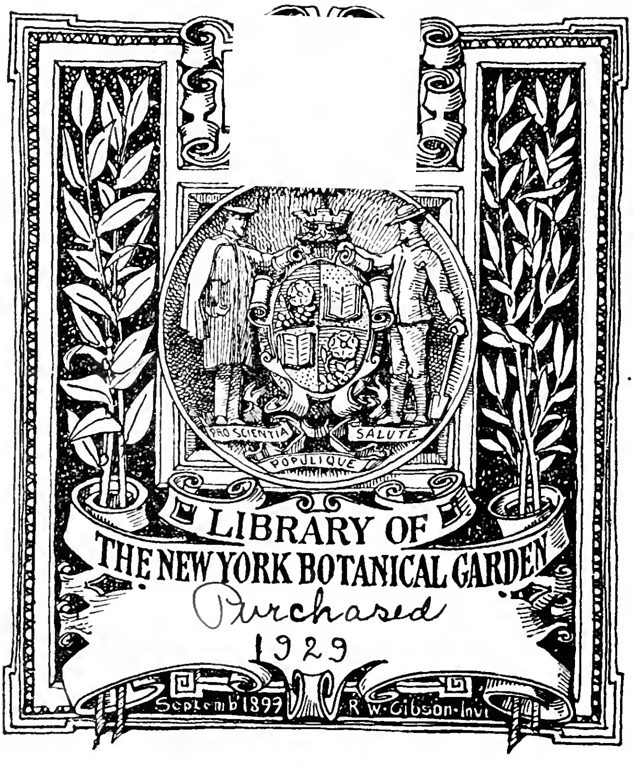

PRO SCIENTIA
SALUTE
POPULIQUE
LIBRARY OF
THE NEW YORK BOTANICAL GARDEN
Purchased
1929
Septemb 1899
R. W. Gibson. Invt

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOLUME 5, 1912

JOURNAL OF ECONOMIC ENTOMOLOGY PUBLISHING CO.

Concord, N. H.

1912

Contents

* Withdrawn for publication elsewhere.
† Paper not received in time for publication.

VOL. 5 FEBRUARY, 1912 No. 1

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Published by
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
CONCORD, N. H.

Entered as second-class matter Mar. 3, 1908, at the post-office at Concord, N. H.,
under Act of Congress of Mar. 3, 1879.

CONTENTS

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

(Organized in 1889)

OFFICERS

President
W. D. Hunter, Dallas, Texas.

First Vice-President
T. J. Headlee, Manhattan, Kansas.

Second Vice-President
R. A. Cooley, Bozeman, Montana.

Secretary
A. F. Burgess, Melrose Highlands, Mass.

LIST OF MEETINGS AND PAST OFFICERS

First Annual Meeting, Washington, D. C., Nov. 12–14, 1889. President, C. V. Riley; First Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11–13, 1890. (The same officers had charge of this meeting.)

Third Annual Meeting, Washington, D. C., Aug. 17–18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15–16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wis., Aug. 14–16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14–15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27–28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21–22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12–13, 1897. President, F. M. Webster; First Vice-President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19–20, 1898. President, Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug., 18–19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22–23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23–24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27–28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26–27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29–31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29–30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1–4, 1906. President, H. Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28–29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27–28, 1907. President, H. A. Morgan; First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28–29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28–29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28–29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27–29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

LIST OF MEMBERS

ACTIVE MEMBERS

Ainslie, C. N., U. S. Bureau of Entomology, 1271 Kensington Ave., Salt Lake City, Utah.
Back, E. A., Agricultural Experiment Station, Blacksburg, Va.
Baker, C. F., Claremont, Cal.
Ball, E. D., Agricultural Experiment Station, Logan, Utah.
Banks, C. S., Bureau of Science, Manila, P. I.
Banks, Nathan, U. S. Bureau of Entomology, Washington, D. C.
Barber, H. S., U. S. Bureau of Entomology, Washington, D. C.
Benton, Frank, 925 N. St., N. W., Washington, D. C.
Bethune, C. J. S., Guelph, Ontario, Canada.
Bishopp, F. C., U. S. Bureau of Entomology, Dallas, Texas.
Britton, W. E., New Haven, Conn.
Brooks, F. E., U. S. Bureau of Entomology, Washington, D. C.
Brues, C. T., Bussey Institution, Forest Hills, Boston, Mass.
Bruner, Lawrence, Agricultural Experiment Station, Lincoln, Neb.
Burgess, A. F., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Burke, H. E., U. S. Bureau of Entomology, Washington, D. C.
Busck, August, U. S. National Museum, Washington, D. C.
Caudell, A. N., U. S. National Museum, Washington, D. C.
Chambliss, C. E., U. S. Bureau of Plant Industry, Washington, D. C.
Chittenden, F. H., U. S. Bureau of Entomology, Washington, D. C.
Cockerell, T. D. A., Boulder, Colo.
Comstock, J. H., Cornell University, Ithaca, N. Y.
Conradi, A. F., Clemson College, S. C.
Cook, Mel. T., Agricultural Experiment Station, New Brunswick, N. J.
Cooley, R. A., Agricultural Experiment Station, Bozeman, Mont.
Cordley, A. B., Agricultural Experiment Station, Corvallis, Ore.
Cotton, E. C., Agricultural Experiment Station, Knoxville, Tenn.
Crawford, J. C., U. S. National Museum, Washington, D. C.
Crosby, C. R., Cornell University, Ithaca, N. Y.
Davis, J. J., U. S. Bureau of Entomology, Lafayette, Ind.
Dean, G. A., Agricultural Experiment Station, Manhattan, Kansas.
Dyar, H. G., U. S. National Museum, Washington, D. C.
Ehrhorn, E. M., Honolulu, H. T.
Felt, E. P., Geological Hall, Albany, N. Y.
Fernald, C. H., Agricultural College, Amherst, Mass.
Fernald, H. T., Agricultural College, Amherst, Mass.
Fiske, W. F., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Forbes, S. A., University of Illinois, Urbana, Ill.
Foster, S. W., U. S. Bureau of Entomology, Washington, D. C.
Franklin, H. J., Amherst, Mass.
French, G. H., Carbondale, Ill.
Gahan, A. B., Agricultural Experiment Station, College Park, Md.
Garman, H., Agricultural Experiment Station, Lexington, Ky.
Gibson, Arthur, Central Experimental Farm, Ottawa, Canada.
Gillette, C. P., Agricultural Experiment Station, Fort Collins, Colo.
Girault, A. A., Brisbane, Queensland, Australia.

Gossard, H. A., Agricultural Experiment Station, Wooster, Ohio.
Gregson, P. B., R. F. D., No. 5, Richmond, Va.
Grossbeck, J. A., American Museum of Natural History, New York City.
Hammar, A. G., U. S. Bureau of Entomology, Washington, D. C.
Harned, R. W., Agricultural Experiment Station, Agricultural College, Miss.
Hart, C. A., State Entomologist's Office, Urbana, Ill.
Headlee, T. J., Agricultural Experiment Station, Manhattan, Kan.
Heidemann, Otto, U. S. National Museum, Washington, D. C.
Herms, W. B., University of California, Berkeley, Cal.
Herrick, Glenn W., Cornell University, Ithaca, N. Y.
Hewitt, C. Gordon, Central Experimental Farm, Ottawa, Canada.
Hinds, W. E., Agricultural Experiment Station, Auburn, Ala.
Hine, J. S., Ohio State University, Columbus, Ohio.
Holland, W. J., Carnegie Museum, Pittsburgh, Pa.
Hooker, W. A., Office of Experiment Stations, Washington, D. C.
Hopkins, A. D., U. S. Bureau of Entomology, Washington, D. C.
Houghton, C. O., Agricultural Experiment Station, Newark, Del
Houser, J. S., Agricultural Experiment Station, Wooster, Ohio.
Howard, L. O., U. S. Bureau of Entomology, Washington, D. C.
Hunter, S. J., University of Kansas, Lawrence, Kansas.
Hunter, W. D., U. S. Bureau of Entomology, Dallas, Texas.
Jennings, A. H., U. S. Bureau of Entomology, Dallas, Texas.
Johannsen, O. A., Agricultural Experiment Station, Orono, Me.
Johnson, Fred, U. S. Bureau of Entomology, Washington, D. C.
Johnson, S. A., Agricultural Experiment Station, Fort Collins, Colo.
Jones, P. R., U. S. Bureau of Entomology, Washington, D. C.
Kellogg, V. L., Stanford University, Cal.
Kelly, E. O. G., U. S. Bureau of Entomology, Wellington, Kansas.
Kincaid, Trevor, University of Washington, Seattle, Wash.
Kirkland, A. H., Huntington, Mass.
Kotinsky, J., Morestown, N. J.
Lochhead, Wm., MacDonald College of Agriculture, Montreal, Canada.
MacGillivray, A. D., University of Illinois, Urbana, Ill.
Marlatt, C. L., U. S. Bureau of Entomology, Washington, D. C.
Morgan, A. C., U. S. Bureau of Entomology, Clarksville, Tenn.
Morgan, H. A., Agricultural Experiment Station, Knoxville, Tenn.
Morrill, A. W., Phoenix, Ariz.
Moulton, Dudley, 11 Ferry Building, San Francisco, Cal.
Murtfeldt, Mary E., Kirkwood, Mo.
Newell, Wilmon, Agricultural Experiment Station, College Station, Texas.
O'Kane, W. C., Agricultural Experiment Station, Durham, N. H.
Osborn, Herbert, Ohio State University, Columbus, Ohio.
Parrott, P. J., Agricultural Experiment Station, Geneva, N. Y.
Patch, Edith M., Agricultural Experiment Station, Orono, Me.
Pergand, Theo., U. S. Bureau of Entomology, Washington, D. C.
Perkins, R. C. L., Hawaiian Sugar Planters' Experiment Station, Honolulu, H. T.
Pettit, R. H., Agricultural Experiment Station, East Lansing, Mich.
Phillips, E. F., U. S. Bureau of Entomology, Washington, D. C.
Phillips, J. L., Staunton, Va.
Phillips, W. J., U. S. Bureau of Entomology, Washington, D. C.
Pierce, W. D., U. S. Bureau of Entomology, Dallas, Texas.
Quaintance, A. L., U. S. Bureau of Entomology, Washington, D. C.

Quayle, H. J., Whittier, Cal.
Reeves, George I., U. S. Bureau of Entomology, Salt Lake City, Utah.
Riley, W. A., Cornell University, Ithaca, N. Y.
Ruggles, A. G., Agricultural Experiment Station, St. Anthony Park, Minn.
Rumsey, W. E., Agricultural Experiment Station, Morgantown, W. Va.
Russell, H. M., U. S. Bureau of Entomology, Washington, D. C.
Sanborn, C. E., Agricultural Experiment Station, Stillwater, Okla.
Sanders, J. G., Agricultural Experiment Station, Madison, Wis.
Sanderson, E. D., University of West Virginia, Morgantown, W. Va.
Saunders, Wm., Central Experimental Farm, Ottawa, Canada.
Schwarz, E. A., U. S. National Museum, Washington, D. C.
Sherman, Franklin, Jr., State Department of Agriculture, Raleigh, N. C.
Skinner, Henry, Logan Square, Philadelphia, Pa.
Smith, J. B., Agricultural Experiment Station, New Brunswick, N. J.
Smith, R. I., Mayaguez, P. R.
Stedman, J. M., Office of Experiment Stations, Washington, D. C.
Summers, H. E., Agricultural Experiment Station, Ames, Iowa.
Surface, H. A., State Zoölogist, Harrisburg, Pa.
Swenk, M. H., Agricultural Experiment Station, Lincoln, Neb.
Swezey, O. H., Hawaiian Sugar Planters' Experiment Station, Honolulu, H. T.
Symons, T. B., Agricultural Experiment Station, College Park, Md.
Taylor, E. P., Parker, Kansas.
Titus, E. G., Agricultural Experiment Station, Logan, Utah.
Townsend, C. H. T., Piura, Peru.
Troop, James, Agricultural Experiment Station, Lafayette, Ind.
Van Dine, D. L., Rio Piedras, Porto Rico.
Viereck, H. L., U. S. National Museum, Washington, D. C.
Walden, B. H., New Haven, Conn.
Washburn, F. L., Agricultural Experiment Station, St. Anthony Park, Minn.
Webb, J. L., U. S. Bureau of Entomology, Washington, D. C.
Webster, F. M., U. S. Bureau of Entomology, Washington, D. C.
Webster, R. L., Agricultural Experiment Station, Ames, Iowa.
Wheeler, W. M., Bussey Institution, Forest Hills, Boston, Mass.
Wilson, H. F., Agricultural Experiment Station, Corvallis, Oregon.
Woglum, R. S., U. S. Bureau of Entomology, Washington, D. C.
Woodworth, C. W., University of California, Berkeley, Cal.
Worsham, E. L., Capitol Building, Atlanta, Ga.
Yothers, W. W., Orlando, Fla.

ASSOCIATE MEMBERS

Ainslie, G. G., U. S. Bureau of Entomology, Washington, D. C.
Babcock, C. G., Agricultural Experiment Station, College Park, Md.
Barber, T. C., U. S. Bureau of Entomology, Audubon Park, La.
Barnes, Wm., Decatur, Ill.
Bartholomew, C. E., Iowa State College, Ames, Iowa.
Bentley, G. M., University of Tennessee, Knoxville, Tenn.
Berger, E. W., Gainesville, Fla.
Beutenmuller, Wm., American Museum of Natural History, New York City.
Bourne, A. I., Agricultural Experiment Station, Amherst, Mass.
Braucher, R. W., Cornell University, Ithaca, N. Y.
Buck, J. E., Blacksburg, Va.

Burrill, A. C., Madison, Wis.
Caesar, Lawson, Guelph, Ontario, Canada.
Caffrey, D. J., Agricultural Experiment Station, New Haven, Conn.
Cardin, P. G., Santiago de las Vegas, Cuba.
Champlain, A. B., Box 261, Harrisburg, Pa.
Chase, W. W., Capitol Building, Atlanta, Ga.
Clapp, S. C., State Department of Agriculture, Raleigh, N. C.
Coad, B. R., U. S. Bureau of Entomology, Dallas, Texas.
Coe, W. R., Yale University, New Haven, Conn.
Collins, C. W., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Condit, I. J., California Polytechnic School, San Luis Obispo, Cal.
Cory, E. N., Agricultural Experiment Station, College Park, Md.
Couden, F. D., Pioneer Building, Seattle, Wash.
Crampton, G. C., Massachusetts Agricultural College, Amherst, Mass.
Criddle, Norman, Treesbank, Manitoba, Canada.
Crossman, S. S., Amherst, Mass.
Culver, J. J., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Currie, R. P., U. S. Bureau of Entomology, Washington, D. C.
Cushman, R. A., U. S. Bureau of Entomology, Washington, D. C.
Davidson, W. M., U. S. Bureau of Entomology, San José, Cal.
Dickerson, E. L., 5 Broad Street, Newark, N. J.
Doran, E. W., Louisiana Industrial Institute, Ruston, La.
Douglas, B. W., Indianapolis, Ind.
Engle, E. B., Office State Zoölogist, Harrisburg, Pa.
Evans, Wm. E., Jr., Painesville, Ohio.
Ewing, H. E., Agricultural Exp. Sta., Corvallis, Oregon.
Farrar, E. R., South Lincoln, Mass.
Fisher, W. S., Highspire, Pa.
Frost, H. L., Arlington, Mass.
Fullaway, D. T., Agricultural Experiment Station, Honolulu, H. T.
Garrett, J. B., Agricultural Experiment Station, Baton Rouge, La.
Gates, B. N., Amherst, Mass.
Gifford, J. B., Cocoanut Grove, Fla.
Gill, John B., U. S. Bureau of Entomology, Washington, D. C.
Goodwin, W. H., Agricultural Experiment Station, Wooster, Ohio.
Green, E. C., U. S. Bureau of Plant Industry, Brownsville, Texas.
Hardenberg, C. B., Box 434, Pretoria, Transvaal, South Africa.
Harrington, W. H., Post Office Department, Ottawa, Canada.
Hartzell, F. Z., Agricultural Experiment Station, Geneva, N. Y.
Haseman, Leonard, University of Missouri, Columbia, Mo.
Hayhurst, Paul, Agricultural Experiment Station, Fayetteville, Ark.
Hertzog, P. H., Heightstown, New Jersey.
High, Marvin M., U. S. Bureau of Entomology, Brownsville, Texas.
Hodgkiss, H. E., Agricultural Experiment Station, Geneva, N. Y.
Hoff, E. P., Georgetown, Idaho.
Hollister, G. H., 272 Westland St., Hartford, Conn.
Hollister, Wesley O., 634 East Congress St., Detroit, Mich.
Holloway, T. E., U. S. Bureau of Entomology, Brownsville, Texas.
Hood, C. E., Urbana, Ill.
Hooker, C. W., Agricultural Experiment Station, Mayaguez, P. R.
Horton, J. R., U. S. Bureau of Entomology, Lindsay, Cal.
Hudson, G. H., Plattsburg, N. Y.

