and a similar estimate has been made for Sweden (Pivnick, 1977), but I must add that higher estimates have been presented for Canada (Finn and Mehr, 1977).

Canada produces about 250,000,000 broiler chickens a year. If the cost were increased by four cents each, this would add $10,000,000 to the consumers' cost; this is certainly less than the estimated $25,000,000 to $100,000,000 that salmonellosis adds to the cost of the public health system. Assuming that only half of the human salmonellosis is caused directly or indirectly by poultry, the figures are in favour of decreasing *Salmonella* in poultry.

I am optimistic that *Salmonella* control in poultry is feasible and economical. Denmark (Marthedal, 1977) has a simple control system based on *Salmonella*-free rendered material and *Salmonella*-controlled breeding stock. They have few contaminated carcasses and yet they export two-thirds of their production into a competitive market. The percentage of *Salmonella*-contaminated carcasses imported in 1973-74 from Denmark to Japan and Germany was 4% or less (Table 4). Also Denmark records about one-third the human salmonellosis per capita that is recorded in Canada and the USA. In Sweden (Almlof, 1977), there is a relatively small production of poultry, but the incidence of con-
taminated carcasses is about 0.016%, while Canada and the USA have a 1000-fold higher incidence. A recent study (Commission of the European Communities, 1976) shows that one of five participating countries rarely found *Salmonella*-contaminated chickens.

The incidence of *Salmonella*-contaminated carcasses in Canada has been monitored for several years, in the last few years in joint programs between federal Health and Welfare and federal Agriculture (Table 5). For the past few years the incidence has been in the range of 35-40%.

In our sampling we use 5 carcasses per lot, and analysis (Table 6) indicates that in 1976-77, 34% of lots tested had all 5 carcasses clean while in 19% of the lots, all 5 carcasses were contaminated. Thus, although the average incidence is about 40%, it is obvious that some flocks yield *Salmonella*-free carcasses while others yield only *Salmonella*-contaminated carcasses. If the flock is not infected, the carcasses are unlikely to be contaminated.

It is irrational to talk about a *Salmonella*-free food supply, and as a regulatory agency we don't think in terms of zero tolerance for *Salmonella*. However, it seems just as irrational to have unlimited tolerance for a known pathogen which causes so much cost to human public health. What should we tolerate or, more important, what assurance should the consumer and the food-service chef have that the poultry they take into the kitchen isn't going to carry with it some salmonellae?

The probability of accepting or rejecting a lot of contaminated carcasses (ICMSF, 1974) depends on the sample size and the willingness to accept a certain percentage of contaminated carcasses (Table 7). We have looked at a sample size of 5 carcasses per lot and also at a sample size of 3 carcasses per lot. We have also considered accepting the lot of carcasses if 3 of 5 are contaminated, 2 of 5 are contaminated, etc. Then we have calculated the probability of that lot being considered acceptable despite a true contamination rate of 10%, 30% and 60%. Let us consider only the top line. When we examine 5 carcasses per lot and accept the lot despite 3 of the 5 being contaminated, the probability is 0.97 that the consumer may purchase carcasses from a lot with a true incidence of contamination of 30%. Similarly, with the 5/1 acceptance plan, the probability is 0.53 that the consumer will purchase carcasses from a lot in which 30% of the carcasses is contaminated. With this 5/1 sampling and acceptance plan even a lot with 60% of the carcasses contaminated has 9 chances in 100 of ending up in the consumer's kitchen. Sooner or later, public health officers, agricultural officers and the various components of the producing industry will have to decide that the objective of producing poultry is to deliver a nutritious product that also poses less threat in the kitchen than it does at this time.

Let us now turn back to the Canadian perspective. In 1972, the Minister of National Health and Welfare established a committee, known as the Advisory Committee on Food Safety Assessment. The committee
was comprised of 8 people not affiliated with the federal government: 5 were university professors covering the fields of food science, veterinary medicine, nutrition, and microbiology; one was a physician who was director of a provincial public health laboratory; one was the president of a large food and agricultural organization; and one, an outstanding lawyer.

The objectives set by the Minister for the committee were as follows:

1. To identify the major health hazards in the Canadian food supply.
2. To identify priority areas where quality control and processing procedures require greater attention.
3. To consider the role of various government agencies involved.
4. To recommend measures to ensure the safety of the food supply.

The committee, after 3 years and much work, presented their report in 1975. The report contained 37 specific recommendations, and attached priorities to each: 1, 2 and 3 in order of importance. One of these, Recommendation 7, was given priority #1. To quote from the preamble:

“SALMONELLA IN DRESSED POULTRY

Surveys by Health Protection Branch of the Department of National Health and Welfare have established that some 15 to 20% of dressed poultry sold in Canada is contaminated with Salmonella. There have been numerous reports of salmonellosis from eating poultry. To date, federal agencies have developed no significant programs aimed at diminishing levels of Salmonella-contamination in dressed poultry. Effective legislative action such as that taken to eliminate salmonellae from powdered egg products (Food and Drug Regulations, section B22.032) should be worked out to eliminate salmonellae from dressed poultry.”

“Recommendation 7 - priority 1

It is recommended that an ad hoc committee be established to determine and implement practical ways of controlling Salmonella in dressed poultry. The poultry industries and involved government agencies should be represented on this committee.”

If I may digress a bit, I would like to present some information that has a bearing on recommendation No. 7. The Minister’s Advisory Committee said that, “Effective legislative action such as that taken to eliminate salmonellae from powdered egg products should be worked out to eliminate salmonellae from dressed poultry.” In 1962, National Health and Welfare enacted a regulation to prohibit sale of Salmonella-contaminated processed eggs, but by 1969 the egg processing industry had done little to cooperate with this very sensible regulation (Table 8). Then, in 1970 Health and Agriculture began a joint program to convince the producing industry to get on with the job. By 1971, the incidence of Salmonella-contaminated processed eggs had dropped dramatically, and continued to drop thereafter.
In 1975, following release of the Report of the Advisory Committee on Food Safety Assessment, the Minister of National Health and Welfare said that plans would be undertaken to introduce regulations in order to bring about a progressive decrease in the incidence of *Salmonella*-contaminated poultry at the retail level. The words to emphasize are "progressive decrease": no one expected to obtain improvement overnight. To add emphasis the Departments of Agriculture and Health and Welfare jointly met with representatives of consumers, producers and retailers on March 1, 1977, urged them to get on with the job, and offered assistance.

Immediately after March 1, 1977 a committee called the Poultry Industry Committee for *Salmonella* (PICS) was formed and has been most active since that time. The committee consists of 4 main components: feed, poultry, retailers and food-service, and consumers. The poultry component consists of 3 sub-committees: breeders and hatcheries; growers; and processors. The PICS is primarily a committee concerned with production, but the consumers, food service industry and retailers are active and concerned. The federal government provides assistance, at the request of PICS, mainly in the form of experts in statistical design and microbiological methods, some modest sums of money, and some ongoing research.

The PICS subcommittees are surveying the present level of *Salmonella*-contamination in barns, hatcheries, rendered material, slaughter plants, and at retail. The various subcommittees are also preparing educational material to instruct employees and consumers in improved procedures. Thus, these various components of producers, processors and users are *for the first time working together* to attempt to obtain a safer product for the consumer. This is fortunate because there is little hope of decreasing *Salmonella* in poultry unless the rendering industry does its job, and the breeders do theirs. Unless these two realize the interdependence of their efforts, the consumers and the food-service industry will continue to suffer from the contaminated end product. And the retailer will be looking askance at a product that brings a food-borne pathogen into his operation, in close proximity to his delicatessen and cooked meat sales area.