Hungerford, Herbert B., University of Kansas, Lawrence, Kansas.
Hyslop, J. A., U. S. Bureau of Entomology, Pullman, Wash.
Illingworth, J. F., 115 Linn St., Ithaca, N. Y.
Jarvis, T. D., Guelph, Canada.
Jenne, E. L., U. S. Bureau of Entomology, Washington, D. C.
Johnston, F. A., U. S. Bureau of Entomology, Washington, D. C.
Jones, C. R., Manila, P. I.
Kephart, Cornelia Ferris, Agricultural Experiment Station, Durham, N. H.
Kidder, Nathaniel T., Milton, Mass.
King, G. B., Lawrence, Mass.
King, W. V., U. S. Bureau of Entomology, Washington, D. C.
Knab, Frederick, U. S. National Museum, Washington, D. C.
Koebele, Albert, Alameda, Cal.
Kraus, E. J., Agricultural Experiment Station, Corvallis, Ore.
Lewis, A. C., Capitol Building, Atlanta, Ga.
Lowe, F. W., Detroit, Mich.
Mackintosh, R. S., Caledonia, Minn.
Mann, B. P., 1918 Sunderland Place, Washington, D. C.
Marsh, H. O., U. S. Bureau of Entomology, Washington, D. C.
McConnell, W. R., State College, Pa.
McGregor, E. A., U. S. Bureau of Entomology, Dallas, Texas.
McLaine, Leonard S., Amherst, Mass.
McMillan, D. K., Urbana, Ill.
Melander, A. L., Washington State College, Pullman, Wash.
Menagh, C. S., U. S. Bureau of Entomology, Washington, D. C.
Mendenhall, E. W., State Department of Agriculture, Columbus, Ohio.
Merrill, J. H., Agricultural Experiment Station, Manhattan, Kans.
Metcalf, Z. P., State Department of Agriculture, Raleigh, N. C.
Milliken, F. B., Agricultural Experiment Station, Manhattan, Kansas.
Morse, A. P., Wellesley, Mass.
Mosher, F. H., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Nelson, J. A., U. S. Bureau of Entomology, Washington, D. C.
Ness, Henry, Jonesboro, Ark.
Nicholson, J. F., Agricultural Experiment Station, Stillwater, Okla.
Oestlund, O. W., University of Minnesota, Minneapolis, Minn.
Osborn, H. T., U. S. Bureau of Entomology, Salt Lake City, Utah.
Paddock, F. B., College Station, Texas.
Paine, C. T., Redlands, Cal.
Palmer, R. M., Victoria, British Columbia, Canada.
Parker, J. R., Agricultural Experiment Station, Bozeman, Mont.
Parman, D. C., U. S. Bureau of Entomology, Dallas, Texas.
Peairs, L. M., University of West Virginia, Morgantown, W. Va.
Philbrook, E. E., Portland, Me.
Pike, Asa O., 14 Winter St., Saco, Me.
Pinkus, Harry, U. S. Bureau of Entomology, Dallas, Texas.
Popenoe, C. H., U. S. Bureau of Entomology, Washington, D. C.
Price, W. J., Jr., Agricultural Experiment Station, Blacksburg, Va.
Randall, J. L., 707 Bijou Building, Pittsburg, Pa.
Rane, F. W., 6 Beacon St, Boston, Mass.
Reed, E. B., Esquimault, British Columbia, Canada.
Reed, W. V., Capitol Building, Atlanta, Ga.
Regan, W. S., Amherst, Mass.

Ripley, E. P., Weston, Mass.
Rogers, D. M., 6 Beacon St., Boston, Mass.
Rolfs, P. H., Agricultural Experiment Station, Gainesville, Fla.
Runner, G. A., U. S. Bureau of Entomology, Washington, D. C.
Safro, V. I., Agricultural College, Corvallis, Oregon.
Sanford, H. L., U. S. Bureau of Entomology, Washington, D. C.
Sasscer, E. R., U. S. Bureau of Entomology, Washington, D. C.
Satterthwait, A. F., Middletown, Pa.
Scammell, H. B., Box 278, Grand Junction, Colo.
Schoene, W. J., Agricultural Experiment Station, Geneva, N. Y.
Scott, W. M., U. S. Bureau of Plant Industry, Washington, D. C.
Severin, H. C., State Agricultural College, Brookings, S. D.
Shafer, G. D., Agricultural Experiment Station, East Lansing, Mich.
Shaw, N. E., State Department of Agriculture, Columbus, Ohio.
Simanton, F. L., U. S. Bureau of Entomology, Washington, D. C.
Smith, C. P., Agricultural Experiment Station, Logan, Utah.
Smith, G. A., 6 Beacon St., Boston, Mass.
Smith, H. E., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Smith, H. S., U. S. Bureau of Entomology, Salt Lake City, Utah.
Smith, L. M., Carbondale, Ill.
Smulyan, M. T., Amherst, Mass.
Snyder, T. E., U. S. Bureau of Entomology, Washington, D. C.
Somes, M. P., Iowa City, Iowa.
Soule, A. M. G., Woolwich, Me.
Southwick, E. B., Arsenal Building, Central Park, New York City.
Spangler, A. J., Lawrence, Kansas.
Spooner, Charles, Agricultural Experiment Station, St. Anthony Park, Minn.
Stene, A. E., Agricultural Experiment Station, Kingston, R. I.
Stiles, J. C., Blacksburg, Va.
Stimson, James, Santa Clara, Cal.
Summers, J. N., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Thaxter, Roland, 7 Scott St., Cambridge, Mass.
Thompson, W. R., Cornell University, Ithaca, N. Y.
Timberlake, P. H., U. S. Bureau of Entomology, Washington, D. C.
Tothill, J. D., Central Experimental Farm, Ottawa, Canada.
Tower, W. V., Agricultural Experiment Station, Mayaguez, P. R.
Turner, W. F., Agricultural Experiment Station, Auburn, Ala.
Urbahns, T. D., U. S. Bureau of Entomology, Salt Lake City, Utah.
Vickery, R. A., U. S. Bureau of Entomology, Washington, D. C.
Walton, W. R., U. S. Bureau of Entomology, Washington, D. C.
Weed, C. M., State Normal School, Lowell, Mass.
Weed, H. E., Railway Exchange Building, Chicago, Ill.
Weldon, G. P., Grand Junction, Colo.
Whitmarch, R. D., Agricultural Experiment Station, Wooster, Ohio.
Wildermuth, V. L., U. S. Bureau of Entomology, Washington, D. C.
Williamson, Warren, Agricultural Experiment Station, St. Anthony Park, Minn.
Winslow, R. M., Department of Agriculture, Victoria, British Columbia, Canada.
Wolcott, G. N., U. S. Bureau of Entomology, Dallas, Texas.
Wood, H. P., U. S. Bureau of Entomology, Dallas, Texas.
Wood, W. B., U. S. Bureau of Entomology, Washington, D. C.
Worthley, L. H., U. S. Bureau of Entomology, 6 Beacon St., Boston, Mass.
Yothers, M. A., Agricultural Experiment Station, Pullman, Wash.

Young, D. B., Geological Hall, Albany, N. Y.
Zimmer, J. F., U. S. Bureau of Entomology, Washington, D. C.

FOREIGN MEMBERS

Anderson, T. G., Department of Agriculture, Nairobi, British East Africa.
Ballou, H. A., Imperial Department of Agriculture, Barbadoes, West Indies.
Berlese, Dr. Antonio, Reale Stazione di Entomologia Agraria, Firenze, Italy.
Bordage, Edmond, Directeur de Musée, St. Denis, Reunion.
Carpenter, Dr. George H., Royal College of Science, Dublin, Ireland.
Cholodkosky, Prof. Dr. N., Militär-Medicinische Akademie, St. Petersburg, Russia.
Collinge, W. E., 55 Newhall Street, Birmingham, England.
Danysz, J., Laboratoire de Parasitologie, Bourse de Commerce, Paris, France.
DeBussy, L. P., Deli, Sumatra.
Enock, Fred, 42 Salisbury Road, Bexley, London, SE., England.
Escherisch, K., Forstschule, Tharandt, Germany.
French, Charles, Department of Agriculture, Melbourne, Australia.
Froggatt, W. W., Department of Agriculture, Sydney, New South Wales.
Fuller, Claude, Department of Agriculture, Pietermaritzburg, Natal, South Africa.
Gillanders, A. T., Alnwick, Northumberland, England.
Goding, F. W., Newcastle, New South Wales.
Grasby, W. C., 6 West Australian Chambers, Perth, West Australia.
Green, E. E., Royal Botanic Gardens, Peradeniya, Ceylon.
Grosvenor, G. H., University Museum, Oxford, England.
Helms, Richard, 136 George Street, North Sydney, New South Wales.
Herrera, A. L., Calle de Betlemitas, No. 8, Mexico City, Mexico.
Horvath, Dr. G., Musée Nationale Hongroise, Budapest, Hungary.
Jablonowski, Josef, Entomological Station, Budapest, Hungary.
Kourdumoff, N., Opytnoe Pole, Poltava, Russia.
Kulagin, Nikolai M., Landwirtschaftliches Institut, Petrooskoje, Moskow, Russia.
Kuwana, S. I., Imperial Agricultural Experiment Station, Nishigahara, Tokio, Japan.
Lampa, Prof. Sven, Statens Entomologiska, Anstalt, Stockholm, Sweden.
Lea, A. M., Department of Agriculture, Hobart, Tasmania.
Leonardi, Gustavo, R. Scuola di Agricoltura, Portici, Italy.
Lounsbury, Charles P., Department of Agriculture, Pretoria, Transvaal, South Africa.
Mally, C. W., Department of Agriculture, Grahamstown, Cape Colony, South Africa.
Marchal, Dr. Paul, 16 Rue Claude Bernard, Paris, France.
Mokshetsky, Sigismond, Musée d'Histoire Naturelle, Simferopol, Crimea, Russia.
Mussen, Charles T., Hawkesbury Agricultural College, Richmond. New South Wales.
Nawa, Yashushi, Entomological Laboratory, Kyomachi, Gifu, Japan.
Newstead, Robert, University School of Tropical Medicine, Liverpool, England.
Porchinski, Prof. A., Ministère de l'Agriculture, St. Petersburg, Russia.
Porter, Carlos E., Casilla 2352, Santiago, Chile.
Pospielow, Dr. Walremar, Station Entomologique, Rue de Boulevard, No. 9, Kiew, Russia.
Reed, Charles S., Mendoza, Argentine Republic, South America.
Reuter, Dr. Enzio, Agrikultur-Economiska Försöksamstalten, Helsingfors, Finland.
Ritzema Bos., Dr. J., Agricultural College, Wageningen, Netherlands.
Rosenfeld, A. H., Estacion Experimental Industrial Agricola, Tucuman, Argentina.
Sajo, Prof. Karl, Gödöllo-Veresegyhäz, Hungary.

Schoyen, Prof. W. M., Zoölogical Museum, Christiania, Norway.
Severin, Prof. G., Curator Natural History Museum, Brussels, Belgium.
Shipley, Prof. Arthur E., Christ's College, Cambridge, England.
Silvestri, Dr. F., R. Scuola Superiore di Agricoltura, Portici, Italy.
Tepper, J. G. O., Norwood, South Australia.
Theobald, Frederick V., Wye Court, Wye, Kent, England.
Thompson, Rev. Edward H., Franklin, Tasmania.
Tryon, H., Queensland Museum, Brisbane, Queensland, Australia.
Urich, F. W., Victoria Institute, Port of Spain, Trinidad, West Indies.
Vermorel, V., Station Viticole, Villefranche, Rhone, France.

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Vol. 5 FEBRUARY, 1912 No. 1

Proceedings of the Twenty-fourth Annual Meeting of the American Association of Economic Entomologists

The twenty-fourth annual meeting of the American Association of Economic Entomologists was held in the New National Museum, Washington, D. C., December 27–29, 1911.

The business proceedings follow in Part I, while the addresses, papers and discussions will be found in Part II of this report.

PART I, BUSINESS PROCEEDINGS

The meeting was called to order by President F. L. Washburn at 1.30 p. m., Wednesday, December 27, 1911. The attendance averaged one hundred and twenty members and visitors. The following members were present:

C. G. Babcock, College Park, Md.; E. A. Back, Blacksburg, Va.; E. D. Ball, Logan, Utah; Nathan Banks, Washington, D. C.; H. S. Barber, Washington, D. C.; G. M. Bentley, Knoxville, Tenn.; E. W. Berger, Gainesville, Fla.; F. E. Brooks, Washington, D. C.; A. F. Burgess, Melrose Highlands, Mass.; D. J. Caffrey, New Haven, Conn.; A. N. Caudell, Washington, D. C.; W. W. Chase, Atlanta, Ga.; F. H. Chittenden, Washington, D. C.; J. H. Comstock, Ithaca, N. Y.; A. F. Conradi, Clemson College, S. C.; R. A. Cooley, Bozeman, Mont.; E. N. Cory, College Park, Md.; J. C. Crawford, Washington, D. C.; C. R. Crosby, Ithaca, N. Y.; R. P. Currie, Washington, D. C.; R. A. Cushman, Washington, D. C.; H. G. Dyar, Washington, D. C.; E. B. Engle, Harrisburg, Pa.; E. P. Felt, Albany, N. Y.; H. T. Fernald, Amherst, Mass.; W. S. Fisher, Highspire, Pa.; S. A. Forbes, Urbana, Ill.; S. W. Foster, Washington, D. C.; A. B. Gahan, College Park, Md.; W. H. Goodwin, Wooster, Ohio; G. H. Grosvenor, Oxford, England; A. G. Hammar, Washington, D. C.; T. J. Headlee, Manhattan, Kansas; Otto Heidemann, Washington, D. C.; Glenn W. Herrick, Ithaca, N. Y.; P. H. Hertzog, Hightstown, N. J.; W. O. Hollister, Detroit, Mich.; W. A. Hooker, Washington, D. C.; A. D. Hopkins, Washington, D. C.; C. O. Houghton, Newark, Del.; J. S. Houser, Wooster, Ohio; L. O. Howard, Washington, D. C.; S. J. Hunter, Lawrence, Kansas; W. D. Hunter, Dallas, Texas; J. A. Hyslop, Washington, D. C.; J. F. Illingworth, Ithaca, N. Y.; A. H. Jennings, Dallas, Texas; O. A. Johannsen, Orono, Me.; Fred Johnson, Washington, D. C.; Cornelia F. Kephart, Durham, N. H.; W. V. King, Washington, D. C.; Frederick Knab, Washington, D. C.; J. Kotinsky, Morestown, N. J.; A. D. MacGillivray, Urbana, Ill.; B. P. Mann, Washington, D. C.; C. L. Marlatt, Washington, D. C.; W. R. McConnell, State College, Pa.; E. A. McGregor, Dallas, Texas; L. S. McLaine, Amherst, Mass.; C. S. Menagh, Washington, D. C.; E. W. Mendenhall, Columbus, Ohio; Z. P. Metcalf, Raleigh, N. C.; F. B. Milliken, Manhattan, Kansas; A. C. Morgan, Clarkesville, Tenn.; A. P. Morse, Wellesley, Mass.; J. A. Nelson, Washington, D. C.; Wilmon Newell, College Station, Texas; W. C. O'Kane, Durham, N. H.; Herbert Osborn, Columbus, Ohio; P. J. Parrott, Geneva, N. Y.; Edith M. Patch, Orono, Me.; L. M. Peairs, Morgantown, W. Va.; Theo. Pergande, Washington, D. C.; E. F. Phillips, Washington, D. C.; W. D. Pierce, Dallas, Texas; C. H. Popenoe, Washington, D. C.; W. J. Price, Jr., Blacksburg, Va.; A. L. Quaintance, Washington, D. C.; J. L. Randall, Pittsburg, Pa.; W. V. Reed, Atlanta, Ga.; W. S. Regan, Amherst, Mass.; D. M. Rogers, Boston, Mass.; W. E. Rumsey, Morgantown, W. Va.; G. A. Runner, Washington, D. C.; H. M. Russell, Washington, D. C.; J. G. Sanders, Madison, Wis.; E. D. Sanderson, Morgantown, W. Va.; H. L. Sanford, Washington, D. C.; E. R. Sasscer, Washington, D. C.; W. J. Schoene, Geneva, N. Y.; E. A. Schwarz, Washington, D. C.; W. M. Scott, Washington, D. C.; H. C. Severin, Brookings, S. D., Franklin Sherman, Jr., Raleigh, N. C.; F. L. Simanton, Washington, D. C.; Henry Skinner, Philadelphia, Pa.; R. I. Smith, Mayaguez, Porto Rico; T. E. Snyder, Washington, D. C.; Charles Spooner, St. Anthony Park, Minn.; J. M. Stedman, Washington, D. C.; H. E. Summers, Ames, Iowa; H. A. Surface, Harrisburg, Pa.; M. H. Swenk, Lincoln, Neb.; T. B. Symons, College Park, Md.; R. A. Vickery, Washington, D. C.; H. L. Viereck, Washington, D. C.; B. H. Walden, New Haven, Conn.; W. R. Walton, Washington, D. C.; F. L. Washburn, St. Anthony Park, Minn.; J. L. Webb, Washington, D. C.; F. M. Webster, Washington, D. C.; R. S. Woglum, Washington, D. C.; G. N. Wolcott, Dallas, Texas; H. P. Wood, Dallas, Texas; W. B. Wood, Washington, D. C.; E. L. Worsham, Atlanta, Ga.; L. H. Worthley, Boston, Mass.; W. W. Yothers, Orlando, Fla., and J. F. Zimmer, Washington, D. C.

A large number of visitors attended each of the sessions but it was impossible to secure an accurate list.

President F. L. Washburn: You will please come to order. We will now hear the report of the Secretary.

REPORT OF THE SECRETARY

At the time of the last annual meeting there were on the rolls of the Association 126 active, 138 associate and 48 foreign members. During the meeting 16 associate and 2 foreign members were elected and 8 associate members were advanced to active membership, and two associate members withdrew from the association. Since that time one active and two associate members have been dropped for non-payment of dues and one active and one foreign member have died. The present membership is now 132 active, 142* associate and 49 foreign, a net gain for the year of 11.

On November 5, 1910, Mr. E. C. Reed, Director of the Museum at Conception, Chile, who has for several years been a foreign member of this Association, died, but the news did not arrive in time for announcement at the last meeting. July 8, 1911,

* The announcement of the recent death of Mr. F. W. Terry, of Honolulu, Hawaii, was made at the meeting after this report was read. [Secy.]