The Department of National Health and Welfare remains most concerned that the level of contaminated chicken is at about 40%, and turkey may be even higher. The Department did consider regulations that would apply at the retail level, but is presently waiting to see how well the Poultry Industry Committee for *Salmonella* proceeds in its objectives to reduce the incidence of contaminated carcasses to 5% or less. This figure is also the target of the Department of National Health and Welfare.

Let me put aside the Canadian Perspective at this time and conclude from a statement in the Nicholas Turkey News of August/September 1978. It may reflect the U.S. perspective. The quote is:
"The regulations are 5-10 years away. They are coming whether or not we constructively participate. That makes our choice as an industry fairly obvious.

It also made our choice as a company pretty clear—we have decided that the future will require greater control of salmonellases with more limited use of drugs. To prepare for that future, we have started on the largest financial commitment that our company has ever made for improved sanitation."

I hope that others are reading the Nicholas Turkey News and listening to their message. Neither the consumer, the retailer, the food-service industry, the public health associations nor the regulatory agencies responsible for public health are willing to rest with the status quo.

REFERENCES


Table 1. Reported Human Infections by Salmonella in Canada

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number reported b</td>
<td>5,140</td>
<td>4,607</td>
<td>5,235</td>
<td>5,054</td>
<td>4,496</td>
<td>4,301</td>
<td>5,471</td>
</tr>
<tr>
<td>Number hospitalized</td>
<td>1,052</td>
<td>1,028</td>
<td>1,070</td>
<td>874</td>
<td>701</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Average days in hospital</td>
<td>14.3</td>
<td>13.6</td>
<td>12.9</td>
<td>13.1</td>
<td>12.7</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Total days in hospital</td>
<td>15,043</td>
<td>13,981</td>
<td>13,803</td>
<td>11,450</td>
<td>8,903</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Estimated cost for hospital</td>
<td>$1,500,000</td>
<td>$1,500,000</td>
<td>$1,700,000</td>
<td>$1,900,000</td>
<td>$1,800,000</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

a Typhi and paratyphi excluded

b National Enteric Reference Centre of Department of National Health and Welfare

NA = not available
Table 2. Numbers of *Salmonella* Isolated from Humans that were the same as Serotypes Isolated from Poultry and Poultry Related Material (PPRM) - Canada

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number from humans</th>
<th>Numbers same as isolates from PPRM</th>
<th>Percent of total number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>4278</td>
<td>3638</td>
<td>85.0</td>
</tr>
<tr>
<td>1970</td>
<td>4281</td>
<td>3788</td>
<td>86.1</td>
</tr>
<tr>
<td>1971</td>
<td>5317</td>
<td>4715</td>
<td>88.7</td>
</tr>
<tr>
<td>1972</td>
<td>4769</td>
<td>4243</td>
<td>89.0</td>
</tr>
<tr>
<td>1973</td>
<td>5424</td>
<td>4782</td>
<td>88.2</td>
</tr>
<tr>
<td>1974</td>
<td>5270</td>
<td>4671</td>
<td>88.6</td>
</tr>
<tr>
<td>1975</td>
<td>4497</td>
<td>3885</td>
<td>86.4</td>
</tr>
<tr>
<td>1976</td>
<td>4301</td>
<td>3714</td>
<td>86.4</td>
</tr>
</tbody>
</table>

Table 3. Numbers of *Salmonella* Isolated from all Non-human Sources and from Poultry and Poultry Related Material (PPRM) - Canada

<table>
<thead>
<tr>
<th>Year</th>
<th>Total number</th>
<th>Number poultry related</th>
<th>Percent poultry related</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>2040</td>
<td>436</td>
<td>21.4</td>
</tr>
<tr>
<td>1970</td>
<td>1593</td>
<td>501</td>
<td>31.5</td>
</tr>
<tr>
<td>1971</td>
<td>2207</td>
<td>485</td>
<td>22.0</td>
</tr>
<tr>
<td>1972</td>
<td>3289</td>
<td>524</td>
<td>15.9</td>
</tr>
<tr>
<td>1973</td>
<td>2149</td>
<td>584</td>
<td>27.2</td>
</tr>
<tr>
<td>1974</td>
<td>2301</td>
<td>963</td>
<td>41.8</td>
</tr>
<tr>
<td>1975</td>
<td>2705</td>
<td>1187</td>
<td>43.9</td>
</tr>
<tr>
<td>1976</td>
<td>2395</td>
<td>938</td>
<td>39.2</td>
</tr>
</tbody>
</table>
Table 4. Percentage of *Salmonella*-contaminated Raw Dressed Chicken 1973-74

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent</th>
<th>Country</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>17(^a)</td>
<td>Germany</td>
<td>61(^a)</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>14(^b)</td>
<td>Hungary</td>
<td>6(^b)</td>
</tr>
<tr>
<td>Canada</td>
<td>18(^b), 23(^b)</td>
<td>Netherlands</td>
<td>64(^a), 29(^b)</td>
</tr>
<tr>
<td>China</td>
<td>10(^b)</td>
<td>Sweden (Findus Co.)</td>
<td>0(^c)</td>
</tr>
<tr>
<td>Denmark</td>
<td>&lt;4(^a), 4(^b)</td>
<td>Turkey</td>
<td>8(^a)</td>
</tr>
<tr>
<td>France</td>
<td>17(^a)</td>
<td>U.S.A.</td>
<td>11(^b)</td>
</tr>
</tbody>
</table>

\(^a\)Siems et al., 1974; 503 carcasses produced in, or imported into Germany.

\(^b\)Suzuki et al., 1973; 6,523 carcasses imported into Japan.

\(^c\)Lundbeck, 1974; 8,415 samples produced by Findus AB in Sweden.

\(^d\)Health Protection Branch; 157 carcasses from 5 geographical areas in Canada.
Table 5. Incidence of *Salmonella* in Raw Dressed Canadian Chicken<sup>a</sup>

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of carcasses</th>
<th>Percent with <em>Salmonella</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>1970-71</td>
<td>144</td>
<td>15</td>
</tr>
<tr>
<td>1971-72</td>
<td>132</td>
<td>19</td>
</tr>
<tr>
<td>1972-73</td>
<td>259</td>
<td>20</td>
</tr>
<tr>
<td>1973-74</td>
<td>157</td>
<td>23</td>
</tr>
<tr>
<td>1974-75</td>
<td>45</td>
<td>22</td>
</tr>
<tr>
<td>1975-76</td>
<td>154</td>
<td>36</td>
</tr>
<tr>
<td>1976-77</td>
<td>365</td>
<td>39</td>
</tr>
</tbody>
</table>

<sup>a</sup>Mostly carcasses, non-frozen and frozen; also, a few packages of cut up chicken.
### Table 6. Distribution of Salmonella Contamination in Canadian Raw Dressed Chicken
April 1, 1976 - March 31, 1977

<table>
<thead>
<tr>
<th>No. of contaminated carcasses per sample&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Number of samples</th>
<th>Total</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vancouver</td>
<td>Winnipeg</td>
<td>Toronto</td>
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<td>0/5</td>
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<td>4</td>
<td>10</td>
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<td>1/5</td>
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<td>2</td>
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<tr>
<td>2/5</td>
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<td>3/5</td>
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<td>5/5</td>
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<td>7</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>7</strong></td>
<td><strong>25</strong></td>
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</table>

<sup>a</sup>Each sample contained 5 carcasses or, occasionally, 5 packages of cut up chicken.
Table 7. Considerations in Adopting a Sampling Plan

Probability of Accepting lots of Poultry Contaminated with Salmonella Depending on Sampling Plan and Incidence of Contamination

<table>
<thead>
<tr>
<th>Sampling plan</th>
<th>Probability of acceptance (Pa) when incidence of contaminated carcasses is:</th>
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<tbody>
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<td>n</td>
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</table>

n = number of carcasses or packages of pieces tested per lot.

c = number of carcasses or packages of pieces that may be found contaminated with Salmonella without failing the lot.
Table 8. *Salmonella* Contamination of Processed Egg

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of lots</th>
<th>Percent contaminated</th>
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</thead>
<tbody>
<tr>
<td>1969</td>
<td>559</td>
<td>17.5</td>
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<tr>
<td>1970</td>
<td>1081</td>
<td>3.9</td>
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<tr>
<td>1971</td>
<td>1644</td>
<td>1.5</td>
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<tr>
<td>1972</td>
<td>1269</td>
<td>0.8</td>
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<tr>
<td>1973</td>
<td>1742</td>
<td>0.7</td>
</tr>
<tr>
<td>1974</td>
<td>1787</td>
<td>0.8</td>
</tr>
<tr>
<td>1975</td>
<td>2280</td>
<td>1.0</td>
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<tr>
<td>1976</td>
<td>2733</td>
<td>0.2</td>
</tr>
</tbody>
</table>

*Krepel and MacPherson, 1976.*

Figure 1. Sources of *Salmonella* at producer level (committee on *Salmonella*, 1969)
An International Epidemic of Salmonella agona Infections in Man and Animals Traced to Peruvian Fishmeal, 1969-1972

Figure 2. Courtesy of Dr. E. Gangarosa
SUMMARY

Serotyping of salmonella and Arizona cultures from animal disease cases and epidemiologically related sources is reported for October 1, 1976, through September 30, 1977. A total of 3,591 cultures was serotyped. The most frequently identified salmonella serotypes were Salmonella typhimurium, S. choleraesuis var. Kunzendorf, S. typhimurium, var. Copenhagen, S. anatum, and S. heidelberg. The most frequently identified Arizona serotype was 7a,7b:1,7,8. The most frequent sources of cultures in order of frequency were turkeys, chickens, swine, and cattle.

INTRODUCTION

Data for this report were accumulated at the National Veterinary Services Laboratories, Animal and Plant Health Inspection Service, USDA, Ames, Iowa. Other contributors include Paige Laboratory, University of Massachusetts, Amherst, Massachusetts, and the Animal Health Laboratories of the Wisconsin Department of Agriculture, Madison and Barron, Wisconsin.

The purpose of this report is to make the data available to epidemiologists and others who have a need for it. The data are presented in tables as in previous reports in order that comparisons can be easily made.

DISCUSSION

The total number of cultures serotyped during FY 1977 was approximately the same as for the previous two years12 (when making comparisons, note that the FY 1976 report covered a 15-month period). This static situation is possibly due in part to a continued effort to eliminate serotyping of cultures when there is no real need for the detailed information.

During the report period a total of 127 serotypes—109 salmonella (Table 3) and 18 Arizona (Table 4)—was identified. The 10 most common salmonella serotypes (Table 10) accounted for 64.4% of that total and the
1 most common Arizona serotype (Table 4) accounted for 85.9% of that total. Forty-six serotypes were identified only once during the period.

*Salmonella agona* appears to have reached a plateau. It failed to move up in rank (Table 10) since the previous report. In contrast to this, it has continued to become more common in humans in the United States. The reported morbidity in turkeys (Table 5), chickens (Table 6), cattle (Table 7), and swine (Table 8) due to *S. agona* was average to low as compared to other common serotypes. In horses (Table 9), where it was third most common, no morbidity was reported.

Identifications of *S. johannesburg* dropped dramatically from 157 in the FY 1976 report to 18 in this report. Although this serotype has in the past been isolated from a wide variety of sources, it has apparently not become established in any except chickens. These data strongly suggest that an effective program for reducing the *S. johannesburg* problem has been employed.

**REFERENCES**


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| SALMONELLA | 457 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

**TABLE 1: CONTINUED**

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| CITY | AL | AZ | CA | CO | DE | DC | FL | GA | ID | IL | IN | IA | KY | MO | NA | HI | MN | MS | MO | MT | NE | NH | NJ | NY | ND | OH | OK | PA | SC | SD | TN | TX | WA | WI |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|      | 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  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| SALMONELLA | 457 |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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### TABLE 2: DISTRIBUTION OF ARIZONA SEROTYPES BY STATE - FY77

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<tr>
<th>SEROTYPE</th>
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<th>MN</th>
<th>MO</th>
<th>NY</th>
<th>NC</th>
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<th>PA</th>
<th>SD</th>
<th>TX</th>
<th>WI</th>
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<tbody>
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(B) VA. JERUSALEM
(C) VA. COPENHAGEN
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(A) = var. Kunzendorf, (B) = var. Copenhagen

*Number of times the serotype was identified

**Rank beginning with the most common
APPENDIX—ITEM 2
REPORT ON CONGRESSIONAL ACTION REGARDING RESOLUTIONS ON SALMONELLOSIS TO THE U.S.A.H.A. COMMITTEE ON SALMONELLA BY DR. E. T. MALLINSON
(October 31, 1978)

BACKGROUND

During 1977 both the U.S.A.H.A. and American Association of Avian Pathologists (AAAP) passed resolutions directed to numerous U.S. Representatives and Senators regarding the need for additional funding in the areas of serotyping, epidemiology and research needed to implement the recommendations of the U.S.D.A. Advisory Committee on Salmonella. During the January, 1978 USAHA Salmonellosis Seminar, members of USAHA and AAAP agreed to ask their members and industry to contact Congress urging action on the resolutions and appropriation of an additional $2 million for Salmonella activity. The $2 million included: $225,000 for typing, identification and reporting; $200,000 for development of a benchwork of factual information on salmonella incidence by survey of feed components, slaughter animals and products; $200,000 for veterinary services field epidemiology; and $1,375,000 for research including feasibility and pilot field studies.

RECENT ACTIONS:

In March, 1978 Representatives Nolan and Hagedorn of Minnesota reported successful inclusion of an amendment in the U.S.D.A. Appropriations Bill of an additional $360,000 in Salmonella monies for veterinary services APHIS. This was written into the House version of HR-13125 passed by the House of Representatives in June, but was excluded from the Senate version of this bill in July.

During August and September, livestock and poultry associations and individual members of USAHA and AAAP contacted several House and Senate Conferees on the final version of HR-13125 urging priority of Salmonella funding and retention of the $360,000 Salmonella appropriation. Favorable responses were received from Senator Young, Representatives Evans and others. This timely effort was followed by passage of the revised version by the House and Senate on September 29, 1978. The bill, including the $360,000 addition for Salmonella, was signed by President Carter on October 11, 1978 as Public Law 95-448.

EVALUATION:

Veterinary services is exploring feasibility trials for reducing Salmonella in broilers on an economic basis using currently available technology. Such studies, under the right circumstances, could later expand to turkey and swine grow-out. Preliminary reports of ongoing
FSQS plans for implementation of the *Salmonella* benchmark studies, recommended by the U.S. Advisory Committee on *Salmonella*, are also encouraging. Appropriations of emergency funds by SEA-AR for feasibility studies on *Salmonella* reduction in broiler breeders are under consideration. Congress has not, however, provided all the monies that were recommended, and as a result considerable concern persists about the paucity of funds for *Salmonella* research in the feed and production segments of the *Salmonella* infection chain. These particular problems need to be studied to determine the most appropriate action at this time. Finally, we must expand our involvement and communication with epidemiologists in NCDC and FDA in mutual long-range plans for the most rational, acceptable approaches for *Salmonella* reduction in man and animals.
REPORT OF THE COMMITTEE ON SALMONELLA

Chairman: Erskine V. Morse, West Lafayette, Ind.