Mr. D. W. Coquillett, one of the oldest active members, died at Atlantic City, N. J.

Arrangements have been made for sessions during the day and at times that would not interfere with the meetings of other closely related societies.

Financial Statement

Balance in Treasury December 24, 1910		$148.05
By amount received for dues, 1911		187.50
To stenographic report 1910 meeting	$50.00	
Stamps and stamped envelopes	18.12	
Printing	6.00	
Buttons, 1910	9.25	
Buttons, 1911	10.10	
Telegraph and express charges	2.20	
Clerical work, secretary's office	20.00	
Expenses of Committee on Legislation:		
Printing letterheads	4.00	
Printing circulars	16.00	
	$135.67	
Balance in treasury, December 23, 1911	199.88	
	$335.55	$335.55

Respectfully submitted,

A. F. Burgess,
Secretary.

President F. L. Washburn: You have heard the report of the Secretary. What is your pleasure?

J. L. Webb: I move the adoption of the report.

Secretary A. F. Burgess: I would suggest that the motion be modified so that the report can be referred to the Auditing Committee.

President F. L. Washburn: Those in favor say "Aye." Contrary, "No." It is referred. Next in order is the report of the Executive Committee which I will present.

REPORT OF THE EXECUTIVE COMMITTEE

The Executive Committee has had no meetings, because the members are widely separated, but we have conferred by mail and present for your approval, the amendment to the constitution as printed in the program.

With the approval of the committee I went to Columbus in November and interviewed the Committee on Station Organization and Policy there, and, as you may know, the Association of Agricultural Colleges and Experiment Stations passed very favorably upon our suggestion that the stations, as far as possible, pay the expenses of their men to the scientific meetings during the year, or, to at least, one meeting. Of course, this action is not binding on any Director or Board of Trustees, but it will help us, as it expresses the opinion of that organization. Since that meeting I have received letters from several Directors expressing sympathy with this movement.

I have a letter from Dr. True as to whether federal funds can be used to send delegates to any meeting except that of the Association of Agricultural Colleges and Experiment stations. I had heard that he had ruled that government funds could be used for that meeting and no other. Dr. True says that this is not so and that he had never made a ruling that money from that source could not be used for other meetings. He says, "The same rules apply to travel outside the state as inside the state, provided the travel is on station business." I think the outlook is rather favorable for men having their expenses paid occasionally to these meetings.

Voted that the report be accepted.

President F. L. Washburn: We will now hear the report of the Committee on Nomenclature by Herbert Osborn.

REPORT OF THE COMMITTEE ON NOMENCLATURE

Your committee on nomenclature would beg to report that during the present year no extended lists have been offered for approval, and we deem it best not to make any suggestions as to the adoption of another extended list at this meeting. The adoption of the preceding list, has brought the number of accepted names up to nearly 300 and it appears to the committee that the adoption of this number furnishes a very good basis for testing the general acceptance and utilization of the society names. So far as we have been able to determine, the names authorized by the society have in general been accepted by working entomologists, but there have been a number of cases where these recommendations seem to have been overlooked or neglected, sometimes with disadvantage to the uniform usage in entomological papers. The following names have been suggested by Mr. R. L. Webster, and are proposed for adoption at this time:

Potato flea-beetle	*Epitrix cucumeris* Harris.
Box elder aphid	*Chaitophorus negundinis* Thomas.

These are recommended by the committee and we would ask a vote upon them at this time. The committee has been asked to propose some fixed rules concerning the hyphenization of the common names of insects, and while we realize the desirability of uniformity in this matter, it seems to the committee that it is hardly possible to enforce any common usage in this matter and that it will be as well to adhere for the present simply to the adoption of the names and that for the hyphenization, authors should follow one of the standard dictionaries as perhaps the most convenient plan. Since the usage in dictionaries differs, this, of course, will not insure uniformity and the committee is not prepared to specify any one dictionary which it might consider preferable as a standard.

Herbert Osborn,
A. L. Quaintance,
Committee.

President F. L. Washburn: You have heard the report—what is your pleasure?

On motion, the report was accepted.

The report of the Committee on Testing Proprietary Insecticides will be presented by Mr. Sanderson.

E. D. Sanderson: Mr. President, I beg to say that it was my impression that this committee was not continued, but correspondence with the Secretary developed that it had been. We have had no meetings, and I would recommend that the committee be discharged. We have no further use for the committee, in view of the fact that the matter is now handled by the Bureau of Entomology and various other bureaus of the United States Department of Agriculture, co-operating. It seems to me that we might have a report upon the various proprietary insecticides in an informal way that might be serviceable to us and keep us posted as to the status of the various insecticides that are being pushed on the market. Of course, that information could not be given out for publication except through official channels.

PRESIDENT F. L. WASHBURN: You have heard Mr. Sanderson's remarks. Any opinion to be expressed on that report?

A. L. QUAINTANCE: Mr. President, I hardly think the committee should be discharged, at least for the reasons stated by Mr. Sanderson. I do not see how the Bureau of Entomology, acting under the Insecticide Act, could furnish the information that this committee attempted to obtain.

PRESIDENT F. L. WASHBURN: There seems to be some objection to the committee being discharged. Any other expression of opinion on that point? The chair rules the committee be continued.

Report of the Committee on Affiliation with Agricultural Organizations. Mr. Burgess will report for the committee.

SECRETARY A. F. BURGESS: Mr. Chairman, the Committee on Affiliation with Agricultural Organizations consists of Professor Bruner, Chairman, Doctor Hopkins and myself. I find that Professor Bruner will not be present and has not sent a report. Dr. Hopkins has handed me a letter from Dr. Allen, of the Office of Experiment Stations, who is Secretary of the Society for the Promotion of Agricultural Science, which has been largely interested in the proposed affiliation, and, inasmuch as the committee is not ready to make a report, it seems to me that the best thing that can be done will be to have the committee discharged and this letter of Dr. Allen's, with a proposal in regard to affiliation, turned over to a new committee, which can report at the closing session of this meeting. The letter from Dr. Allen states that at the Columbus meeting of the Association of Agricultural Colleges and Experiment Stations, five societies, the American Society of Agronomy, the American Society of Animal Nutrition, the American Farm Management Association, the Society for the Promotion of Agricultural Science and the Official Agricultural Chemists, expressed their approval for a plan of affiliation and were willing to federate under the terms which were proposed at the last meeting of this Association, and which were printed in the February number of the JOURNAL. I would suggest that the present committee be discharged, inasmuch as Professor Bruner is not here, and that the matter be turned over to a new committee, who can take this letter regarding the proposed plan and report at the last session of this meeting.

It was moved and carried, that such a committee be appointed by the Chair.

President F. L. Washburn: We will now listen to the report of the Committee on Legislation by Mr. Symons.

T. B. Symons: Mr. President and Members of the Association, I would like to say that I have not been able to see Professor Worsham, though I submitted a copy of my report to him, but have not received a reply. The other member of the committee, Dr. Smith, to whom I submitted part of the report, replied and agreed to the same, as follows:

REPORT OF COMMITTEE ON LEGISLATION

Mr. President and Members of the Association:

Your committee submits a report of progress together with a brief history of the legislation governing the importation of foreign nursery stock and other plants during the past year.

The activities of this committee began with the so-called Simmons bill of the last session of Congress. After elaborate hearings, in 1910, this bill was favorably reported from the committee on agriculture to the House (January, 1911). Owing to the conditions of this concluding session it was impossible to bring it up in its regular course and secure for it a full discussion. Under suspension of the rules it came up for a 20-minute consideration on nearly the closing day of the session, and the measure failed to secure the necessary two-thirds vote to pass it under suspension of the rules.

As a result of conferences with the legal and other officers of the Department of Agriculture and with several important leaders in Congress, an entirely new bill was drawn up by the Department of Agriculture and submitted to members of this committee and a number of State inspectors, entomologists and pathologists, and was approved by them. This new measure was introduced in both houses of Congress at the special session called by the President, and is the bill now before Congress. There is every reason to hope that it will become a law. It will be subject to amendment, and certain minor changes have already been suggested in the measure by the Department of Agriculture.

In the early spring, when it appeared that the bill would be brought up in the House, your committee had printed a statement setting forth the necessity for such legislation, for distribution to the agricultural press of the country, and also procured one thousand copies of a statement of facts regarding the history of such legislation, printed in the Journal of Economic Entomology, and one thousand copies of the favorable report of the Agricultural Committee. It was intended to send these articles together with the committee's statement to all organizations and parties whose influence would aid in securing the passage of the bill. On account of the substitution of an entirely new bill before the present Congress, this matter was not sent out.

Your committee has now sent out in place of this matter another statement together with a circular issued from the Office of the Secretary of Agriculture, giving a copy of the bill and explanation of its scope to all parties whom we thought would be interested in securing the legislation.

It is the belief of your committee that the present bill offers the least features which could possibly interfere with the proper conduct of any importing business, consistent with the desire for any protection at all. Your committee disclaims any antagonism on the part of its members to any legitimate interest and in fact has done its utmost during the past five years to bring about an amicable understanding among all parties concerning this legislation.

The present bill has already been indorsed by many national and state organizations, and it is hoped to have as many individuals write their congressmen regarding the bill as possible. We believe that the entomologists and horticultural inspectors of the country should unite in a vigorous attempt to secure this legislation, irrespective of what petty affiliations may demand. It is a time when our influence and prestige is at stake.

The time has come when each of us should exert every effort to arouse the public conscience in our respective states to the necessity of such legislation. Your committee recommends that a larger committee be appointed to take care of this important matter, so that the burden of the work can be distributed and a larger representation appear at any hearings that may be announced.

Your committee is indebted to the Bureau of Entomology and especially to Doctor C. L. Marlatt, who has active charge of the legislation for the Bureau, for much assistance in an endeavor to aid in promoting the measure to the present state.

Respectfully submitted,

Thomas B. Symons, *College Park, Md.*,
J. B. Smith, *New Brunswick, N. J.*,
E. L. Worsham, *Atlanta, Ga.*,
Committee on National Legislation of the American Association of Economic Entomologists.

T. B. Symons: I would like to say, Mr. President, that Mr. Marlatt is present and I feel sure that he would be pleased to give the Association the advantage of his views on the present status of affairs.

Mr. Marlatt: The history of the effort to secure a national quarantine and inspection law covering imported plants is familiar to most of you. A brief statement may, however, be made of the efforts in this direction of the last year,—efforts which again were unsuccessful, largely due to the opposition of the legislative committee of the national nurserymen's association.

The bill submitted to the last Congress was, as you know, a compromise measure, in which the wishes of nurserymen were acceded to wherever possible. At their instance, examination was provided for at the point of destination on the premises of the importer instead of at the port of entry, thus meeting the main objection which had been raised to the bill in its earlier stage. A number of other important changes were made at their instance, all, in fact, of moment except the elimination of the power of establishing when necessary foreign quarantine against particular plants to keep out diseases or insect pests which could not otherwise be excluded. This provision has merely to be stated to indicate its importance. It is aimed especially at such dangers as the potato wart disease and the white pine blister rust, which pathological experts assure us no inspection or disinfection would reach. It would seldom apply to the regular import trade in seedling nursery stock.

As thus amended, the bill was introduced during the concluding session of the last Congress and was favorably reported from the agricultural committee of the House, but owing to legislative conditions of this session of Congress, largely limiting the activities of this body to special subjects, it was not possible to have the plant bill brought up in the regular course and given adequate discussion. As a result of the continuous and strong effort near the close of the session, it was brought up ahead of its regular turn on the unanimous consent calendar, which, however, practically allowed no opportunity for debate or proper presentation of the urgency of the measure. Much of the few minutes available was occupied by the chief opponent of the measure, representing the views of the importing nurserymen, in a violent denunciation of the measure and the men who were promoting it, and when it came to a vote it failed to secure the necessary two-thirds support to pass it under the suspension of the rules. This result was evidently in no sense a test of the feeling of the House, and undoubtedly if the bill had been fully understood it would have received almost unanimous support.

At the special session of the present Congress brought together at the call of the president for a particular purpose, opportunity was not afforded to push this legislation. Nevertheless, the subject was again taken up with congressmen interested in the House and with the chairman of the senate committee on agriculture, who was also interested in pushing the bill; and at the suggestion of the latter, with Mr. Mann, the minority leader on the floor of the House. The result of various conferences led to the drawing up of an entirely new bill by the solicitor of the Department of Agriculture, in conference with the different bureaus interested and with several state officials who could be brought together easily and particularly from states perhaps most affected by import nursery trade.

During the extra session this bill was introduced in both the Senate and the House (S. 2870 and H. R. 12311). The chief point of divergence from the bill of last year is that inspection of imported nursery stock is to be left to the different states instead of being undertaken by the federal government. This change was made because, on investigation of the subject from a legal standpoint, it appeared that the federal authority did not extend to imported goods after they had once passed out of the hands of the common carrier and were on the premises and in the possession of the owner at point of destination. In other words, the federal government's authority only extended to the goods before they had been freed from customs or while in interstate transit. While it would perhaps be possible to accomplish the result in other ways, inasmuch as most of the states already had machinery for inspection, and in some of these the inspection was fully as efficient as it would be under federal control, it was deemed a better arrangement to leave the inspection entirely to the state authorities, the federal government standing ready to render such assistance as might be necessary or to act in an advisory capacity as at present. The bill, however, is strengthened by the provision for a complete system of notification, both by requiring a permit previous to importation and by subsequent advices to be furnished by the customs officers, the broker, or first receiver of the stock, and the common carrier transporting it. This will enable the Department of Agriculture to secure promptly or in advance full information concerning every bit of imported living plant material, and make it possible to transmit complete information to the officials in the different states. Any special foreign dangers which can not probably be controlled by inspection are still covered by the section providing for foreign quarantine. The features of domestic quarantine remain as before, providing a federal means of preventing the spread and stamping out if possible of points of infestation by new pests or diseases.

This bill is now before both houses of Congress, and in this long session there should be ample time for its full discussion, and presentation on its merits. The outlook for favorable action is therefore good.

T. B. Symons: Mr. President, I think we should have a very frank discussion of this matter, because, if there is one set of people that should agree on any matter, we entomologists should agree on the bill we want to get behind, and if you have objections to the bill it seems to me that now is the time to present them, so that the Association can get behind a bill that is agreeable, if this one is not desirable.

Secretary A. F. Burgess: Mr. President, it has occurred to me that, as this inspection matter is one with which the Horticultural Inspectors will have more to deal with than the entomologists, and, as the Horticultural Inspectors will hold a meeting Thursday evening and will probably discuss the matter, that it might be well for us to let our formal action on it go over until Friday morning, after the Horticultural Inspectors have had a chance to discuss the matter, and probably we would agree with their findings, and they could, perhaps, discuss it better and save time for us.

It was so moved and carried.

E. D. Sanderson: I move it be made a special order for Friday morning. Carried.

President F. L. Washburn: Report of the Committee on Entomological Investigations, by E. D. Sanderson.

REPORT OF THE COMMITTEE ON ENTOMOLOGICAL INVESTIGATIONS

To the American Association of Economic Entomologists:

Your committee on entomological investigations begs leave to report, as follows:

A preliminary report of the committee giving the entomological projects now being investigated by members of the association has been published in the December number of the Journal of Economic Entomology. Since that time several workers have furnished additional reports and their list of projects is appended herewith. Your committee sent out letters of inquiry to the heads of the departments of 48 institutions, 45 reports were received. Of these, 34 gave a statement of their projects; 6 replied, but either were carrying on no investigations or were unable to report; and 5 declined to report.

The 34 parties reporting had a total of 154 projects. Of these, 77 were investigations of the life history and means of control of certain insects; 31 involved merely means of control of insects; 10 were monographic studies; 10 were studies of groups of insects affecting certain crops; 9 were investigations of insecticides; 5 were studies of various phases of environment as affecting insect life; 4 were studies of parasites and parasitism; 3 were general biological studies; 2 investigations considered the relation of certain insects to disease; and 2 projects used insect material in the study of the principles of heredity. It is thus seen that half of the projects relate to individual insect pests, while about 15 per cent are broad investigations of fundamental problems of insect biology or control.

Of the 154 projects, report was made of 110 in regard to the funds from which they were supported. Of these 110 projects, 33 were supported by the Adams Fund, although at least half as many more supported by state funds were of a similar nature. In general, the experiment station entomologists have but one or two Adams Fund projects, in a few cases their entire time being devoted to this work, but one station reports four Adams Fund projects and another five. It seems to your committee that it is doubtful whether over two, or at most three, investigations, such as are contemplated under the Adams Act, can be properly carried on at a station under this fund, unless there be a large force of entomological workers.

Interest seems to have waned in the San José scale, as only three states reported upon it as against four of last year. Seven states are investigating the Woolly Aphis, namely: Arkansas, Illinois, Kansas, Georgia, Maryland, Ohio and Virginia. Seven states are investigating the Peach Tree Borer, namely: Tennesee, Arkansas, Texas, Mississippi, Missouri, Maryland and Canada, three of these investigations being under the Adams Fund. Seven workers in six states are investigating the Codling Moth, namely: Arizona, Colorado, Kansas, Utah, New York and Georgia.

The number of investigations of the Woolly Aphis and the Peach Tree Borer would seem to indicate a widespread interest in these two insects. Your committee is not prepared to say that it is not desirable that this work should be duplicated in all of these states. It would seem evident, however, that where several adjacent states are investigating the same insect that their conclusions must necessarily, if correct, be very similar and it would seem highly desirable that there be some co-operation, in outlining this work, in method of reporting it, and by way of conference concerning its progress. The committee would suggest that where it is found that so large a number of states are interested in a subject, that one or two of these topics be made the subject of a conference or discussion at our annual meeting.