The Committee met on October 31, 1978. Thirty-five members and guests were in attendance.

The agenda embraced presentations and discussions on the following subjects:

The Final Report on the National Salmonellosis Seminar held January 10-11, 1978 in Washington, D.C. was given. This Seminar was sponsored by USAHA with the following co-sponsors: U.S. Department of Agriculture, U.S. Food and Drug Administration, Center for Disease Control, Atlanta, Georgia, Office of the Surgeon General U.S.A.F., and American Veterinary Medical Association. Approximately 250 registrants were in attendance. Three thousand copies of proceedings were prepared and cooperatively published and distributed by USDA-FSQS and the Extension Service.

Dr. William Dubbert, USDA, FSQS, briefed the group on the USDA Salmonella Advisory Committee final report. It was indicated that the number one goal was the bench mark studies on salmonellae prevalence in feeds, poultry and livestock entering slaughtering facilities, and in the meats leaving these plants. Dr. Ralph Johnson, FSQS, briefly presented tentative plans for benchmark studies from the laboratory standpoint.

Dr. John Orsborn, California Department of Agriculture, Livestock Health Division, discussed problems associated with S. dublin infections stemming from raw milk. The epizootiological and epidemiological patterns were described.

Dr. Rube Harrington, USDA, APHIS, National Animal Disease Laboratory updated the Committee on salmonellae serological identification activities. The complete report of this agency appears as a part of the Committee Report.

Dr. H. Pivnick, Department of Health and Welfare, Canada, gave a progress and status report on the Canadian Plan for reduction of Salmonella in poultry. A comprehensive overview of the Canadian efforts was presented as a part of the U.S.A.H.A. general program.
Dr. Roger Feldman, CDC, Atlanta, Georgia presented epidemiological data relating to turtle-associated salmonellosis in the U.S. 1970-1976 and the effect of public health action.

Dr. Edward Mallinson, Pennsylvania Department of Agriculture, Division of Avian Health gave a thorough briefing on Congressional actions regarding the resolutions pertaining to salmonellosis. During 1977 both the U.S.A.H.A. and the American Association of Avian Pathologists presented resolutions to appropriate members of the U.S. Congress on the critical need for additional funding of salmonellae serotyping, epidemiology, and research required to implement the recommendations of the U.S.D.A. Advisory Committee on \textit{Salmonella}. A copy of Dr. Mallinson's report is appended as a part of this Committee's Report.

Dr. I. L. Peterson, USDA, APHIS, VS, discussed proposed plans for implementing feasibility studies on \textit{Salmonella} control in breeder/poultry flocks and the economic benefits to be gained. Funds in the amount of $360,000 were appropriated for this study by the 95th Congress.

Dr. H. G. Purchase, USDA-SEA-AR, discussed the critical need to support ongoing and additional \textit{Salmonella} research by federal and university laboratories.

Other aspects for \textit{Salmonella} control in the environment through the use of sodium acid sulfate were presented by Dr. David Tudor, Rutgers University (retired).

A letter to the Committee Chairman from Dr. Conwell Johnson regarding the use of formaldehyde to control salmonellae in rendered animal products and feeds was brought before the Committee and discussed by Dr. Dubbert.

Appreciation is expressed to U.S.A.H.A. past Presidents Goldstein and Janawicz for their encouragement and support for the Seminar. The excellent presentations by the program participants is acknowledged. Gratitude is expressed to Drs. William Dubbert and H. G. Geyer for editing, publishing and mailing the Seminar Proceedings and arranging facilities for the meeting.
The bovine tuberculosis eradication picture in the United States in fiscal year 1978 continued to show an apparent downward trend in the incidence of the disease. This trend to a lower incidence of the disease is evidenced by the discovery of fewer tuberculous herds in the past 3 years in spite of increased efforts to locate such herds by the use of work forces and a substantially increased rate of granuloma submissions from regular-kill slaughter cattle. A better indicator of the incidence of bovine tuberculosis than the number of tuberculous herds discovered each year is the number of regular-kill slaughter cattle found with lesions of tuberculosis as compared to the total cattle slaughtered. This figure has shown a slow but steady decline over the past 3 years. The success rate in tracing tuberculous regular-kill slaughter cattle to their herds of origin has also improved from a success rate of 45 percent last year to 52 percent this year.

One must, however, be cautious in assessing program progress not to become overly optimistic and suffer a letdown in program effort such as the one we suffered in the 1940's following the announcement that all of the States had attained modified-accredited status.

Work forces were a major factor in the discovery of tuberculous herds again this year as they have been the past 3 years. Work forces were activated in Missouri and Kentucky this year to trace and test cattle from tuberculous herds in those states. Eleven of the 22 newly affected herds discovered this year were associated with these work forces.

There has been a major change in the area status of the country during the past 15 months. The States of Maryland, Montana, New Jersey and North Carolina joined Colorado, Connecticut, Maine, Minnesota, New Hampshire, New Mexico, North Dakota, Rhode Island, Utah, and Wyoming as accredited-free States (figure 1). This brings the total to 14 States plus the Virgin Islands that reached this plateau in the eradication scheme. The balance of the States (36) plus Puerto Rico are modified-accredited areas. Ten of these States, Alaska, Arizona, Delaware, Nevada, New York, Oregon, South Dakota, Vermont, Washington, and West Virginia have not shown any evidence of Mycobacterium bovis (M. bovis) infection in the State for 5 or more years.

M. bovis was found in 22 herds this year which were not previously known to be infected. These herds were located in 11 States (figure 2). In
addition there were five herds which were known to be affected in a previous year in which infection was again disclosed this year. These herds were located in 4 States, Florida, Kansas, Missouri, Texas, and in Puerto Rico. The 22 newly infected herds were distributed as follows: Kentucky and Missouri, four each; Texas, 3; Illinois, Iowa, Louisiana, two each; and Kansas, Maryland, Massachusetts, Oklahoma and Pennsylvania, one each.

The tuberculous herd found in Maryland was a particularly unfortunate occurrence in view of the fact that Maryland had reached accredited-free status only a short time before the herd was discovered. Maryland authorities are to be congratulated upon the exemplary way in which the case was handled. No spread of infection was found within Maryland.

Good epidemiology continues to be the prime factor in the discovery of tuberculous herds. Twenty of the 22 newly infected herds found this year were found through epidemiological means (figure 3). There were 10 herds located through the tracing of exposed cattle sold from affected herds, 9 herds located through tracing of tuberculous slaughter cattle, and one herd located by contact herd testing around an affected herd. In addition to the 20 herds located by epidemiological means, one affected herd was found through area testing and one herd on a reaccreditation test. Nationwide, 23 of the 27 M. bovis herds this fiscal year (85 percent) were discovered through epidemiologic tracing methods (figure 4). The further down the road we get toward completion of the program, the more significant the role of epidemiology becomes.

One outstanding example of persistent and thorough epidemiology resulted in the discovery of an M. bovis infected herd in a Midwestern State. A steer slaughtered in Tennessee in March 1977 revealed lesions of tuberculosis. This steer was consigned to slaughter by a high volume Illinois slaughter buyer who had purchased cattle for this slaughter lot at 8 markets in two separate States. The list of consignors of cattle to the markets from which the affected steer might have originated was narrowed down to 39 and work was started to tuberculin test these herds. There were 28 herds composed of 1,097 cattle tested with no success from the standpoint of locating the source herd of the tuberculous steer. The 29th herd tested was a beef herd of 176 cattle. This test revealed two reactors which revealed laboratory confirmed tuberculous lesions upon slaughter. The entire herd was subsequently depopulated. The successful conclusion of this investigation is due entirely to the dedication and perserverance of the regulatory personnel, State and Federal, assigned to the case. This is the degree of epidemiologic effort that must be made in all States if we are to accomplish eradication of bovine tuberculosis.

The depopulation of cattle exposed to bovine tuberculosis has been an effective program tool for several years. Its effectiveness is limited, however, by the fact that for economic reasons only a porton of the af-
fected herds found each year were depopulated (figure 5). Fiscal year 1978 was a particularly significant year from a depopulation standpoint with 14 of the 22 newly tuberculous herds found this year being depopulated. In addition, five affected herds found in the previous year were depopulated. There were, therefore, 19 of 27 herds depopulated this year for a depopulation rate of 70 percent (figure 6). This is the highest depopulation rate ever attained by the program since depopulation of tuberculous herds was started. If the program is to be completely successful, however, a depopulation rate of 90-95 percent is needed. To attain this goal it will be necessary for State and Federal governments to adequately compensate livestock owners for cattle destroyed and/or impose mandatory depopulation.

In spite of the fact that everyone agrees that individual animal identification is the key to successful traceback of diseased animals, we are still woefully lacking in this area. Figure 7 graphically shows the importance of identification to the success rate in finding the source herds of regular-kill tuberculous cattle. Only 8 percent of the tracebacks of 25 tuberculous regular-kill cattle without identification were successful in finding the herd of origin. Conversely, the success rate was 80 percent in finding the herd of origin of 40 tuberculous regular-kill cattle which were individually identified.

There were 1,955 traceback investigations of suspected tuberculous regular-kill cattle completed in fiscal year 1978 (figure 8). Of that number, 1,890 cases were not laboratory confirmed as tuberculosis and were administratively closed without a field investigation. The balance of the cases (65) were laboratory confirmed as tuberculosis and a field investigation was made. Tuberculosis was laboratory confirmed, therefore, in 3.32 percent of the tissues submitted for laboratory examination. This compares to 3.68 percent laboratory confirmation for the previous reporting period.

The outcome of the 65 field investigations closed in fiscal year 1978 is shown in figure 9. It is interesting to note that although 34 (52.3 percent) of these investigations were successful in locating the herd of origin of the tuberculous slaughter animal, additional infection was found in only 16 (47 percent) of these 34 herds. Was the tuberculous slaughter animal the only tuberculosis affected animal in the six herds that were negative on test, or was something missed? Only time will give us a partial answer to this question. Of the remaining seven successful investigations, two were of Canadian origin where the herds of origin were tested negative and five led back to dispersed herds. The 31 (47.7 percent) unsuccessful investigations all led back to feedlots, dealers, or markets where the lack of identification contributed to the failure to locate the herd of origin. It is obvious that those States which do not have laws which require dealer licensing and proper record keeping need to take immediate action to gain such laws and to strictly enforce them when they are passed.

There was a significant increase in the number of granulomas sub-
mitted from suspected tuberculous slaughter cattle this fiscal year (2,228) as compared to 1,512 for the last reporting period (figure 10). This 32 percent increase in submissions is encouraging and is an indication of the increased cooperation that the program is receiving from Meat and Poultry Inspection personnel. Individual identification devices were reportedly present on only 1,076 (48 percent) of these animals and these reported identification devices were submitted with the tissues in only 537 cases (49 percent of the cattle with identification devices). As heartening as this is, there were still 28 slaughter establishments in the country slaughtering over 20,000 cows each from which no submissions were made (figure 11). There were 117 slaughter establishments slaughtering over 20,000 cows each from which 1 or more specimens were submitted. One plant in this category had 187 cases submitted from it this year.

A summary of the comparative-cervical (c-c) tests conducted from July 1, 1977, to June 30, 1978, is shown in figure 12. Of the 6,384 c-c retests of caudal fold suspects, 4,957 (77.6 percent) were conducted within 10 days. Over 94 percent, (6005) of all c-c tested animals were classified as negative on the first c-c retest. Of the 34 animals that fell into the reactor zone, on the first retest 15 (44.1 percent) had gross lesions of tuberculosis on postmortem examination. Seven of the 22 newly detected \textit{M. bovis} herds this fiscal year were so classified by use of the c-c test.

\textit{M. bovis} PPD tuberculin has been used for all field testing since October 1, 1977. In the first nine months of use, 3,623 (.189 percent) of the 1,913,325 animals tested were classified as either suspects or deviators. This is significantly lower than the .268 percent for the same period in 1977 and .279 percent for the same period in 1976 when HCSM 010 tuberculin was the official tuberculin for field testing.
Tuberculosis Eradication

Bovine Tuberculosis Area Status
September 30, 1978

- Modified accredited area (36)
- 36 plus Puerto Rico
- No *M. bovis* for over 5 years (10)

Legend:
- Accredited free state (14)
- 14 plus Virgin Islands
- Modified accredited area (36)
- 36 plus Puerto Rico

* *M. bovis* for over 5 years (10)
Tuberculosis Eradication

27 Tuberculous Herds by Location
Fiscal Year 1978

[Map showing 27 tuberculous herds by location with symbols indicating newly infected (●) and previously infected (▲) herds.]
Tuberculosis Eradication

Methods of Locating 22 Tuberculous Herds Initially Detected During Fy-78

- Traceback of regular kill slaughter animals (9)
- Reaccreditation (1)
- Area testing (2)
- Tracing exposed cattle from affected herds (10)
Detecting Herds with TB Infection
1968 through 1978

Epidemiologic tracing
All other tuberculin testing

Tuberculosis Eradication Program
Tuberculosis Eradication

Proportion of Tuberculous Herds Depopulated
Fiscal Year 1978

19 Herds depopulated
27 Tuberculous herds
Tuberculosis Eradication

65 Tuberculous Cases (Regular Kill) Animals Identified and Unidentified

Fiscal Year 1978

- 25 with no identification: 92% unsuccessful, 8% with identification
- 40 with identification: 20% unsuccessful, 80% successful
Tuberculosis Eradication

Tuberculosis Traceback Investigations (Regular Kill)
Fiscal Year 1978 (Cases Closed)

Cases not tuberculosis
Cases of tuberculosis

Fiscal Year

<table>
<thead>
<tr>
<th>Year</th>
<th>Cases not tuberculosis</th>
<th>Cases of tuberculosis</th>
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<tr>
<td>1971</td>
<td>150</td>
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<td>58</td>
<td>1516</td>
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<td>1978</td>
<td>65</td>
<td>1890</td>
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1955
## Tuberculosis Eradication
### 65 High Risk 6-35 Cases Closed
#### Fiscal Year 1978

<table>
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<th>Histo-culture</th>
<th>Comp. <em>M. bovis</em></th>
<th>Comp. no isol.</th>
<th>Sugg. <em>M. bovis</em></th>
<th>Sugg. no isol.</th>
<th>Gran. <em>M. bovis</em></th>
<th>Gran. no isol.</th>
<th>Other <em>M. bovis</em></th>
<th>Total</th>
<th>Total</th>
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<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
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<tr>
<td>Successful neg herd test (Canada)</td>
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<td>Successful dispersed herd</td>
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<td>3</td>
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<td>3</td>
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(No. indicates the number of cases, % indicates the percentage of cases.)
Tuberculosis Eradication