Your committee endeavored to secure some data as to the relation of investigation work to teaching but was unable to secure sufficient information to warrant any conclusion. The reports do indicate, however, that in three states the amount of demonstration work being carried on has seriously handicapped research work; that this is not more generally true indicates the differentiation of extension and research work, which should be carried further wherever necessary.

Your committee finds that the large majority of our workers are now clearly outlining projects which they are investigating. In some departments the work does not seem to be organized under any system of projects; the investigations are of a broad nature and the resulting conclusions are secured from accumulative evidence. We are impressed with the fact that those departments which organize their work under definite projects, and confine their investigations to specific lines of work seem to be securing more definite results for the energy expended.

It is evident from the previous summary of the reports that about 90 per cent of our workers are more or less in sympathy with the idea which the work of this committee represents, namely, of acquainting each other with the work under way.

From the reports submitted it is evident that there is now but little practical co-operation between departments or institutions, in the prosecution of entomological research. Your committee believes that wherever different departments of the same institutions or workers in different institutions are working on similar or the same projects that it should be their first duty to try and co-operate with each other in every practicable manner.

But few of those reporting outline projects which they expect to undertake during the next calendar year. This may very possibly be due to the fact that the matter had not yet been decided upon. Your committee can appreciate that there are very good arguments both for and against the publication of proposed projects. They would appreciate instructions from the Association as to its wish in this matter, so that they may act accordingly in sending out the questions prior to another report. Only five persons of those replying declined to furnish the information. Some of these refusals came from some of our most effective and respected workers. Their communications to your committee should be regarded as confidential. Two of them give no definite reason for their refusal to report, except general objections to publicity. The other three have discussed the matter somewhat and their objections are the same, namely: that by making a public statement of the investigations they are carrying on that other workers who lack ideas of their own, will take up similar lines of work, and either forestall them or share the honors with them. In other words, as one of the correspondents expresses it, "Original thinkers must bear the burden of intellectual parasites." One correspondent cites an instance in which another worker took his idea from him, and with more time and money to prosecute the research, has been able to proceed further without giving the originator any recognition.

These objections furnish food for thought, and your committee does not wish to discuss them in detail. Were we working upon private foundations, as are some of our universities, these objections might be valid, though we are inclined to question their altruism even then, but it must be remembered that we are working under appropriations made by the national or state governments for the welfare of the general public. Because one individual sees a subject which needs investigation, and which he believes would be of value is no reason why another should not undertake it, if the interest of the public seems to demand it. Certainly we should all have due regard to professional courtesy, and should give proper credit to the source of our ideas, but when this is done the obligation is paid, if we feel that the investigation is for the interest of the public whom we are serving. If a subject is worthy of investigation there should be no reason but expediency why one or several workers should not take up the matter, whether it is or is not being prosecuted by the one who has announced it.

We should have such an understanding between ourselves as would make it decidedly uncomfortable for those who are guilty of this sort of "parasitism" and who do not give proper consideration to those to whom they are indebted.

Your committee feels that the general purposes for which it has been created has met with the approval of the membership of this association. We are also encouraged to believe that the general idea of furnishing each other with a statement of the lines of work being carried on is in the line of progress from the action of the directors of the Agricultural Experiment Stations at their recent meeting at Columbus. After some discussion by several of the leading experiment station directors, a motion was unanimously passed by the experiment station section of the American Association of Agricultural Colleges and Experiment Stations, directing the committee on Station Organization and Policy to consider and report at the next meeting how a statement of the projects being carried on by the various experiment stations may be published for their use, either by the office of experiment stations or otherwise. Those who advocate this movement support it with much the same line of reasoning which has been advanced by this committee, and took occasion to compliment the American Association of Economic Entomologists upon their enterprise in this matter.

Respectfully submitted,
E. D. Sanderson,
T. J. Headlee,
Franklin Sherman, Jr.,
Committee.

(Supplemental Report)

Crustacea

1. (A) Crayfish of Mississippi; a systematic and biologic study.
R. W. Harned and R. W. Lobdell, Agricultural College, Miss.

Acarina

2. Tick investigations in Montana with particular reference to *Dermacentor venustus*. (Coöperation with Bureau of Entomology and U. S. Biological Survey.)
R. A. Cooley, Mont. Agr. Exp. Sta., Bozeman, Mont.

Mallophaga

3. Poultry parasites. A study of the Mallophagan parasites of domestic fowls with methods of control.
G. W. Herrick, Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y.

Coleoptera

4. Elm leaf-beetle; means of control.
G. W. Herrick, Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y.
5. Alfalfa weevil. (Coöperation with Bureau of Entomology.)
E. G. Titus, Utah Agr. Exp. Station, Logan, Utah.

6. (A) Bean Leaf-beetle; life history, means of control.
R. W. Harned, Agricultural College, Miss.

7. (H) Boll weevil in Mississippi; a study of its habits, factors in natural control, spread, and means of control.
R. W. Harned, Agricultural College, Miss.

8. (H & S) Hickory Twig-girdler (*Oncideres cingulatus*); life history and control.
L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

9. Rose-chafer; means of control.
E. A. Back, Va. Agr. Exp. Sta., Blacksburg, Va.

10. (H & S) Striped cucumber beetle; control.
L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

11. (A) Sugar beet silphid (*Silpha bituberosa*); life history and control.
R. A. Cooley, Montana Agr. Exp. Sta., Bozeman, Mont.

Hemiptera

12. (H & S) Tarnished plant bug; life history, means of control.
L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

13. (H & S) Apple leaf-hopper; means of control.
L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

14. Woolly Aphis.
E. A. Back, Va. Agr. Exp. Sta.,Blacksburg, Va.

15. (A) Sugar beet root-louse (*Pemphigus betæ*); life history, and means of control.
R. A. Cooley, Mont. Agr. Exp. Sta., Bozeman, Mont.

16. (H & S) San José scale; general survey of status in Missouri and control work.
L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

17. (A) Oyster shell scale; study of control by insecticides.
R. A. Cooley, Mont. Agr. Exp. Sta., Bozeman, Mont.

18. (H & A) Scale Insects of Mississippi; survey of species; life history studies and means of control.
R. W. Harned and S. F. Blumenfeld, Agricultural College, Miss.

Lepidoptera

19. Fruit-tree leaf-roller; life history and control on apple.
G. W. Herrick, Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y.

20. Larch case-bearer; life history and means of control.
G. W. Herrick, Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y.

21. Codling moth; life history and control in Western N. Y.
R. W. Braucher, Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y.

22. Codling moth spraying experiments.
E. G. Titus, Utah Agr. Exp. Sta., Logan, Utah.

23. (A) Bud infesting insects of the apple.
A. L. Melander, Wash. Agr. Exp. Sta., Pullman, Wash.

24. (H & S) Peach tree borer; means of control. (Coöperation with department of horticulture.)
L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

25. (A) Peach tree borer; life history, means of control.
S. F. Blumenfeld, Agricultural College, Miss.

26. (A) Cutworms of Montana; life history and means of control.
R. A. Cooley, Mont. Agr. Exp. Sta., Bozeman, Mont.

27. (H & S) Evergreen bagworm (*Thyridopteryx ephemeræformis*); life history and means of control.

L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

28. (H & S) Spotted tentiform leaf-miner (*Ornix prunivorella* Cham.); life history, distribution and means of control.

L. Haseman, Mo. Agr. Exp. Sta., Columbia, Mo.

Diptera

29. Apple maggot; biology and methods of control.

J. W. Illingworth, Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y.

Thysanoptera

30. (S) Onion thrips and other truck crop insects; to determine best means of control. (Coöperation with department of plant pathology.)

J. G. Sanders, Wis. Agr. Exp. Sta., Madison, Wis.

General Subject

31. Sugar beet insects.

E. G. Titus, Utah Agr. Exp. Sta., Logan, Utah.

32. Cranberry insect investigations. (Coöperation with department of plant pathology of same station and U. S. Bureau of Entomology.)

J. G. Sanders and assistant, Wis. Agr. Exp. Sta., Madison, Wis.

33. (A) Pecan insects; a systematic and biologic study of pecan insects.

R. W. Harned, Agricultural College, Miss.

Incidental to Insect Control

34. Arsenical poisoning of fruit trees. (With coöperation of the director and the associate chemist.)

E. G. Titus, Utah Agr. Exp. Sta., Logan, Utah.

35. Spraying experiments in apple orchards. (Coöperation with departments of Botany and Demonstration Farms.)

A. L. Melander, Wash. Agr. Exp. Sta., Pullman, Wash.

36. Fumigation studies.

C. W. Woodworth, Cal. Agr. Exp. Sta., Berkeley, Cal.

President F. L. Washburn: Any remarks on this very thorough report of the committee? The chair is under the impression, with all due respect to the committee, that it is hardly within its province to criticise a station's work or its business management.

On motion the report was duly accepted.

Report of the Committee on Employment Bureau for Entomologists. The speaker is chairman of that committee, which consists of two other members, Messrs. Burgess and Osborn. The report is as follows:

REPORT OF THE COMMITTEE UPON THE FEASIBILITY OF HAVING AN EMPLOYMENT BUREAU FOR ENTOMOLOGISTS IN CHARGE OF THIS ASSOCIATION.

The committee believes that some such agency as suggested at our last meeting would be a desirable thing, and would prove useful for members of the Association as well as adding to the usefulness of the organization as a whole. The expense to members seeking positions would be far less than that at present paid to teachers' agencies. It has been suggested that some one duly appointed should have a book of registration in which any entomologist desiring employment or change of position should be entered, with his qualifications. From this register the information would be given to entomologists desiring to fill positions. A small fee would probably have to be charged to cover the cost of correspondence and clerical work. Whoever had charge of this work would necessarily be expected to regard communications from applicants as confidential.

Respectfully submitted,

F. L. Washburn,
Herbert Osborn,
A. F. Burgess.
Committee.

President F. L. Washburn: Any comments upon the report?

Wilmon Newell: Mr. President, I move that the report be adopted and that the President and Secretary of the Association be authorized to put its recommendations into effect. Carried.

President F. L. Washburn: I will now appoint the committees for the meeting.

Committee on Resolutions: P. J. Parrott, S. J. Hunter and W. C. O'Kane.

Committee on Memorial Resolutions: H. T. Fernald, T. B. Symons and T. J. Headlee.

Committee on Auditing: J. G. Sanders and A. L. Quaintance.

Committee on Affiliation with Agricultural Organizations: F. M. Webster, S. A. Forbes and W. C. O'Kane.

Committee on Nominations: E. P. Felt, E. L. Worsham and W. D. Hunter.

I will add one member to the Committee on Affiliation of the Horticultural Inspectors with this Association, namely, Mr. Burgess, and to the Membership Committee, Mr. Ball.

I have been asked to announce that the annual meeting of the Journal of Economic Entomology Publishing Company will be held at the New Ebbitt Hotel at 4.45 this afternoon. The annual address before the Entomological Society of America will be given by Prof. J. H. Comstock at the Cosmos Club at eight o'clock tonight. On Thursday night the annual meeting of the American Association of Horticultural Inspectors will be held at the New Willard Hotel and on Friday night the members of the Association will be the guests of the Entomological Society of Washington at a smoker at the Saengerbund Hall.

The next business will be action by the Association on the following amendment to the constitution as proposed by the Executive Committee: "That article 3 of the By-laws be amended so that section 1 will read as follows: 'The annual dues of active members shall be $2.00 and of associate members, $1.50, which shall be payable in advance, the same to include a subscription to the JOURNAL OF ECONOMIC ENTOMOLOGY. No dues shall be payable from foreign members but they shall be charged $1.50 for the JOURNAL if they desire it.' "

PRESIDENT F. L. WASHBURN: It is moved and seconded that the amendment be adopted as read. Any remarks.

H. E. SUMMERS: Mr. President, I believe for two years past I have made one remark that I wish to make again. It is that we are not showing honor to our honorary members, to our honorary foreign members, by charging dues for our proceedings. The foreign membership has been regarded as an honorary membership that has not been bestowed indiscriminately. We have, I know, had some applications from foreign entomologists to be admitted to that list, and they were refused on the ground that it was regarded distinctly as an honor, and it seems to me that not to give them the proceedings freely is a rather petty matter. Personally, I would rather join with a few members and pay for the proceedings than see this action by a national association, which it seems to me will make us look rather small in the minds of some of the foreign entomologists. I refer here, of course, only to a part of this total amendment, and, to bring this matter to a focus, I move to amend the motion by striking out the words "but they shall be charged $1.50 for the JOURNAL if they desire it."

E. D. SANDERSON: Mr. President, by striking out this matter, it will not change the status of the case. These men have been charged for the JOURNAL for the past four years. They are regular subscribers to it, practically all of them. If that is struck out, then this Association will have to pay for it, if I am not mistaken. I do not believe that the Publishing Company should furnish the JOURNAL free. It is not a good business proposition. If the Association were running the JOURNAL, it would be a different matter, and if we want to send these complimentary copies, this Association ought to pay for them. My own opinion would be that it would be all right to strike that phrase out, but, unless there is some other action by this Association, it would not change the case, as far as I can see.

PRESIDENT F. L. WASHBURN: The Secretary reminds me that it would make a difference of $75.00 in the annual income from the JOURNAL if that were taken off.

E. P. FELT: Mr. President, there is another phase to be considered, and that is that the JOURNAL in which our proceedings are published contains a great deal more than the proceedings of this Association, and I see no reason why the Association of Economic Entomologists should be under obligations to furnish this additional matter at least to our foreign members. I doubt very much if any one of them would resent it in the slightest if we adopt the amendment as originally proposed.

H. E. Summers: May I ask why this Association should put into its constitution a statement that they should be charged for the JOURNAL? If the decision as to whether these members should be charged for the JOURNAL depends on the Journal Publishing Company, then this Association has nothing to do with it and this phrase would seem out of place in our constitution.

SECRETARY A. F. BURGESS: The Journal Publishing Company has a contract with the Association that it will furnish to the active and associate members of the Association the JOURNAL for $1.00 a year, the regular subscription price being $2.00, and the Journal Publishing Company has furnished to foreign members of this Association the JOURNAL for $1.50 a year, on account of extra cost of mailing, and, as long as the dues were to be raised to the members of the Association, active and associate, $1.00 to cover subscription to the JOURNAL, the same arrangement was applied to foreign members. The foreign members pay for their Journal; the active and associate members pay for their JOURNAL.

H. E. SUMMERS: Mr. President, was that a contract with the Journal Publishing Company that they furnish the JOURNAL to the active and associate members of the Association, or is that incorporated in the constitution?

SECRETARY A. F. BURGESS: It has nothing to do with the Constitution of the Association of Economic Entomologists. It is a contract.

E. P. FELT: Mr. Chairman, I would move that the last sentence be amended, to read, beginning after "foreign members," "but such membership shall not entitle the holders thereof to receive the JOURNAL OF ECONOMIC ENTOMOLOGY gratis." Carried.

SECRETARY A. F. BURGESS: Mr. President, I have a letter here from the General Secretary of the Society for the Advancement of Education in the South. It was sent the second of December and as it was impossible to act upon it, I will read the letter now, since I wrote the Secretary I would bring it up at this meeting.

CHATTANOOGA, TENN., December 2, 1911.

MR. A. F. BURGESS, *Sec.*,
Bureau of Entomology,
WASHINGTON, D. C.

My dear Sir,

The Society for the Advancement of Education in the South extends a very cordial invitation to your organization for such of your members as live in the 16 Southern States to meet with our organization, arrange a program for themselves, and thereby increase the interest in your organization among such of your Southern members as usually do not attend your own meeting. Our organization meets on December 27, 28, and 29, 1911. Only at night does our Society meet in a body as all meetings in the daytime are Departmental meetings. Railroads have granted a special rate of one and a half fare for a round trip east of the Mississippi and south of the Ohio rivers. Every possible courtesy will be extended to your organization by way of making arrangements for the railroad and hotel accommodations, meeting halls, all of which is in the hands of the General Secretary of this organization.

Should the time be too short to arrange a program, and should the matter not yet have been considered by you, we hope you will bring it to the notice of the officials at your meeting so that action can be taken in this line when we will again extend the invitation to you in course of a few months to meet with us in another state in the South. You will note that a large number of your members living in the South never attend your meetings in the North.

We should very much like to hear from you at your earliest convenience regarding this matter. If you will give a meeting, we will be glad to announce it in our program which will go to the press December 12th.

Most respectfully,
H. E. Bierly,
General Secretary.

Secretary A. F. Burgess: This Society is one of which I know very little, and it seemed to me it would be very desirable for the Association at this time to appoint a committee of three members from the Southern States, and turn the matter over to them, and let them report at the last session as to whether they consider further action advisable. On motion, so referred.

President F. L. Washburn: I will appoint on that committee Wilmon Newell, E. L. Worsham and W. E. Rumsey.

Wilmon Newell: Mr. President, there is one resolution that I would like to offer before we adjourn. One of the oldest members of this Association and one who has been very faithful in attendance has been ill for several weeks at his home, and I think it is only proper that this Association should send him a telegram of condolence. I refer to Dr. John B. Smith, State Entomologist of New Jersey, and I move that the President and Secretary send such a telegram, assuring him of our sympathy. Carried.

At the morning session, Thursday, December 28, the President announced the recent death of Mr. F. W. Terry, Assistant Entomologist to the Hawaiian Sugar Planters' Experiment Station, at Honolulu, Hawaii, who was an associate member of the Association and referred the matter to the Committee on Memorial Resolutions for action.

He also called on Dr. E. P. Felt to make a statement concerning the Journal of Economic Entomology.

E. P. Felt: Mr. Chairman, with the permission of the Association, I would like to bring up a matter, in order that you may act upon it more intelligently later, in case you care to do so. All the members of the Association know that for the past four years we have had the JOURNAL OF ECONOMIC ENTOMOLOGY, which has been the official organ of this Association. The Journal Publishing Company has been responsible for the venture, and started it with the idea of demonstrating the feasibility of conducting such a publication. At a meeting last night, it was shown that our assets were in at least fair condition and that we have some property of considerable value in the way of earlier numbers. It was decided, by the stockholders, that it was advisable to put the JOURNAL upon a more thorough business basis. We are simply bound together now by Articles of Organization, and that more thorough business basis will take one of two forms,—either incorporation, with the idea of continuing the Journal Publishing Company as an independent organization, or else it will be taken in charge by the Association. We didn't go into this undertaking for the purpose of making money, and my idea in bringing it up at this time is this: If the Association of Economic Entomologists wants to take over the JOURNAL OF ECONOMIC ENTOMOLOGY I think I am well within my rights in saying that the stockholders will waive practically all their claims, all their investments of both time and money,—practically, though perhaps not absolutely,—and then, with the Association back of it, it ought to be even stronger than it has been, and is at the present time. My suggestion is that a committee of three representative men, preferably not stockholders in the Journal Company, be appointed, with power to confer with a similar committee representing the Journal of Economic Entomology Publishing Company, and see if we can arrange a basis which will be mutually satisfactory, and have a report from this committee tomorrow morning. Just to facilitate this matter, I would like to move, Mr. President, that a committee of three, preferably not stockholders in the Journal Company, be named from the floor, to take this matter up with the representatives of the Journal Company and report tomorrow morning.

The motion prevailed and the following members, not stockholders in the Publishing Company were nominated from the floor and elected: A. L. Quaintance, W. C. O'Kane and A. D. Hopkins.

At the afternoon session Thursday, December 28, several matters of business were transacted.

PRESIDENT F. L. WASHBURN: There is a matter of business to come up at this point. The committee nominated by your body to consider the advisability of the Association taking over the JOURNAL feels obliged to report at this time in order that they may consult a lawyer before tomorrow morning regarding the legal aspects of the case, and, therefore, I will call upon Mr. O'Kane to read the report of the committee's deliberations.

W. C. O'Kane: The reason why it is necessary that this committee should make this report now will be evident when you learn the recommendations of the committee. Your committee makes the following recommendations:

REPORT OF THE COMMITTEE ON THE POLICY OF TAKING OVER THE PUBLICATION OF THE JOURNAL OF ECONOMIC ENTOMOLOGY

Your committee makes the following recommendations:

1. That the liberal proposition of the Journal of Economic Entomology Publishing Company to transfer to the American Association of Economic Entomologists its publication and net assets be accepted.

2. That the publication of the Journal of Economic Entomology be entrusted to an Editor, and an Associate Editor and a Business Manager nominated by an Advisory Committee of six members which latter shall be elected by the Association, two members to serve three years, two members to serve two years and two members to serve one year, and that thereafter two members be elected annually for a term of three years.

3. That, recognizing the arduous duties of the Editor and the Business Manager and the great value of their services, the Editor be paid an honorarium of one hundred dollars annually, and the Business Manager an honorarium of one hundred dollars annually.

4. Since the Association must assume corporate form in order properly to conduct the business of the Journal, it is further recommended that the American Association of Economic Entomologists be now incorporated to succeed the American Association of Economic Entomologists, unincorporated, with the following Constitution and By-laws:

A. L. Quaintance,
A. D. Hopkins,
W. C. O'Kane,
Committee.

W. C. O'Kane: Your committee believes that if you choose to accept this plan, it would be wise to submit this constitution to a lawyer to-night in order that its phrasing may be examined to see whether any word here or there at least need be changed in order to make it conform to the proper legal phrasing. It, therefore, reports merely these four recommendations, without a recommendation as to the wording of the constitution, so that, if you decide to accept the report, the constitution may be submitted to him to-night and to you again tomorrow.

E. D. Sanderson: I would like to ask a question. Was the idea, that the dues should not include the subscription, to avoid the post-office difficulties?

W. C. O'Kane: The post-office authorities have ruled that a separation must be made. If we assume corporate form, a separation must be made of dues and subscription.

E. D. Sanderson: We could handle that by a club rate.

W. C. O'Kane: It still is permissible to have a sliding scale, as now exists.

E. D. Sanderson: We could handle that, Mr. President, I should think, by adopting the amendment suggested yesterday.

W. C. O'Kane: That plan was mentioned by the committee, but not included in the recommendations, because, in adopting the constitution for an incorporated association, if you choose to incorporate, the existing constitution can be used instead of the one with yesterday's amendment. In other words, there is no use in amending the constitution of the incorporation.

B. P. Mann: Mr. President, I have just had experience, within a few months, with a movement that lasted two years, of substituting a new corporation for an old one, and the decision was that, in starting a new corporation, you start a new organization. It is a new organization without any regard to its past history.

President F. L. Washburn: What is your pleasure, Gentlemen, with regard to this matter? It is a pretty serious step, of course.

E. D. Sanderson: Mr. President, to get it before the Association, I would move that we accept the report of the committee and instruct them to proceed and report for final action tomorrow. That is, we accept the spirit of the report without committing ourselves. Instruct them to go ahead and put it in proper legal shape, so we can take final action tomorrow.

A. L. Quaintance: I wish to point out that there is no necessity of having a lawyer pass on the form of a constitution unless we can secure favorable action from the Association.

President F. L. Washburn: The motion is made and seconded that the committee's report be accepted and that the committee continue its work until tomorrow, finding out the legal aspects of the case, and report for final action tomorrow morning.

President F. L. Washburn: Those in favor of the motion will say "Aye." Opposed, "No." Carried. The committee will report tomorrow morning, on the results of their further investigations.

The President and Secretary have prepared a telegram to be sent Dr. Smith by night-message, which reads as follows:

"Washington, D. C., December 28, 1911. Dr. J. B. Smith, New Brunswick, N. J. The American Association of Economic Entomologists, at its first session, unanimously voted to extend to you their sympathy in your sickness and to express their great regret at not having you with us at this meeting, and their hope that you will soon be able to again take up your work.

"(Signed) F. L. Washburn, *President.*
A. F. Burgess, *Secretary.*"

If I hear no criticism of that, I will infer that it is acceptable to you as worded.

The following business was transacted at the closing session, Friday morning, December 29.

President F. L. Washburn: We will call for the report of the Committee on Resolutions, by Mr. Parrott.

REPORT OF COMMITTEE ON RESOLUTIONS

Ladies and Gentlemen of the American Association of Economic Entomologists:—

Whereas,—The United States National Museum, the Entomological Society of Washington and the Cosmos Club have most generously furnished accommodations for the meetings of our Society, and have contributed in so many ways to the comfort and enjoyment of visiting entomologists, be it

Resolved, That the sincere thanks of the Association be extended to the proper authorities.

Whereas,—The suppression of the Gypsy Moth is the most serious tree-insect problem, which confronts the United States, be it

Resolved, That the State officials in the infested area, and the United States Government be urged to exert every effort to prevent the further spread of the pest, and to secure its control, and be it further

Resolved, That in view of the enormously large territory covered by this insect, the several States concerned and the United States Government be urged to render the financial aid necessary for the most efficient prosecution of the work.

Whereas,—The obituaries of members of this Association are invariably printed in at least one of the entomological journals of this country, and usually in several, and it would therefore seem unnecessary to duplicate them in a magazine devoted to the results of investigation where space even for this purpose is limited,

Resolved, That we recommend that the memorial resolutions hereafter take the form of a necrology only, and be prepared by the Secretary of the Association.

Respectfully submitted,

P. J. Parrott,
S. J. Hunter,
W. C. O'Kane,
Committee.

On motion, adopted.

Report of the Committee on Auditing.

Secretary A. F. Burgess: Mr. Chairman, I have the Report of the Committee on Auditing.

REPORT OF THE AUDITING COMMITTEE

Your auditing committee for the 24th annual meeting begs to report that it has carefully examined the accounts of your Secretary and has found them in satisfactory condition.

Respectfully submitted,

J. G. Sanders,
A. L. Quaintance,
Committee.

Adopted as read.

Report of the Committee on Memorial Resolutions, Professor Fernald, Chairman.

REPORT OF THE COMMITTEE ON MEMORIAL RESOLUTIONS

Mr. President and Gentleman of the Association of Economic Entomologists:

Your Committee on Memorial Resolutions herewith submits its report.

During the past year death has removed from membership in this body DANIEL W. COQUILLETT, CARLOS E. REED and F. W. TERRY. The first of these was for many years one of the most prominent of American entomologists; the second a pioneer in a region hitherto almost untouched; and the third a man whose work had already given promise of large results to follow.

This body desires to place on record its sense of the great loss which the death of these workers entails upon our science and our Association.

H. T. FERNALD,
T. J. HEADLEE,
J. B. SYMONS,
Committee.

On motion, the report was duly adopted.

Report of the Committee on Membership, Professor Osborn.

REPORT OF THE COMMITTEE ON MEMBERSHIP

Your committee on membership begs leave to report the following recommendations:

For foreign membership:

T. G. Anderson, Nairobi, British East Africa.
K. Escherisch, Forstschule, Tharandt, Dresden, Germany.
A. T. Gillanders, Alnwick, Northumberland, England.
G. H. Grosvenor, University Museum, Oxford, England.

For transfer from associate to foreign membership:

A. H. Rosenfeld, Estacion Experimental Agricola, Tucuman, Argentina.

For transfer from associate to active membership:

George A. Dean, Manhattan, Kansas.
R. W. Harned, Agricultural College, Miss.
W. B. Herms, Berkeley, Cal.
J. S. Houser, Wooster, Ohio.
A. H. Jennings, Dallas, Texas.
H. F. Wilson, Corvallis, Oregon.

For transfer from active to associate membership:

E. L. Dickerson, New Brunswick, N. J.

For associate membership:

Wm. Barnes, Decatur, Ill.
E. W. Berger, Gainesville, Fla.
A. C. Burrill, Madison, Wis.

D. J. Caffrey, New Haven, Conn.
P. G. Cardin, Santiago de las Vegas, Cuba.
A. B. Champlain, Harrisburg, Pa.
B. R. Coad, Dallas, Texas.
G. C. Crampton, Amherst, Mass.
Wm. Davidson, San José, Cal.
H. E. Ewing, Corvallis, Oregon.
Leonard Haseman, Columbia, Mo.
M. M. High, Brownsville, Texas.
W. O. Hollister, Detroit, Mich.
H. B. Hungerford, Lawrence, Kansas.
J. F. Illingworth, Ithaca, N. Y.
Cornelia F. Kephart, Durham, N. H.
W. V. King, Washington, D. C.
L. S. McLaine, Amherst, Mass.
A. L. Melander, Pullman, Wash.
C. S. Menagh, Washington, D. C.
E. W. Mendenhall, Columbus, Ohio.
F. B. Milliken, Manhattan, Kansas.
J. A. Nelson, Washington, D. C.
F. B. Paddock, College Station, Texas.
D. C. Parman, Dallas, Texas.
W. S. Regan, Amherst, Mass.
V. I. Safro, Corvallis, Oregon.
H. L. Sanford, Washington, D. C.
H. B. Scammell, St. Anthony Park, Minn.
H. C. Severin, Brookings, South Dakota.
F. L. Simanton, Washington, D. C.
George A. Smith, Boston, Mass.
Harrison E. Smith, Melrose Highlands, Mass.
M. T. Smulyan, Amherst, Mass.
M. P. Somes, Minneapolis, Minn.
A. J. Spangler, Lawrence, Kansas.
Warren Williamson, St. Anthony Park, Minn.
W. B. Wood, Washington, D. C.

The following members have withdrawn during the year:
C. F. Adams, E. F. Hitchings, A. H. McCray and J. W. Toumey.

Three active and four associate members are in arrears for dues for three years and it is recommended that the Secretary notify them of their delinquency and if the amount due is not paid within three months that they be dropped from the roll.

Respectfully submitted,

HERBERT OSBORN,
E. D. BALL,
E. P. FELT,
Committee.

PRESIDENT F. L. WASHBURN: It is moved and seconded that the Secretary cast a ballot electing the nominees to membership. Carried. The Secretary is instructed to cast a ballot in their favor.

President F. L. Washburn: We will hear the report on the relations to the Society for the Advancement of Education in the South.

REPORT OF SPECIAL COMMITTEE

To the Association of Economic Entomologists:

Your special committee appointed to consider the invitation of Mr. H. E. Bierly, General Secretary of the Society for Advancement of Education in the South, to meet in joint session with that society, begs to report as follows:

We find, on investigation, that the meeting of the Society named is now being held in Atlanta, Georgia, and a joint meeting at the present time is therefore impossible.

The Committee is of the opinion that joint meetings of the Society for Advancement of Education in the South and the American Association of Economic Entomologists would not be to advantage, owing to the marked difference in the nature of the work being done by these respective organizations.

Your Committee, however, fully recognizes the great importance of the work being done by the Society for Advancement of Education in the South, and recommends that our southern members, as individuals, affiliate with that Society wherever possible and practicable to do so.

Your Committee further recommends that the Secretary of our Association be requested to address to Mr. Bierly a letter of thanks for the invitation extended, together with a copy of this action.

Wilmon Newell,
E. L. Worsham,
W. E. Rumsey,
Committee.

On motion, the report was adopted.

President F. L. Washburn: We would like to hear the report, Mr. O'Kane, of the committee that was appointed to consider the taking over of the Journal by the Association.

W. C. O'Kane: Mr. President and Members of the Association, the committee had an informal talk with an attorney in Washington, who says that the existing constitution will adapt itself all right to the corporate form, if the Association decides to adopt the corporate form, so that this phase of it, as far as the committee can tell and after this hurried examination by the attorney, seems to be all right, and, therefore, the committee's report is rendered to you in the shape in which it was read yesterday. I shall read that again, if you wish.

The report given on page 20 was read and also the following changes to the constitution and the by-laws:

Article I, Section 2, add "(5) to publish the Journal of Economic Entomology;" Article III, Section 1, line five, substitute "the Board of Directors" for "an executive committee"; To article III, Section 1, add "Annual dues shall not include subscription to the Journal of Economic Entomology."

President F. L. Washburn: You have heard the report of the committee. What is your pleasure?

A Member: I move its adoption. Motion seconded.

Secretary A. F. Burgess: Mr. President, I would like to ask about one thing. If I understood the reading correctly, the Advisory Committee was to be of six members, two to be elected for three years, two for two years, and two for one year, and no further provision was made. It seems to me there ought to be a provision to this effect,—that thereafter two members should be elected for three years, so as to make the committee continuous. I didn't hear that in the report, and I think that clause ought to be added.

W. C. O'Kane: That was the intention. We were thinking more of the arrangement of the Board and Editors than of that particular detail.

Adopted by unanimous consent and added to the committee's report.

A. D. Hopkins: Mr. Chairman, there is another thing I think should be added with regard to the Executive Committee, the chairman of the Advisory Board should be a member of the Executive Committee.

W. C. O'Kane: The constitution doesn't specify standing committees.

A. D. Hopkins: Well, we can specify the chairman of a given committee to act on the Executive Committee.

Secretary A. F. Burgess: If I might suggest, the Executive Committee consists of the officers of the Association,—the President, two Vice-Presidents and the Secretary. Those four men are the Executive Committee. Now, if you make a member of your Advisory Committee, or chairman of your Advisory Committee a member of the Executive Committee or Board of Directors and he is going to continue for more than one year, it will be necessary to elect him President, a Vice-President, or the Secretary of the Association.

E. P. Felt: The Advisory Committee, as proposed in this report, is simply the Advisory Board of the Journal of Economic Entomology, under a new name, and it is supposed to give advice regarding the general policy of the Journal. It was continued to give stability and conservatism to the Journal of Economic Entomology, and the nomination of the officers of that Journal was put in the hands of this committee. I see no particular need of adding the name of the chairman of that to the Executive Committee, though I do not object. It strikes me that it is going to complicate matters without any very material gain.

A. D. Hopkins: I fail to see where there is any possible complication in adding to the Board of Directors. I wish to make a motion in this form, that "the above officers, together with the chairman of the Advisory Committee, shall constitute the Board of Directors," if we adopt this Board of Directors rather than Executive Committee. I think there is very little difference. I think an Executive Committee will legally be considered as having the same status as a Board of Directors. I merely present this as my opinion, as a desirable thing to do.

President F. L. Washburn: You move that as an amendment to the original motion, which was to adopt the report?

A. D. Hopkins: Yes.

President F. L. Washburn: Any second to that?

E. D. Sanderson: I will second that, to get it before the house. I would like to ask a question, and that is, are the duties of this Advisory Committee defined in any place in the constitution?

E. P. Felt: The duties of the Advisory Committee, I think, are defined in the report of the committee made to the Association. It states how they shall be elected, and that they shall nominate the officers of the Journal.

E. D. Sanderson: The Advisory Board has acted as such on general matters of policy and on matters of business policy, for instance, the consideration of advertising has been referred to that Board, and I think it highly desirable that we have a Board of this kind, and, without any criticism of the management of the Journal, which would hardly be in order, I do believe that we should have a Board who would take a little more active interest in the policy of the Journal, and I think we ought to continue the members of that Board from year to year, having one man as chairman, and having him, in addition to the Editor and the Business Manager, as a Director. I think that such a policy obtains in some other associations.

Herbert Osborn: I would like to suggest that Professor Sanderson may not know how much interest the committee has taken and how closely we have watched the things that appeared in the Journal, and how quick to detect if it were going astray. (Laughter.)

E. D. Sanderson: Mr. President, I haven't been in a position to judge of that, but I didn't mean that as a criticism of the Advisory Board at all, but merely that we do want the benefit of judicious criticism.

President F. L. Washburn: There is a motion before the house in the form of an amendment, which almost takes the form of a minority report, Dr. Hopkins, because I notice you were on the committee for which Mr. O'Kane reported.