Number of 6-35's Submitted FY 78

- 6-35 Cases submitted: 2,228 (233)
- Number with ID devices: 1,076 (48%)
- Number of ID devices submitted: 537 (49%)

Graph showing the monthly submissions from October to September.
Tuberculosis Eradication

Granulomas Submitted from 145 Federal Establishments Slaughtering Over 20,000 Cows (July 1, 1977 through June 30, 1978)

Veterinary Services Laboratories, Ames, Iowa

- None: 28 Establishments
- 1-9 Cases: 94 Establishments
- 10-187 Cases: 23 Establishments
## Comparative - Cervical Retest Results

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<th>Within 10 days</th>
<th>%</th>
<th>2nd retest</th>
<th>%</th>
<th>Total</th>
<th>%</th>
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<tbody>
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<td><strong>Neg.</strong></td>
<td>4657 (1=N. bovis)</td>
<td>94.0</td>
<td>229 (1=NGL)</td>
<td>86.7</td>
<td>4957</td>
<td>100.0</td>
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<td><strong>Susp.</strong></td>
<td>269 (18=NGL) (2=M. bovis)</td>
<td>76</td>
<td>30 (19=NGL)</td>
<td>11.4</td>
<td>305</td>
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<td><strong>Rct.</strong></td>
<td>31 (16=NGL) (15=M. bovis)</td>
<td>0.6</td>
<td>5 (5=NGL)</td>
<td>1.9</td>
<td>36</td>
<td>100.0</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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<td></td>
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<td>5337</td>
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</table>

Within 10 days:
- **Neg.**: 4657 (94.0%)
- **Susp.**: 269 (76%)
- **Rct.**: 31 (0.6%)

After 60 days:
- **Neg.**: 1348 (94.5%)
- **Susp.**: 76 (5.3%)
- **Rct.**: 5 (1.9%)

No. %
---
1st retest: 1427 (100.0%)

2nd retest: 264 (100.0%)

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**Note:**
- (1=NGL) = Negative Tuberculin Reaction
- (2=NGL) = Positive Tuberculin Reaction
- (M. bovis) = Mycobacterium bovis
- (NGL) = Negative to Low Grade Reactions
In the fall of 1977, Bovine Tuberculosis was discovered in southwest Missouri among dairy cattle. The situation was interesting from an epidemiological viewpoint. Many of the problems of Tuberculosis eradication are well illustrated in this study.

The situation had its beginning when an animal with advanced Tuberculosis lesions was reported by a Wisconsin Packing Plant on August 1, 1977. In this instance, the lesioned animal was identified by a backtag which made location of the herd of origin a relatively easy matter. Many times, in a Tuberculosis investigation, we are faced with the problem of little or no identification. This case, obviously, is advanced, as are a good many of our workable cases. It is equally important in Tuberculosis eradication that small or atypical lesions be reported also.

The herd of origin in the 6-35 was located by means of a backtag to Herd “A” in southwest Missouri. A test of this herd on August 25, 1977 revealed 33 reactors, 19 negative (Fig. 1). All animals associated with the lesioned animal responded to the tuberculin test. *M. bovis* was confirmed in this herd. The lack of relationship between size of response and visible lesions in reacting animals was well illustrated in this herd. At least four animals with $X_{2.5}$ or less responses had lesions while one animal with an $X_{1.5}$ response was No Gross Lesions. Balance of herd was depopulated with no gross lesions observed. The cats were destroyed and no gross lesions were observed. Laboratory tests were also negative. Two dogs on the premises were negative to the tuberculin test. Owner has restocked his premises and has passed one negative test.

An epidemiological study on Herd “A” revealed the most obvious source of infection was in cattle purchased from Herd “B” (Fig. 2). Herd “A” had made two purchases from Herd “B”. Five cows in the fall of 1976 and another of nine cows in April 1977. The last purchase included the 6-35 lesioned animal. This particular animal had steady loss of weight while in the herd until sold. Subsequent investigation revealed that Herd “B” was badly infected. Investigation of Herd “B” led to the establishment of a workforce in Springfield, Missouri, September 1977.

Locating the source of infection in Herd “A” was relatively easy. Unfortunately, this is one of our problems facing us today—finding the sources of infection. Further study of Herd “B” revealed a probable source but because of time and large number of animals purchased from other sources, it is impossible to state conclusively that this was the most likely source. Herd “B” was an Accredited-Free herd and has been for years (since 1962). Again, this is not a new problem; however, it should be obvious to all of us that an effort must be made to insure that the Accredited-Free Herd Plan reflect the true TB status of the herd.
TUBERCULOSIS OUTBREAK

credited-Free Herd Plan reflect the true TB status of the herd.

Tracing of sales from Herd “A” was not extensive (Fig. 3). Few animals had been sold. Four bull calves were traced and destroyed as exposed animals. Two bull calves were not located. Heifer calves were retained in herd for replacement purposes. Cull cows were sold for slaughter. One neighboring herd that was possibly exposed was tested with negative results.

HERD “B”

Herd “B” was an Accredited-Free herd located in southwest Missouri. The herd consisted of 195 purebred Holstein animals.

Herd “B” also had a purebred Hereford herd of 267 head. In addition, a purebred herd of Hampshire swine was maintained. In general, these herds were isolated from each other. Part of the Hereford herd did have limited contact with the herd of swine. The dairy herd had been Accredited-Free since 1962 with no responses reported. On occasion, orphan or weak calves from the Hereford herd were brought to the dairy premises for supplementary feeding for a period of time and then returned to a segment of the Hereford herd. One such animal was slaughtered at Herd “B” premises and had a bronchial lesion that was confirmed as M. bovis. The first test on the Holstein herd revealed 71 reactors to the caudal fold test of 195 animals. On post mortem examination, 33 animals had gross lesions with 16 animals that were condemned. The Hereford herd revealed six reactors of 267 tested on the first test; all were No Gross Lesions. The six originated in the same group as the lesioned animal previously found on slaughter. This group was later slaughtered—no gross lesions observed. A review of the possible sales from Herd “B” revealed that the workforce concept was indicated to efficiently accomplish traceback activities. Consequently, a workforce operation was established at Springfield, Missouri in the fall of 1977.

Tuberculosis lesions in the slaughter animals in the swine herd had been reported for two years. All laboratory reports indicated a problem with M. avium infection. However, the breeding animals were tested and further surveillance made on slaughter swine. At this time, it appears that the problem in the swine is due to M. avium infection. This supports epidemiological studies that indicate that there was no direct exposure from the dairy herd to the swine herd. Dogs that were in contact with the dairy herd were tested and were classified negative. Cats in contact with the dairy herd were destroyed. No gross lesions were observed on post mortem in the cats. Laboratory results on tissues submitted were also negative.

Results of an epidemiological study made of the sales from Herd “B” indicated that there were three classes of exposed animals (Fig. 4).

1. Number One priority animals were those sold directly out of Herd “B” at private treaty, at their Annual Consignment Sale and those sold at Regional Purebred Holstein Sales.
2. Number Two priority were animals from other than Herd "B" which were on Herd "B" premises for a period of time (few days to a week) at the time of yearly consignment sales.

3. Herd "B" exhibited extensively at local and State Fairs. Other animals associated with Herd "B" were possibly exposed.

Sales from both the Hereford herd and the Holstein herd of Herd "B" were traced. Nineteen states received cattle from Herd "B" (Fig. 5). One infected herd was disclosed in Oklahoma. Results of followup testing activities in Missouri revealed five additional infected herds out of 241 herds tested on first test; 14,271 (first test) cattle tested. One *M. bovis* herd was located in Oklahoma.