A. D. Hopkins: Well, as I understood it, the motion had been made to adopt, and it is open for discussion.

President F. L. Washburn: The motion from your committee was to adopt the report of your committee.

A. D. Hopkins: I am presenting this, not as a member of the committee, but as a member of the Society.

President F. L. Washburn: The chair is a little bit in doubt as to the original wording of the constitution and what bearing Dr. Hopkins' amendment will have on that wording, but he is ready to present it to you, and we will now, if you please, vote on the amendment as given by Dr. Hopkins. Those in favor of the amendment will say "Aye." Those opposed, "No." The motion is lost. Now we will vote on the original motion, to accept the report of the committee as given. Those in favor will say "Aye." Opposed, "No." Carried.

Is the Committee on Nominations ready to report?

REPORT OF THE NOMINATING COMMITTEE

The nominating committee respectfully submits the following report:

For President, W. D. Hunter;

For First Vice-President, T. J. Headlee;

For Second Vice-President, R. A. Cooley;

For Secretary, A. F. Burgess;

For Councillors for the American Association for the Advancement of Science, H. E. Summer, E. D. Sanderson;

For members of the Advisory Committee of the Journal of Economic Entomology,

For three years, L. O. Howard and S. A. Forbes;

For two years, Wilmon Newell and C. P. Gillette;

For one year, H. T. Fernald and Herbert Osborn;

For Committee on Nomenclature, Herbert Osborn.

Signed,

E. P. Felt,

E. L. Worsham.

I approve except as to the nominee for president.

W. D. Hunter,

Committee.

President F. L. Washburn: You have heard the report of the Committee on Nominations.

T. B. Symons: I move the Secretary cast a ballot for the officers recommended by the committee. Carried.

President F. L. Washburn: Under the head of "Miscellaneous Business," you probably know, that the nurserymen and the horticultural inspectors have come to a most harmonious understanding, and that we are justified, all of us, in pushing the bill which has been framed and which we will present to Congress next year, with the few amendments read last evening at the meeting of the Horticultural Inspectors. Therefore, is it your pleasure, as a body, to officially endorse this bill already endorsed by the Horticultural Inspectors?

E. D. Sanderson: Mr. President, I take it that the Committee on Legislation has the same report to make that they had last night for the Horticultural Inspectors. I move the report be adopted and that the Secretary be instructed to forward to the President of the Senate, the Speaker of the House and the Chairman of the Agriculture Committees, the endorsement of this Association of the bill in its amended form, as recommended by the Committee.

The amendments agreed upon with the nurserymen in the meeting for the Horticultural Inspectors were outlined and the motion duly carried.

T. B. Symons: I would add that the committee recommends that the present committee be dismissed, and that a new committee be appointed, and that the same funds given last year be placed at its disposal the coming year. Motion seconded and carried.

The chair will be pleased to appoint three men from this body to represent us in matters of legislation here in Washington and elsewhere, to work in conjunction with the three members of the Horticultural Inspectors' Association, and I therefore appoint the following members of this committee: Mr. Sanderson, Dr. Forbes and Dr. Felt.

T. B. Symons: Mr. President, I would like to report, as chairman of the Committee on Affiliation of the Horticultural Inspectors, that the committee recommends that it be continued to consider this matter for another year. The report was adopted as presented and the committee continued.

W. C. O'Kane: Mr. President, one matter in connection with the incorporation of this Association. There are necessary legal papers to be drawn up and signed, and, therefore, I should like to make a motion that this part of the proceedings be entrusted to our Executive Committee, the Board of Directors, consisting of the President, the two Vice-Presidents and the Secretary. The motion was duly seconded and carried.

Herbert Osborn: I would like to ask if, under the election of officers, it is necessary to propose the Editor, Associate Editor and Business Manager of the Journal. These names have been suggested by the Advisory Committee, who is prepared to make the nominations. We nominate, for the Editor, Dr. E. P. Felt; Associate Editor, W. E. Britton, and Business Manager, A. F. Burgess.

President F. L. Washburn: You have heard the nominations by the committee.

President F. L. Washburn: It is moved and seconded that the President cast the ballot for the election of these gentlemen as officers of the Journal. Carried.

E. D. Ball: Mr. President, was the Report of the Committee on Affiliation with Agricultural Organizations read? We had a very fine meeting of the Societies at Columbus, and a number of them ratified that constitution.

President F. L. Washburn: There should have been a report but I understand that the committee desires further time.

E. D. Sanderson: Mr. President, I would like to call attention to two things. In the first place, the Committee on Entomological Investigations is a standing committee, and I think the intention was to have the men nominated the same as our other standing committees, in rotation, putting two new men on each year. If that is correct, there should be two men named by the nominating committee, and, personally, I would like to be relieved from duty on that committee. The other point is that I should like to suggest to the incoming President and Secretary that they go over our list of members and send a list to the Permanent Secretary of the American Association for the Advancement of Science of those members which should be made fellows. There will be a revision of the list of fellows at the next meeting, and all men who are professionally engaged, who have a professional standing in entomology, are entitled to be fellows, and it is the desire of the Council that they all be made fellows.

President F. L. Washburn: Ordinarily we have a motion that we hold our meeting at the same time and place as the meeting of the American Association for the Advancement of Science. Such a motion was carried.

R. A. Cooley: Mr. President, in an entirely informal way, and not to further encumber our records, it seems to me desirable that we, as an Association, have in mind the practicability or desirability of dividing the Association conservatively into sections. If the Horticultural Inspectors are affiliated with us at a later time, it would seem desirable to have a Section of Horticultural Inspectors. If the Apiary Inspectors' Association is affiliated, it would seem to be desirable to have such a Section. I think, though I have not worked out the details, that this may distinctly improve our programme, and I hope that the Committee on Affiliation will have this matter in mind in connection with their deliberations so that they may at least have convictions should this matter arise in the near future, as seems likely to be the case. It occurs to me that the Association of Economic Entomologists, in point of attendance and in point of interest, is a fair sample of almost any division of the American Association for the Advancement of Science. Several of these sections have divided programmes. There has been an increasing tendency to crowd our programme. The discussions following papers should be more deliberate,—in some cases more extended. I believe it might be well to have a standing committee on programme and that papers presented might be reviewed. This may have been previously discussed. It might be well to classify our programme, so that we will be following some natural and logical classification and, as individuals, attend one or another section, according as our interests lead us. I have nothing definite in mind and yet I feel certain that the tendency of affairs is in that direction and that, eventually, we will arrive at some such division of our programme,—a discussion of insecticides, perhaps, in one section, life histories in another, methods in another,—or some other such classification.

E. D. Sanderson: Mr. President, I want to heartily second what Professor Cooley has said. It seems to me that it is the line of natural evolution of this Association, as of the Botanical and Chemical Societies, and they are divided as he has said. The main objection to the several organizations, it seems to me, is that it makes an unnecessary amount of machinery and there is always a chance for conflict in arranging programmes, places of meeting, etc. With one general secretary of an organization looking after the sectional programmes, this would be easier to handle. Then there is another matter, and that is that we are getting in this organization a number of men who are not interested in entomological problems which appeal to many others. I know men who are engaged in shade tree work in our large cities, and others, like our Secretary here, who are working on the gypsy moth in New England, who are very little interested in the Hessian Fly in Kansas, for instance. Now, there is a large number of these city entomologists, we might say, who, if we had a section for that sort of work, might come into this Association, and who are not interested at present. I believe this is the natural line of evolution.

E. P. Felt: Mr. President, it seems to me that we could probably work out something of that kind, and I think the Secretary would be the party to handle it. That is, one man in one place receives all the titles. If he has to consult with one man 350 miles away and with another party on the Californian coast, it is pretty difficult, and I believe that, with just a little study on the proposition, our Secretary could devise a tentative plan for a sectional programme at our next meeting, and group the papers accordingly, and then the Association, at the beginning of the session, could vote on whether it would have a sectional programme or not. Begin the first session, perhaps, with general papers, and then possibly the next day divide along different lines, as determined by the subject matter available.

President F. L. Washburn: Of course, if they determined not to do that, you could not carry out the programme for that year.

E. D. Sanderson: I am not particularly in favor of a programme committee. I believe the Secretary is the man to handle that, but there is a point as regards organization. If these affiliations could be arranged, we would have, in some respects, to change our constitution, to provide for admission of certain classes of membership which we don't now, and that should be considered by this committee and put in definite shape so that we can have something tangible to discuss next year.

President F. L. Washburn: It looks to me as if we are coming to that, the abstracting of papers, or else have sections. We can't do justice to our programme.

I wish to thank the Secretary for his very kindly and generous services, with which we are all familiar.

E. D. Sanderson: Mr. President, in regard to the nomination of this Committee on Entomological Investigations, in view of the fact that the Nominating Committee haven't had time to consider it, I move that the incoming President name a committee of three on that subject, and that hereafter the Nominating Committee nominate one new member on this committee each year, the same as is done with other standing committees. I believe that three will do as well as five on this committee, and it will be uniform, then, with our other standing committees. Motion duly seconded and carried.

Wilmon Newell: Mr. President, I wish to move that this Association tender to the retiring President a hearty vote of thanks for his very efficient administration. Carried.

T. B. Symons: I move we adjourn. Carried.

PART II

President F. L. Washburn: I will ask First Vice-President Ball to take the chair.

Vice-President Ball: You will now have the pleasure of listening to the annual address of the President, Professor Washburn.

THE RELATIONS OF THE STATION ENTOMOLOGIST TO HIS ENVIRONMENT

F. L. Washburn, *Entomologist, State Experiment Station, University of Minnesota, Minneapolis.*

1. The Economic Entomologist and General Conditions Surrounding his Work:

At the very beginning it must be said that the Economic Entomologist occupies an anomalous position among professional workers. He is not a scientist in the strictest sense of the term, nor is he a systematist, and he certainly is not a farmer, whom it is his duty to serve, but, partaking somewhat of each of these classes, he is looked at askance by all three. Reviving certain ancient terms, we might say the "egg-slicers" of Johns Hopkins have no use for him, the "species makers" at Washington would hardly receive him with open arms, and the farmer, as you know, looks with suspicion upon anything not sufficiently connected with the soil to warrant his stamp of approval. We find the entomologist, then, a man "betwixt and between." His cousin, working on entomology in an institution not given over to economic questions, can choose the problem to which he feels especially called, while the station entomologist has to be ever ready to solve riddles, not of his own seeking always, but questions of all kinds which are thrust upon him, frequently quite unexpectedly, and in such numbers that they cannot be solved in a life time.

On the other hand, the work of the scientist is not, by any means, appreciated in the practical world of today among such a large class as is the work of that one who makes use of a few facts determined by the former, applying them in a way advantageous to the public.

The successful economic entomologist of today is essentially a practical man, keenly observant, with a knowledge of botany and general agriculture, a judge of human nature, a good mixer, a good speaker, and, perhaps we should add, a good politician, in the cleanest interpretation of the term. He is, withal, systematic in his work, a careful note taker, just and generous to his fellow workers.

Finally, these qualifications must rest upon a good foundation in the way of preparation for the work. He publishes what he thinks he knows, sometimes publishing too quickly, be it said, for he frequently has cause to change his views after his earlier conception has been frozen in cold type. He makes mistakes,—Heaven protect us from the man that does not! With all the printed matter on entomology coming to his desk, he may fall into the habit of skimming superficially over literature bearing upon his work, and may, and sometimes does, draw incorrect conclusions from his reading. The habit of hasty reading is happily overcome, however, by the use of subject index cards, with which we are all familiar.

Points upon which many entomologists (as well as other station workers, be it said) may be criticised are plagiarism, non-acknowledgment of facts or illustrations obtained from other entomologists, the taking away of records of experiments, and making use of same after leaving an institution; borrowing specimens for a period of ninety-nine years or more; deliberately attempting to obtain an offer from some other institution in order to make use of it in getting a raise of salary in the station in which he is already employed, and other misdeeds of a more or less glaring nature.

Perhaps one of the worst failings of the average entomologist is to accept without proof the statements or conclusions of his fellow workers, and errors are thus transmitted sometimes from one generation to another, until some one more thoughtful than his contemporaries or predecessors, by his own work discloses the error of a certain statement. Unfortunately there are among us few entomologists bold enough to publicly criticise their own publications, when they have discovered a mistake, though an early rectification might do a world of good. Duplication of work, then, would seem desirable both as a check, and to put an end to the transmission of erroneous statements.

We are all, I think, learning that it is unwise to make predictions as to insect injury. As you may remember, it was predicted that the Cotton Boll Weevil would never advance to the point it has reached, yet, in spite of this, and similar warnings, I am today repeatedly predicting in Minnesota that no grain aphis will, on account of our climate, which is practically as favorable to aphid parasites as to the aphids themselves, cause any serious injury in our fields.

The importance of constant watchfulness over our own work and our own words cannot be overestimated,—a mistake before the public is costly,—we lose the confidence of our constituents; as President Vincent of our own University has aptly said: "The discomfiture of the expert is joy to the average citizen!"

One great disadvantage we labor under lies in the fact that we do not hear all the criticism which may be given our work. We are applied to for relief, we give that relief to the best of our ability, and in eight cases out of ten that is the last we hear of it. Our constituent may have failed to get good results, either through his own negligence or carelessness, or through our not understanding all the conditions surrounding his problem. He may be heaping maledictions upon us in his own mind, of which maledictions we are profoundly unconscious. We work largely, be it said, under the ban of the "silence of the critical." It is a far cry from economic entomology to poetry, yet I am led to enlarge upon this by quoting a few lines from a poem by O. W. Firkins of the University of Minnesota, not yet published. This silence is like

> "The silent rise, the silent set of suns;
> The silence wherein blooms and fades the rose;
> The silence of illimitable snows;
> The soundless sap, the blood that noiseless runs;
> The silence of poised storm and brooding guns," etc.

I have believed in the past most thoroughly in the entomologist, and all scientists in fact, or men of any profession, having hobbies quite distinct from their work. I have believed, and still believe, that any man in a profession who has a lively interest in some recreative work or play brings so much more to his specialty, yet I see danger, as we advance toward middle life and beyond, and our ambition in our profession becomes possibly a little less keen, that one may give too much attention to a hobby, and too little to his specialty, in other words, the hobby and the specialty may change places. This is, most certainly, to be guarded against.

2. Relations of the Economic Entomologist to the Farmer:

We can perhaps all unite in saying: "God bless the insect!" It creates the entomologist, and makes for diversified farming; it turns wheat growers, corn growers, cotton growers and others into genuine farmers, and our relation to the latter is perhaps the most important of all, since it was to promote the cause of agriculture that our office was created.

It is a pleasure to note that while some years ago any professor was looked upon as unpractical, a bookworm, and a dreamer, the professor of today is a specialist, he is appealed to frequently by the public, and despite the criticism previously alluded to in this address, this fact, in connection with our work, is encouraging, and it is a pleasure to realize that it is appreciated.

The inducing farmers to accept results, however, and teaching them how to apply an effective remedy for certain destructive pests is a difficult and very important part of our work, more difficult, perhaps, than finding the remedy itself. It represents almost one half of the problem; this need of constant reiteration of methods which you may have published and spread broadcast in the past, feeling secure in the belief that every one knew and practiced them. We frequently awake to the realization that a large portion of our farmers are ignorant of the simplest truths published in the earlier part of our state work. I think we are frequently not explicit enough with farmers; they are suspicious of new remedies, slow to adopt them, and some still have the attitude of holding the professor's results in contempt. Here is where the work of the Agricultural Extension Division can be and is effective.

The value of a personal interview also cannot be overestimated; personal contact counts for much more than letters, which latter, even though carefully worded, are sometimes misleading, and may possibly convey an impression entirely at variance with the thought of the entomologist. This impression might be easily righted in a conversation with a farmer, or in a general talk before a body of farmers. Then, too, a trip to see a farmer, or a body of men interested in agriculture, is to them a compliment and a source of gratification. It cannot be denied that our constituents are hard to win over to our views. As a rule orchardists are progressive and glad to make use of the entomologist's results; or, is it that they realize a lower price is paid for fruit exhibiting any blemish caused by an insect? Many lumber men, possibly, are quick to take advantage of facts disclosed by our work, but we venture to say that not a very large proportion of the latter follow the scientific methods suggested by Hopkins, intended to control the devastations caused by various insects. Some market gardeners are alive to the value of modern methods; some invent good methods of control themselves, but the general farmer, as stated above, is hard to win over; it is with the younger generation, the coming farmers, that our work is the most effective. The importance of personal contact with the farmer is so great that if the chief himself cannot give time to it, we believe there should be at all times during the growing season, men in the field who represent the chief. These men should be carefully chosen. They should be efficient, honest, well grounded in their work, and last, but not least, mature, and good mixers. Do not send out boy assistants among your constituents.

Some farmers, particularly the foreign farmers, are suspicious and fatalistic, both of which qualifications are obstacles to our work. They are also sometimes suspicious of friendly overtures, or, on the other hand, expect the state to go to all the expense and trouble of freeing their fields of vermin.

Manifestly the same general axioms above cited, would apply to our relations with stock raisers, housekeepers, nurserymen and others, though the inspection of domestic and imported nursery stock plays such a prominent part in our work that it calls for and will receive, in this address, a chapter by itself.

3. The Relation of the Entomologist to the Director of the Station, to Other Administrative Officers, and to his Fellow Station Workers: While there is a marked difference of policy in administration in different stations, and while some of the younger institutions have had to go and are going through a period of political upheaval, very disastrous to good work, most of us, I assume, are fortunate in being associated with directors of broad views, honest in the treatment of their staff, and, in many instances, we find a bond of friendship often, which, far from being the cause of any partiality, goes a long way toward advancing harmonious and productive work. Due deference, of course, is to be paid the director and his position in his official capacity. He frequently acts as an advisor without dictating, or in any way hampering the projects of his entomologist.

Where the station is connected with the state university, as it is in many of our states, official communications from the entomologist to the president and board of regents should, and generally do, go through the director to the chief executive. The business relations, therefore, of the entomologist, are entirely with the former, and it is unwise, as some of the younger and more hasty, and a few of the older entomologists may have discovered, to attempt to go around the director. Any direct clash, or an appeal to higher authorities is apt to result disastrously. This is as it should be, even though the entomologist may have right on his side, for any other result, in nine cases out of ten, would be disastrous to the discipline of the institution. Happy the entomologist where the station staff, aware of the fact that each one is working for the common good, and not ambitious to advance his own reputation at the expense of community interests, meet in council where projects of various kinds are discussed in a friendly and harmonious way.

I believe, since the faculty of the college, or the working staff of the station, is the bone and sinew of the institution, that there should not be so great a discrepancy between the salary of the directors or deans and the members of the working force as prevails in some of our institutions. Something nearer an equal footing goes far toward promoting the best work.

It is to be deplored that, in comparison with other divisions, the division of entomology is frequently allowed but small financial assistance for its work, rather lowering its importance in the eyes of the public and other station departments. While horticulture, agriculture, animal husbandry, etc., get, as a rule, liberal appropriations, the entomological appropriations are apt to be out of all proportion to the important relation the work bears to these leading subjects.

It is unfortunate, too, and in a measure accounting for the condition just cited, that from the public viewpoint economic entomology is not conspicuously constructive. People see the gratifying results produced in agronomy, horticulture, animal husbandry, and agriculture, and usually regard entomological work as of minor importance, a side issue, possibly, a little of which, a very little, is necessary to secure best results in the other branches of agricultural work.

A source of annoyance to the entomologist of a station, where the funds of his division are controlled by the university authorities, is frequently found in the relations to the comptroller or purchasing agent of the university. The ruling that requires all supplies to be bought by the purchasing agent is a "penny wise and pound foolish" policy, where the custom prevails of this officer accepting the lowest bid for material for scientific work. This results, at times, in the institution obtaining what the entomologist or other worker cannot use, and is an actual money loss to the institution. I have known, in the past, of a purchasing agent sometimes changing one's order, through a mistaken sense of economy, the agent having apparently thought something else would do as well. The loss and disappointment caused in this way could be prevented if the professor in charge were allowed to order his goods directly. While these mistakes and vexatious delays are to be deplored, we should respect the necessity which demands that an institution should be businesslike, and expenditures kept within its income.

Loyalty toward an institution on the part of its employees is, of course, an absolute necessity, but we must not overlook the fact that loyalty on the part of an institution toward its employees is equally necessary. An entomologist employed by a station on a given salary to do a certain stipulated amount of work, should not be compelled to add to his work and responsibility without a perfect understanding and an agreement to that effect between the director of the station and himself. This principle is undoubtedly recognized by most directors. When an institution, through its executive head, has adopted the policy of saying to members of its working force (and it is to be regretted that there are such institutions): "Show us a larger offer from another institution, and we will consider raising your salary," a deliberate invitation is extended to a worker to treat with other institutions with this object in view. Under these trying and unsanctified conditions I believe an entomologist is justified in seeking relief. The policy smacks too much of business methods and too little of professional ethics and college courtesy.

Co-operation in some large problem upon the part of members of a station staff does much toward doing away with selfish aims and aspirations on the part of the individual. Where station workers intimately concerned with the work, take up the subject of corn, for example, or clover, or other crop, treating the problem in all its aspects, the force is working more as a unit, and we get more of a co-operative feeling than in any other way.

4. The Entomologist's Relations to his Employees:

Honesty, loyalty, ability and generosity are the prime requisites on the part of assistants in the entomological department; are they not also the requisites to be looked for in the chief entomologist in his relations to his employees? Should he not give all due acknowledgment to his assistants, if necessary erring a little on the side of generosity in this connection, to create good feeling and confidence?

The question of granting credit to assistants has been well and frequently discussed in this Association, and the concensus of opinion appears to be in favor of giving all credit for originality on the part of an assistant where he has done a piece of work in question entirely by himself, with little or no direction from the head. Even when such help has been given, some entomologists are altruistic enough to waive their claims in the work and give all credit to an assistant.

The general rule above mentioned, seemingly followed by all members, appears excellent, yet there are at times objections to the plan. Human nature is not always strong, and ambition on the part of an assistant to get credit for a piece of work is sometimes so great as to blind him to the advantage accruing from consultation. Some possibly will avoid consultation with the chief for that reason, and thereby the best results are not only not secured, but an entire season of work may be wasted. Frequently two heads are better than one in an entomological problem, and the assistant should be generous enough toward the work to admit that. One station worker known to me, chief of his division,—and there are probably others,—follows this method with seeming success; he will materially help an assistant in a project undertaken by the latter, yet allowing the assistant to have full credit. In return he expects his assistants to do the same in the projects that belong distinctly to him.

The young entomologist, for a few years, should be absorbent rather than exhalent. It would be well for him to follow the old adage to "say nothing and saw wood" for a while, and seek to bind his friends and employers to him with hooks of steel. One point, especially, he should bear in mind in connecting himself with an institution; namely, that all notes, records of work, photos, drawings, etc., made during working hours, are distinctly the property of the institution. This also applies to the notes (which must be something more than mental notes) of the chief of the division, and covers the case where a temporary assistant takes away with him a duplicate copy of a report of his work, which he may, or may not use in another institution, or in some method in no way connected with the institution employing him when the records were made.

While on the subject of employees, let me say we should, I believe, adopt the policy of spending more money on men of high efficiency, rather than on apparatus or publications. Able men in economic entomology are so rare that only the institutions financially fortunate, and following a generous policy can hold them.

5. The Relations of an Economic Entomologist to Students:

Not all entomologists teach; on the other hand some have more teaching, much more, than is compatible with research work, and again, we find a favored few with just enough teaching to vary their other work. I believe, other things being equal, that the earnest investigator makes the best instructor. A platform speaker, one who is constantly addressing the public, is rarely a good teacher, since he acquires a looseness of expression, and a certain superficiality of thought which affects his teaching relations with students.

It is evident that there is not enough teaching of economic entomology, at least (possibly because the subject is looked upon by the authorities as a side issue); it is not taken seriously enough in many of our institutions, to enable us to turn out enough sufficiently competent men each year to fill positions offering emoluments of from $1000 to $2500 yearly. I am speaking now largely from my own experience. Every year we have demands upon our institution in this line which we cannot comply with, and it is to be hoped that you will all use your influence where needed, to strengthen this hitherto weak point in economic entomology.

6. The Relations of an Economic Entomologist to Agricultural Extension:

Agricultural extension has, in some of our institutions, the rank of a division, on the same basis as other divisions, and it has for its duties the placing before farmers in a popular way the results obtained by other divisions, as well as taking charge of meetings, such as, in some states, Farmers' Institutes, and the like, the holding of short courses for farmers, demonstrations in the field, demonstrations at fairs, exhibits, etc. Such a division in the station, and Agricultural College is of great value, relieving other divisions of much of the routine work otherwise demanded of them. I am now speaking of the only one with which I am familiar, namely, the Agricultural Extension Division in the Agricultural Department of the University of Minnesota. In the case of this division its enormous mailing list enables it to get literature to a vast number of farmers; this literature consisting of extension bulletins, Farmers' Library and similar matter, as well as press sheets to state papers and the press at large.

The good accomplished by such work is great, though not always unmixed with disadvantages, for since the extension division staff is not made up altogether of specialists, and one man frequently has to talk upon a number of subjects in different fields, an entomologist is somewhat surprised, to say the least, at incorrect or half complete information in his line, emanating from such a division, and inasmuch as the entomological division gets blame or praise for anything in the insect line coming from the experiment station, I believe all questions relative to insects, received by the agricultural extension division should be referred to him, and that, in general, the work along different agricultural lines, as representing the different divisions, should be directed by the specialists on the station staff, whose work it concerns. This was, as stated above, evidently the original intention in establishing the division, and a plan which should be followed in any experiment station or agricultural college proposing this feature.

In November of the current year it was my privilege to hear President Butterfield discuss Agricultural Extension at the Columbus meeting. It seems that thirty-two states have agricultural extension in some form. It further appears to have been the idea of the committee that the extension division should be thoroughly co-operative when it is a part of an agricultural college, and that it should not act independently of other divisions. Technical subjects presented by the extension division should either be handled by station men directly engaged in such questions, or by extension men acting under the supervision of the station specialists. Otherwise we are apt to find the station men and agricultural college professors advancing ideas to students quite at variance with those promulgated over the state by the extension force. It would seem, then, that unless extension divisions feel the importance of this co-operation, and act accordingly, they fail in their purpose. It has further been suggested that not only should the extension division help the farmers along the lines indicated above, but that it is equally its duty to bring to the notice of station workers, agricultural conditions prevailing in different parts of the state which call for special attention.

7. The Relations of an Economic Entomologist to his Fellow Entomologists, and the Relations of this Association to the Public:

Surely these yearly meetings are of inestimable value, not only in affording each entomologist an opportunity to bring back to his state new views of advantage to the citizens of that state, but also as an encouragement and stimulus in the way of our ideals and aspirations, the mere being together as a unit adds to our self-respect, and the strength of our cause. Like the traditional bundle of sticks which the old man bade his sons get together, we present together an impregnable cohort, though singly, in our own bailiwicks, each one of us has frequently to bend to the storm, and has felt from time to time, perhaps, not unlike a bruised and broken reed.

Though having interests in common, each of us is confronted by conditions somewhat different from those of his fellows. Each of us takes on, if you please, the "color" of his locality, and since different localities call for different lines of work, when we think of a certain individual his special line of work is suggested by his name. Finley's word "ergocentric" applies here, by which he would designate the method of regarding an individual in the light of his occupation or job, and measuring his efficiency in ergons. We expect an entirely different class of papers from men of different sections of the country; the mention of one man's name suggests grain pests; another, insecticides; another, boll weevil; others fruit insects, etc. Since we used the word "color" above, let us carry the fanciful illustration farther, and say that each one of us may represent a colored patch in the make-up of Joseph's coat, but collectively, we represent a pretty good coat, and unlike the woven garment of Biblical times, we will add materially to our strength and beauty as time goes on.

I believe, if any criticism is to be made upon this Association as a body, it is that we have in the past lacked organization, and have not realized the value of co-operation. This lack is being overcome, and Sanderson's motion that we keep in touch with each other's work for the purpose of co-operation, was a movement in the right direction. Apropos of this motion, I note that Dr. Smith, as early as 1895, in his presidential address, mentioned our needs along this line.

The present year's request, in connection with what we may well call the Sanderson-Headlee list, appears to call for too elaborate information. Few of us are willing to take the time to send to headquarters all of the data asked for. In our opinion it is sufficient to name the problem, and let each man determine how much information he cares to make public, and how far he cares to go in co-operating and discussing methods with some other man who has a similar problem. It might be said in passing that this publication of our projects in no way conflicts with the rulings in the office of Experiment Stations as regards Adams Fund projects. Dr. True, in deference to wishes expressed or unexpressed, is not inclined to make public a list of Adams Fund projects, simply in order not to offend any one desiring to keep his project to himself, but he sees no possible objection to any entomologist so desiring, to make his Adams Fund project a matter of public information.

One word as regards our programme: That we should have more time has been our constant plea. I believe, further, that we would save time if the presidential address were made, and the first business session held in the evening.

I would suggest avoiding long technical papers with tables, all of which can be better read than listened to, and, I believe it has been decided to read by title only, except in symposia, those papers whose authors are not present. After all it is the personality of the man we seek and enjoy. We can read his paper if we wish to in our JOURNAL. We are fortunate in having this publication, and it certainly deserves the support of each and every one of us.

In looking over the list of projects of the present year, compiled by Chairman Headlee, I note activity along important lines, and believe (in spite of some minor criticism when the plan was suggested) that this work will do much to promote co-operation and progress. I have already given the report of the committee on the Entomological Employment Bureau. The need of some such action upon our part was shown at our last meeting, and has been apparent, I believe, for many years.

Regarding legislative matters, you all know the conditions under which we labor. I believe our legislative committee should be larger than at present—a committee of five or six can put up a bolder front before a Congressional committee than a committee of three, and it frequently happens that of the three only two can be at Washington at the proper time. A discussion of the so-called "Howard Bill" belongs more particularly to the Association of Horticultural Inspectors rather than to this Association, yet the Chair is ready and willing to put to vote any motion made along this line.

There is a bill pending before Congress, known as the Page Bill, which, I believe, materially affects us as station workers, and which appears to meet, according to utterances at the Columbus meeting, with decided objections upon the part of many station representatives. Under the provisions of this act a state would be given a large amount of money for extension work upon condition that the legislature appropriate an equal sum. Some states in which agricultural colleges are already very liberally provided for would benefit by this bill, but it would appear that, in states where the institutions are not so generously cared for, this bill, if it became a law, would work a hardship. It would be, in such states, very difficult for the station, and consequently, for the entomological department or division, to secure for general work a decent allowance of state funds, since it would result in such a drain upon the state treasury to meet the demands of the Page Bill conditions, that some of the agricultural colleges and experiment stations would get but little state money for departments other than the extension division. It would appear then, if we were to take any active part as a body, in federal legislation, that this is a matter for our careful consideration.

The executive committee has made a most determined effort to influence the directors of the various stations to pay the way of their entomologists to these annual meetings. Your President with the knowledge and approval of the other members of the Executive Committee, met the Committee of the American Association of Agricultural Colleges and Experiment Stations on Station Policy and Organization at the Columbus meeting in November. At their hands the project received generous consideration, and we can congratulate ourselves upon the fact that we have made a step forward toward the desired goal. The text of the resolution as passed by the Association is as follows:

"At the request of one of the societies, with which members of the Station's Staffs would naturally be associated, the question of members of the staff attending the meetings of the Scientific Societies was discussed. Your committee believes that the leading members of the Staff should, for their own sakes, so far as they are able, attend the sessions of at least one such Society annually. It also believes that the Station administration should be alive to the fact that there are frequently meetings and conventions which the best interests of the Stations demand that it be represented. In such cases, the proper official should be sent as the Station's representative and at its expense."

The details of the working out of this policy belong to administrative bodies in connection with each station, and, therefore, it is left to each station to arrange. In considering this matter the committee on station organization and policy took the ground, naturally, that this should apply to all divisions; that it should not be regarded for a moment as a charity on the part of the station toward one of its workers, but rather as an advantage to the station to have its men at the meetings, thereby helping it to keep in touch with the most modern methods. Of course, the Association of Agricultural Colleges and Experiment Stations cannot dictate to the boards of regents, or boards of trustees, but, I believe that directors as a whole are trying to look upon this matter favorably, and it is for you as entomologists to present your claims to your various stations, and to use your influence in this direction as far as possible, It might be wise, perhaps, to ask for a general traveling fund as a part of your budget, of such a size as to enable you to use some of it, when the proper time comes, to be present at these meetings.

While attending the above meeting I was struck with the value to the station entomologist of many of the papers and discussions, and I am quite of the opinion, an opinion shared by a number of the members of this association, that we would do well to affiliate with the American Association of Agricultural Colleges and Experiment Stations, not necessarily cutting off from the American Association for the Advancement of Science, but perhaps holding alternate meetings with each one of the aforesaid associations. An entomologist of the station is frequently brought into such intimate relations with the policy of administration of station affairs and agricultural college affairs that such an affiliation would seem to be most advantageous. Further, it is extremely probable that gradually associations and societies treating on subjects allied to ours will meet at the same time as the above named association, so that if our sessions were held prior, or after the sessions of the other societies, we would have an opportunity to attend the sessions of the societies referred to. I believe that under these conditions it would not be so difficult for station entomologists to have their traveling expenses to the meetings taken care of. I shall be very glad to leave this matter with you for your discussion and vote. Such affiliation may be considered from two standpoints; a personal standpoint, and the standpoint of the public. One worker has told me that he would prefer to be affiliated with the American Association for the Advancement of Science, because he gets more of a cultural uplift, as he expresses it, from association with the more technical and scientific workers. This thought may have occurred to others of us. On the other hand, the needs of our station work should be considered. How are these needs to be best supplied?

A few states, sad to relate, at least we know of one, have state laws making it impossible for a station to pay the way of any of its staff to meetings outside of the state. It is unfortunate and evidently arises from the thought on the part of the legislature that such trips are for pleasure, rather than for business. Entomologists should do all they can to convince farmers in the various states that these are not junketing trips. A director in a state so hampered would be acting along progressive lines if he sought to have such narrow-minded legislation repealed.

We are pleased to note the presence, as an active factor in our work, of the federal insecticide law, and to add that some of our states, Minnesota at least, have also state laws in no way conflicting with the federal law. These laws should serve to protect our farmers and orchardists from impositions.

Our relations to the Federal Bureau are so close that a word in passing may not be out of place. It is undoubtedly the policy of the Bureau, when sending its field workers into any state, either to co-operate with the station entomologist of such state, or have an understanding with him along this line. This is purely a matter of professional courtesy, and I believe such process is invariably followed by Dr. Howard.

It is a deplorable fact that the Department of Agriculture will not assist its men pecuniarily in attending these meetings, from which they would naturally reap so much profit. This results in a marked depletion in attendance of our meetings away from Washington.

I believe our method of electing officers is faulty and undemocratic. The appointing of a nominating committee of three by the president each year, who, in turn, select the president and vice-presidents for the following year, savors a little bit too much of a close corporation. I do not wish to be understood for a moment as intimating that our association has within it a political machine, far from it, and there may never come a time when we are guilty of such methods, yet we are growing, and, in years to come our numbers will be vastly increased. Therefore, to avoid any suspicion of nepotism in the future, I am going to suggest that we employ a different method of electing officers, in order that no available presidential timber, of which there is much in this association, be allowed to lie idle year after year. Whether such a change would take the place of a larger committee, or whether such a committee should be elected by members of the association rather than appointed by the chair, I leave to you to decide, supposing you care to make a change; I am merely advancing my own thought in regard to the matter.