SPECIAL COMMENTS — MISSOURI INFECTED HERDS

Missouri Herd "E" has an interesting history. The owner originally sold the animal from Herd "B" as an exposed animal (without test). On post mortem, the animal did not have visible lesions of Tuberculosis. Animal was purchased from Herd "B" in 1973. Tissues were submitted for laboratory examination and *M. bovis* was cultured from tissues submitted. Histopathology was negative. This herd remains under quarantine and is being tested on schedule. Tracing of sales from this herd has not at the present time revealed extension of the infection to other herds.

MISSOURI HERD "F"

Owner originally denied still having one animal that was traced to him. Another purchased animal was a cervical reactor and was No Gross Lesions on post mortem. At a later date, it was discovered that the owner still had the one animal that he had previously denied having. This animal was a Tuberculosis reactor and was killed with extensive lesions in the Spring of 1978. Investigation of the sales from this herd is underway. It appears that there will be an excess of 100 sales to trace. Many of these herds were tested during the workforce effort. A review of these records also indicates that he had other animals from Herd "B" during the past several years. Herd is under quarantine.

HERDS "C" AND "D"

Sales have been traced with no further infected herds found this date. An attempt was made to locate the source of the infection in Herd "B". In contrast with the obvious source in Herd "A", the situation is Herd "B" was much more complicated. Areas considered were: (Fig. 6)

1. The Holstein herd was established in 1962. The origin was New York state and the owner lived in Maryland. The herd was accredited in Missouri in 1962.

2. Since 1963, additions from Herd "B" originated in 10 states: Arkansas, Wisconsin, Kansas, Virginia, Georgia, Illinois, Tennessee, Pennsylvania, New York and Missouri (See Fig. 6).

3. One source herd in Missouri originally received cattle from a herd that *M. bovis* was confirmed in Kansas after the sale occurred. All of
these animals passed one negative test prior to entering the herd. Herd "B" bloodlines are composed principally from this herd. This remains the most likely of Herd "B" infection, although this cannot be proven at this time.

SUMMARY OF MISSOURI WORKFORCE ACTIVITIES

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herds tested</td>
<td>289</td>
</tr>
<tr>
<td>Animals tested</td>
<td>14,271</td>
</tr>
<tr>
<td>Herds with Caudal Fold Suspects</td>
<td>42</td>
</tr>
<tr>
<td>Caudal Fold Suspects</td>
<td>246</td>
</tr>
<tr>
<td>Animals tested cervical</td>
<td>1,417</td>
</tr>
<tr>
<td>Animals reactors on cervical test</td>
<td>145</td>
</tr>
</tbody>
</table>

(17.5% of herds) (1.8% of animals tested) (10.23% of cattle tested)

A statistical summary of the workforce activities have been presented. Six infected herds were confirmed in Missouri, one herd confirmed in Oklahoma. Nineteen states were involved in receiving exposed cattle. One source herd was responsible for infections in the other five herds. As of this time, no other spread of infection from these herds is known. No concurrent infections were confirmed in other species of animals. Many of the current problems in Tuberculosis eradication were illustrated in this study. This study points out the extreme dedication required by all people involved that will be needed to reach our goal of Tuberculosis eradication.
Herd “A” Investigation • Falcon, MO

- Forty-eight animals tested
  - 15 negative
  - 33 reactors
  - 14 with gross lesions of Tuberculosis
  - *M. bovis* confirmed

- 100% of animals associated with 6-35 case reacted to the test (33)

- Four animals with P or X₂ responses or *smaller* had gross lesions
  - One animal with X₁₅ response was NGL

- Two dogs were negative to the test; Cats were destroyed
  - No other susceptible animals on the premise

- Balance of herd was depopulated
  - No gross lesions observed

- Owner has restocked
  - Has passed one negative test
Possible Sources of Herd "A" Infection

1. Estate sale 1973
   - Tested negative
   - Sold 5 in 1976
   - Sold 9 in 1977
   (6-35 Subject)

2. Tested 1977
   - Negative

3. Tested 1977
   - Negative

A

B (Accredited)

- Sold 5 in 1976
- Sold 9 in 1977
- Tested 1977
  - 124 negative
  - 71 reactors
  - 33 gross lesions
Summary of Investigation of Sales From Herd "A"*

- 4 bull calf sales were located and animals destroyed as exposed.
- Herds tested negative.
- Two cows sold for slaughter (1=6-35 subject).
- One bull calf moved to Canada. Disposition of this calf not determined.
- One bull calf not traced.
- Sale barn records destroyed.
- Two bull calf sales not located.

*Limited to time infection probably introduced into herd (fall 1976)
Epidemiological Studies of Movements of Animals From Herd “B”

Three Classes of Exposed Cattle:

- Direct movements from herd “B”

- Premise exposed cattle—on premise 2 to 7 days prior to consignment sales

- Animals exposed at various exhibits
States Involved in Receiving Exposed Cattle from Herd "B"

- States tested negative
- States with infected herds

Herd B
REPORT OF THE COMMITTEE ON TUBERCULOSIS AND JOHNE’S DISEASE

Chairman: John M. Dick, Harrisburg, Pennsylvania

Co-Chairman: Paul L. Spencer, Springfield, Illinois


The committee met on the afternoons of October 31 and November 1, 1978.

Nineteen committee members and 19 guests were in attendance for all or a part of the meeting.

The Committee Chairman commended Dr. P. L. Smith for his services as Committee Chairman during the past four years.

Dr. Lloyd Konyha presented a brief status report on the National Tuberculosis Eradication program.

The committee spent considerable time discussing present program deficiencies. Information relative to these deficiencies will be included with committee recommendations.

Dr. Konyha briefed the Committee on the Tuberculosis Task Force Critique held in St. Louis. Results of the critique indicated a need for “work forces” of this type on occasion. The size of the force is dependent upon the work load, of more importance is the sole responsibility of personnel to the tuberculosis program duties for the duration of the work force.

Reports on recent M. bovis outbreaks were given as follows:

1. Dr. Konyha — Maryland outbreak
2. Dr. Perryman — Kentucky outbreak
3. Dr. Stumpf — Southwest Missouri outbreak
4. Dr. Dick — Pennsylvania outbreak

Dr. Larsen gave a preliminary report on the “Time/temperature study” on destroying Mycobacteria in pork products destined for consumption without additional cooking. Details will be available when the report has been published.

Dr. Watson presented information on a problem with a quarantined dairy herd in Idaho and attempts to qualify the herd for release from quarantine under current UMR requirements.

The problems of Mycobacteriosis in swine were discussed at length.
Dr. Spangler presented the report of the sub-committee on Johne’s Disease. Principal items are:

1. No accurate data on the incidence of the disease currently exists. The American Association of Bovine Practitioners is developing a survey of their membership concerning incidence of the disease in their practices. The AABP is commended for their efforts and leadership. The results should be of value to the cattle industry, practitioners and regulatory officials. Once the incidence is established the economic impact of Johne’s Disease can be more accurately calculated.

2. Fecal culture appears to be the diagnostic method of choice. All states are encouraged to develop this laboratory diagnostic capability. If personnel training is needed NVSL should be contacted and they will arrange for this training.

3. Information to date indicates that Johne’s Disease vaccine promises hope in controlling the disease. Additional trials and further evaluation is needed before recommendations can be made for extensive use of vaccines. No vaccine is currently licensed for interstate shipment. Research on a reduced dosage to minimize nodule formation and still provide protection is now underway.

The work of this subcommittee will be continued throughout the coming year.

Dr. Spencer presented the report of the subcommittee on establishing Tuberculosis Accredited Free Herds of Goats. Principal items were:

1. Survey of states — 21 states presently have laws or regulations providing for such herds. The average number of accredited goat herds per state is 23.

2. Incidence of tuberculosis of goats in U.S. is very low or non-existent but has been reported. Persons with expertise in goat diseases and the tuberculosis epidemiologists expressed no reservations as to the PPD tuberculin test being effective in goats.

The subcommittee will be continued for another year with the purpose of determining effectiveness of the comparative-cervical test in goats and to propose an appropriate amendment to include goats in the Tuberculosis Uniform Methods and Rules.

Dr. McLaughlin presented the report of the subcommittee on the use of Paraprofessionals for Routine Screening Tuberculin Testing. Technicians, employed by State or Federal governments, are now being utilized in California, Connecticut and Rhode Island. Detailed reports on testing by technicians from all three states were presented; all were very favorable.

Dr. Duncan presented the report of the Subcommittee on the Evaluation of the National Tuberculosis Eradication Program. This detailed and very informative survey report contained a number of items which have been incorporated into the recommendations of this committee.
The Committee on Tuberculosis and Johne's Disease recommends to the Executive Committee the adoption of the following:

The motions are:

Motion #1. Mycobacteriosis in Swine. (a) The time/temperature study conducted by U.S.D.A. on the destruction of Mycobacteria in certain pork products is completed but not published. It is anticipated that this study will be accepted by FSQS resulting in a better utilization of PFC swine carcasses and that the economic loss due to the disease will be greatly reduced. The Committee highly commends this study as a very positive step forward.

(b) This Committee recommends that field studies should be conducted by USDA to determine the etiology of this disease.

Motion #2. Program Improvements

The present tuberculosis eradication program depends primarily on slaughter surveillance and secondly on tuberculin testing of livestock. The Committee discussed certain deficiencies in the program and recommends the following:

(a) A need for improvements in staffing and training of meat inspection personnel in the large high volume kill plants by reason of the increased work load placed on inspection personnel due to sampling for brucellosis, pseudorabies, drug residues, etc.

(b) A continued effort to identify all livestock for breeding, feeding and slaughter purposes which is essential to all livestock disease control and eradication programs.

(c) Reevaluation of the procedures for accreditation of veterinarians relative to tuberculin testing, possibly including continuing education. A subcommittee to review and develop these procedures will be appointed.

(d) Following recommendations of other committees, we also recommend that steps be taken to require the licensing of all livestock dealers which should include the requirements for record keeping.

(e) The committee recommends continuation of USDA funding for research to develop a new diagnostic test for tuberculosis.

Motion #3. Paraprofessionals

Recommends that approval be given for the use of technicians, employed by state and federal governments and directly supervised by state or federal veterinarians, to conduct routine screening tuberculin tests. Utilization of technicians in any state would be contingent on the laws of that State.

The subcommittee report outlining the qualifications and training for the use of paraprofessional personnel was approved by the Executive Committee of U.S.A.H.A. in 1975.
Motion #4. Proposed changes in Uniform Methods and Rules — Bovine Tuberculosis Eradication.

Part I — Definitions
(a) Delete item 12, “Surveillance”
(b) Renumber items 13 through 18 as items 12 through 17
(c) Add a new definition to be item 18 as follows:

“Routine Screening Tuberculin Tests” — caudal fold tuberculin tests conducted as part of an area eradication program in which all responding animals are reported to the appropriate animal health official.

Part II — Official Test Procedures
B. Add Technicians jointly approved by state and federal governments may conduct routine screening tuberculin tests when directly supervised by state or federal veterinarians.

D. Delete all present wording and replace with “Single cervical test. This test is recommended for use in herds affected with bovine tuberculosis and for testing exposed cattle from such herds. It shall be applied only by a veterinarian employed in a full-time capacity by the state or federal government.”

G. Tuberculin Test Interpretation
Add “1.” before the words “the following are —”
Change present 1 to “a.”
Change present 2 to “b.”
Delete present 3
Change present a to “c”
Change present b to “d”

Add the following “No animal with a response is eligible for export or interstate movement.”

Add “2” — Comparative Cervical Test — “Responses shall be reported and plotted on the scattergram. Classification of responses shall be according to the scattergram.”

Add # “3” — Single Cervical Test — all animals with response shall be classified as a reactor. Responses shall be recorded in mm.

Part IV — Quarantine Procedures
3. Delete the sentence reading “Minimum quarantine period shall be 10 months from slaughter of lesion reactors.”

Part V — Special Retests of High Risk Herds
4. b. Delete present paragraph and substitute the following: “In all other cases the remainder of the herd shall be tested by the caudal fold test, with responding animals classified as suspects and retested with the comparative-cervical test.”

Motion #5. Johne’s disease — The committee recommends that funds for the USDA research study on the use of a vaccine and the determination of an effective dosage be continued.
REVISION OF THE
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 the 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.

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 units as the Executive Committee may by a two thirds vote approve, shall be eligible to official membership in the 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 activity 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. Said Organization shall have 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 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. All past presidents shall automatically become life members.

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 or 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. 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
REVISION OF THE CONSTITUTION

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.

There shall be five districts. Said districts shall be known as (1) the Northeast: consisting of the States of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; (2) the North Central: consisting of the States of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; (3) the Southern: comprising the States of Alabama, Arkansas, Georgia, Florida, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, Puerto Rico, and the Virgin Islands; (4) the Western district: consisting of the States of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming; (5) the District-at-Large: consisting of Allied Organization Members and all Elected Regional Delegate Members.

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 insure 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.

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 the 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, and Second 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 proceed-
ings 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 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 President, 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 twenty-five dollars ($25) at any one time on his own authority. 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 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).

6. Treasurer: The Treasurer shall keep an accurate account of all Association moneys received and disbursed. He shall receive from the Secretary all moneys 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 President. 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 twenty-five dollars ($25) for any given expenditure. 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.

ARTICLE VIII—AMENDMENTS

The Constitution 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.

ARTICLE IX—ELECTION OF OFFICERS AND ELECTED REGIONAL DELEGATES

The Nominating Committee shall annually report to the membership of this
REVISION OF THE CONSTITUTION

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.

BYLAWS

ARTICLE I—ORDER OF BUSINESS

Registration.
Call to Order.
Report of Secretary.
Report of Treasurer.
President-Elect's Address.
Reading of Papers.
Reading of Papers.
Committee Reports.
Discussion.
Unfinished Business.
New Business.
Nomination 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 twenty dollars ($20), 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 meeting site in the selected location as well as the duration of said meetings shall be determined by the officers of the Association in consultation with the executive officer representing the animal health...
department of the state in which the meeting is to be held.

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 at least two-thirds of this number are executive officers repre-
senting the animal health departments of their respective states.

ARTICLE V—DUES

The dues for individual membership in this Association shall be twenty
dollars ($20.00) 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 ($3.00) 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 one
hundred fifty dollars ($150) each per annum, payable in advance (on or before
January 1st each year) to the Secretary of this association.

This constitution and by-laws was considered by the Executive Committee and
unanimously approved on October 20, 1977 — Minneapolis, Minnesota, and approved
by the membership at the 82nd Annual Meeting — Buffalo, New York, October 31,
1978.
83rd ANNUAL MEETING
October 28-November 2, 1979
THE TOWN AND COUNTRY HOTEL
San Diego, California

84th ANNUAL MEETING
October 24-31, 1980
GALT HOUSE HOTEL
Louisville, Kentucky

85th ANNUAL MEETING
Dates of Meeting and Hotel
to be announced later
Detroit, Michigan