8. The Relation of an Economic Entomologist to his Publications, Lectures, Bulletins, Correspondence, etc.:

The publications emanating from the office of an entomologist represent, undoubtedly, one of the most important features of his work. Consideration of the best time for publishing material, and the nature of the printed matter, the style of illustrations and other factors needed in order to accomplish the most good to those most concerned, should receive our most careful attention. In this connection the economic entomologist stands in rather a peculiar position. He needs, in the first place, to "make good" if I may use that expression, with his farmer constituents; at the same time his publications reach, or should reach, a class of men and women who call for something a little different in the subject matter than that demanded by the farmer, this class we may designate as the general public. Thirdly: he has his reputation to sustain among his fellow entomologists, and at the stations where they are located. Finally, our station entomologist is frequently state entomologist as well, and as such is dependent to some extent upon legislative support, and his publications have to be such as to place his work in a practical and otherwise favorable light before those to whom he looks for financial help.

Some years ago we listened to an admirable address by one of our older members, one whom we all respect and admire, in which, while criticising the tendency of some to make a display of themselves in print, he used the expression "beating the entomological drum," thus symbolizing the making of a great noise by an entomologist, and attracting attention thereby, although, as we know, there is nothing in a drum but air, and a superabundance of potential sound. The simile was good; at the same time the speaker referred to may have taken a too critical attitude toward the matter. As stated above, many entomologists are dependent, more or less, upon popular support. If they do not meet with that, their work, of necessity, stops. What more natural, and really praiseworthy thing than for them to realize that their work has to be thoroughly advertised over their respective states? They probably feel that they *have* to beat the "entomological drum," although it may not always be to their liking. We are prone, however, some of us, as mentioned elsewhere in this address, to rush into print without sufficient provocation, and it certainly behooves us to adopt some such watchword as "publish in haste and repent at leisure" to prevent many occurrences of vain regret and wounded pride.

I personally regard the illustrations accompanying our publications as also of extreme importance, believing we are all, both entomologists, and the public as well, children of a higher growth, and, as such, are attracted to pictures. I believe, if the farmer's eye is caught by a picture, he is more likely to read the subject matter connected therewith than if his attention were not so attracted. I believe it helps, also, to place, as far as possible, completely descriptive text under each photograph intended to instruct the farmers and general public. In my own work I use illustrations, photos, drawings and colored plates wherever I can, and, feeling as I do, would urge all entomologists, in asking for appropriations for their work, to endeavor to secure a generous amount which can be used for this purpose. Recall, if you please, the accurate and neat illustrations of Slingerland, the finished reports of Felt and others, and you will realize, I believe, how much such productions add to the reputation of the institutions they represent.

As to the comparative merits of photographs and drawings we all know there are some subjects which lend themselves only to photography, and of the others the entomologist with a little experience, can readily determine whether a photo or drawing is called for. There are those, but few in number, I believe, who claim the camera should be used in all cases because, as they say "the camera does not lie" and the artist's or entomologist's interpretations are not always the true ones, the personal element being too largely represented. As a matter of fact you can all think of instances innumerable where the camera cannot be depended upon to bring out structural details.

I believe that as a general thing our bulletins, treating of some destructive insect, should contain, first, a brief popular description of the insect and its work, using drawings and photographs generously, and secondly, following the above, remedial and preventive methods. All of this could well be in bold faced type, and should be arranged in a form attractive to the eye. Following this, which represents the essential points, of course, from the farmers' standpoint, may well come the account of the work in detail in ordinarily small type, using whatever illustrations are necessary and available, the more the better, if they are pertinent; the author remembering that fellow workers at other stations may profit by a lucid explanation of methods. Acknowledgment of the source of authorship of illustrations not original should be made under each drawing or photo, not merely referred to in a prefatory note.

Postal card bulletins are, in a way, most excellent, as are also bulletins which take the form of spraying calendars. These latter are much appreciated by orchardists, and others who like explicit directions in this line, concisely put. You doubtless all have your views upon these points, in many cases far better than those briefly alluded to by the speaker, and we need give no more time to this feature. At the Minnesota Station the entomologist publishes occasional bulletins in the regular station series, also press bulletins as occasion demands, as well as circulars, the latter issued as publications from the office of the state entomologist. The station entomologist, who is also state entomologist, publishes in the latter capacity, a biennial report to the governor of the state. He and his staff also issue from April to August inclusive a monthly publication known as *Minnesota Insect Life*, in order to place before Minnesota's farmers, gardeners and others, items of value in suggesting remedial measures at a time when most needed.

The subject of photography is one that has hardly been touched upon by members of this Association in the past. It appears to me that we might well have some co-operative work in this line by those of us who are interested, the aim of such work being directed toward the production of the best forms of illustrations, both photos and drawings, as well as cuts and colored plates.

9. The Relation of the Economic Entomologist to the Public Press:

There is no question but that we owe much to our daily and county papers. I know of no better way to get widespread information to the farmers of a certain district quickly, and to be sure of reaching all interested individuals, than by placing such information with the editors of our rural papers, and I have no doubt we all find editors willing and ready to help us in this particular. Personally, however, I have found, and probably my experience has been duplicated many times by those present, that the average reporter loves to make a good story, and he will frequently distort what you have to say to him personally, in order to have the information make a good showing in his paper. This practice prevails particularly in our city papers. These erroneous statements are copied largely from our daily papers by the county press, and in that way spread over the entire state, and to other states as well. You have probably all experienced the embarrassment of the results of a chance remark made in the hearing of a reporter. I might cite instances innumerable to illustrate this; one in particular occurs to me, coming to my notice recently in my own district.

One of our field men made the remark before a local reporter in the country, that a certain cricket had been observed eating the eggs of grasshoppers. The reporter at once printed the statement that the common black cricket was destroying grasshoppers, which statement not only circulated freely among the papers in various parts of the state, but I was amazed to receive from Kansas a clipping from a Denver, Colorado, newspaper, saying the state entomologist of Minnesota predicted that the black cricket was eating grasshoppers in such numbers that the pest would soon cease to be a cause of anxiety.

Again, too, apart from the errors of city reporters, which are numerous, and sometimes intentional, we find grotesque mistakes in our country papers. The confounding in Minnesota, for instance, of the Seventeen-year Locust, with true locusts or grasshoppers, has been the cause of laughable items in some of the papers. In August a Minnesota county paper came out in a paragraph with startling headlines, with the following declaration: "WITHIN THE PAST WEEK SEVERAL FARMERS HAVE SEEN THE GENUINE RED-LEGGED SEVENTEEN-YEAR OR ROCKY MOUNTAIN LOCUSTS FLYING HIGH IN THE AIR." Again another newspaper referred to "a visitation of the seventeen-year locust." The entomologist, in a desire to straighten out the matter, sent a letter, which he deemed fairly lucid, to the editor of the last named paper. In his next issue the editor treated the matter in this way, in big headlines, "No Fear of Grasshoppers. The editor is in receipt of the following letter, which ought to dispose of all predictions and rumors surrounding the pest mentioned." Then follows my letter, which simply referred to the Seventeen-year Locust.

What can we do to make the country papers and our daily press amenable? Personally, I can suggest no remedy, unless it be to give nothing to a reporter unless it is typewritten, and secure from him a promise that if he makes use of the news, it is to be given exactly as stated. Even then, the resulting article is sometimes surprising, to say the least.

The men in my office have been given strict instructions to give nothing to a reporter over the 'phone. We have tried giving such news repeatedly, only to be frequently embarrassed and dismayed at the result, We, therefore, reply to an inquiry over the 'phone by telling the reporter who calls us up, that we will be very glad to give him information if he will come to the office personally.

10. The Relation of the Economic Entomologist to his Fellow-Citizen:

There is a general feeling that a professor must stick to his books and express no opinion upon politics or civic questions of importance. It is to be hoped that no entomologist, wherever situated, will be content with an interest in his special field of work; society calls upon him to be a good citizen, as well as a good "bugman" and he should feel the responsibility of interesting himself in questions of vital interest, and in the social activities of his community, not only for altruistic reasons, but also because in doing so he rounds out his own character, and avoids the narrowness so often met with in specialists.

Our idea of personal service for the public good might well be enlarged to include our social obligations towards our fellow-townsmen, and not limited to the somewhat narrow confines of our specialty.

11. The Relation of the Entomologist to the State Legislature:

Many institutions forbid their employees to frequent the lobby of the legislature, and almost all would frown upon any member of the staff attempting to get an appropriation for any purpose whatever, which did not have the sanction of the Board of Regents. In our own institution the Board, previous to the meeting of the legislature, prepares a budget for presentation, the result of careful deliberation upon the part of the various faculties and the board. This is as it should be, for we must not forget in our ambition and interest in our own work, that the institution must be a unit, and that we frequently have to sacrifice what seems to be our right for the good of all. There are occasions, however, when an entomologist is privileged, and perhaps, obliged, to fight for a legislative appropriation. This is disagreeable to the highest degree, but seems to be, sometimes, almost a duty, if one has his work at heart.

12. The Relation of the Entomologist to Commercial Interests:

By commercial interests in this connection I refer particularly to those concerned in the manufacture of insecticides or spraying machinery. Manufacturers are quite prone to be overgenerous in donating to entomologists samples of some manufactured article, with a request that it be tested, and a report made upon the results of the test. In our department in Minnesota we avoid absolutely such a relationship, for it is very evident that a favorable report is expected, which will be used later on as an advertisement. Is not this experience practically the same in all stations?

The necessity of avoiding the advertising of anything in our state publications is too evident to be commented upon. In doing this an entomologist at once opens himself to criticism, as you know. It is sometimes, however, difficult to avoid publicly referring to some article which we have found to be, from our standpoint, the best there is for its advertised purpose. Individuals, of course, have to use their judgment as to what attitude they take in such cases.

Under this caption we might also discuss whether an entomologist is in duty bound to serve professionally all citizens and business interests by giving up a considerable amount of his time to any one party. I refer to requests on the part of business houses for treatment of their store rooms or mills or even private houses which are infested with an insect or insects. It would seem that, should he respond freely and without charge to every firm so calling upon him, he would be so crowded with work of a personal nature, and of benefit to only a few individuals, that his regular legitimate work, which is primarily along agricultural lines, would suffer. Here, again, each entomologist has to decide, from the conditions of his own environment, and the conditions surrounding individual cases, as to the position he takes in this connection.

13. The Relation of the Entomologist to the Inspection of Nursery and Foreign Stock:

Many of us have in our charge the inspection of nurseries, and to this inspection has recently been added the work of inspecting foreign stock imported into our various states. This varies in amount and in importance enormously in various localities, and I presume the nurseryman type is about the same wherever we find it, representing a wide-awake, aggressive body of men, as a rule willing to cheerfully abide by the laws, but frequently resenting any legal interference which seriously affects the pocketbook.

Many nurserymen are orchardists, and realizing that the sale of fruit depends largely upon its freedom from insect blemish, are ready to quickly adopt any method for preventing insect injury which the entomologists have found to be good. Of course, among nurserymen, as among all classes of men, we find the narrow minded, the selfish, the short-sighted, and the poorly educated. That we must expect, and fortunate is the entomologist who is tactful enough, and, at the same time, sincere enough to keep up harmonious relations between his office and all of his constituents in this line of work.

Turning to the subject of inspecting foreign stock, different inspectors would naturally have far different experiences to relate. The difficulty we experience in Minnesota is that so many boxes are examined without finding a single trace of injurious insect, that the importers look upon this inspection as needless and absurd, and frequently chafe at the restraint in the matter of unpacking, which is occasioned by our interpretation of the law. The Minnesota state inspection law makes it a misdemeanor to interfere with the state inspector in the discharge of his duties. This prevents the opening of foreign boxes by nurserymen or florists before the arrival of the inspector or his deputy. I speak, however, as a representative of the state where importation is not so great as in many of the states to the south and east of us. I believe that nurserymen generally are in favor of some uniform law or laws governing inspection in all states.

Conclusion:

The time has arrived and passed for closing this address, and mindful of a long series of "don'ts" for public speakers, which I have carefully studied, "Don't exceed your time limit, don't tell a long story, don't try to be funny, don't fatigue you audience, don't wander from your subject, don't apologize, don't be awkward," etc., I hasten to the end, for I fear I have heard for some time a murmur of impatience throughout the audience, in which I could distinguish these words:

> "And still he talked,
> And still the wonder grew
> That an Entomological President
> Should say so little new."

Nevertheless the speaker hopes that you have found something of interest and value in the address. Even if you have not, he feels that he has done his best, and therefore, makes his bow, retiring with an untroubled conscience, thanking our faithful secretary for his helpful services in connection with the programme of this meeting.

Before stopping, however, I must say a few things which are in my heart to say at this moment. We all join, I know, in the enjoyment of the good-fellowship evidenced on the occasion of these meetings, quite apart from the gain we experience in information as to new facts. And, after all, it is our attitude toward each other,—toward our fellowman, that really counts in the long run. Think of many of our present members! Look back into the past also and you will realize how much the personalities we have known meant for us. Let us, therefore, while retaining our high ideals of work and efficiency, entertain a warmth of regard toward each other, which will dull, in a measure, the keen edge of criticism; and let us seek to find the good in our fellowman rather than his weakness. May we not forget that good work, for its own sake, is the best incentive, and further that honesty and generosity are the corner stones underlying altruism. Above all else, remember that courtesy and cultivation, gentleness of manner and refinement of thought are in no way hostile to practical work, and that, although a man may have a high degree, if he has attained that purely by excellence in a special line of work, and has not obtained with it the breadth of culture for which that degree stands, he fails in reflecting the credit upon the institution granting the degree which he otherwise would.

Many of us were fortunate enough to enjoy, in our early training, the helpful association with teachers, not only of scholastic ability, but also markedly sympathetic, gifted with a largeness of mind and heart, which made them, and still makes many of them, a power for good amongst their students and in the community in which they reside. These rare and gifted men will not always be with us. Some of them we have already lost, and as time goes on all will have sooner or later, to retire from the field they have so ably filled. Manifestly it is the duty of all, and particularly the younger entomologists, to carry on that enthusiasm for work, that spirit of generous self-sacrifice which made association with their teachers so helpful and delightful. It is for each succeeding generation of entomologists to keep alive and pass on to their successors this holy fire, kindled by our illustrious predecessors.

VICE-PRESIDENT BALL: The constitution provides that the discussion of the President's address shall go over until the next session, so we will go on with the programme and the President will take the chair.

President F. L. Washburn: I note that the time asked for the members who have papers in no case exceeds fifteen minutes. I will, therefore, hold each member to the time which he requested, and which is stated on the programme.

The first paper is by W. C. O'Kane, on "Methods in Photographing Insects."

METHODS IN INSECT PHOTOGRAPHY

By W. C. O'Kane

The writer of this paper wishes to disavow at the outset any claim to expert knowledge of photography. The matter here presented is not offered in that light.

It is suggested, however, that as a group of workers in a specialized field, we have not brought photography to its highest point of possible service to our particular needs. Insect photography, whether to aid scientific study or for purposes of preparing illustrations, is not the same as pictorial or portrait photography. The questions of posing, lighting and details of process are capable of being answered in a particular way for our special purposes.

The writer believes that we may and should acquire a common fund of individual experiences in photographing insects, and that from these will naturally crystallize out a method of procedure that is the best and that will ultimately be of great value to all of us. This paper is offered, therefore, simply as the writer's individual experience, as a contribution toward the above.

Cameras. In our laboratory three cameras are in general use.

In photographing insects or their work at same size, or at enlargements of two or three diameters, or at similar reductions, an apparatus is used ordinarily cataloged as a "Copying and Enlarging Camera." This is a horizontal stand. The bed is eight feet long. At the front of the camera is a platform which is made to rise and fall by means of a long, continuous thread screw, operated by a hand wheel located at the rear of the stand convenient to the operator when focusing. The lens mounting is provided with a large prism which bends the light rays at a right angle. Thus an object is posed on a horizontal platform, but the operator works always at a convenient level, no matter what the bellows extension may be.

The second camera is used for photomicrographic work at enlargements of five to eighteen diameters, especially of small, opaque objects, such as flea beetles, and the like. The stand is home made. The bellows and plateholder were once part of a device for making lantern slides. On the platform rests an ordinary, compound microscope which happened in this case to be ancient and discarded. The photographic lens is carried at the lower end of the tube of the microscope. This tube was sawed off at the upper end so that the limits of its bore would not interfere with the diverging light rays coming from the lens. Connection is made between the microscope and the camera proper by means of a black cloth tube. The object to be photographed is placed on the stage of the microscope. The advantages of this arrangement are as follows: The mechanical and revolving stage with which the microscope is fitted permits of moving the object delicately and smoothly into the center of the field of vision. The focusing is done by moving the lens tube up and down with the ordinary focusing screw, thus avoiding disarranging or jarring the object. The bellows are previously extended to whatever point is desired in order to obtain the magnification wished for, the stand itself having been marked at the various points at which the plate-holder should rest to give certain magnifications. This method of getting the object into the field and into focus has been found rapid and satisfactory.

The third camera is a regulation 5 x 7 field outfit.

Lenses. With the large camera first described a set of Zeiss Protar lenses are used. There are three compound lenses, the focal depths of which are 13 3-4, 11 3-16 and 8 3-4 inches respectively. Any of these may be used singly, or any two may be used in combination. In the latter case the resulting lenses have much shorter focal depth. The single lenses are used for copying and moderate enlarging. The combination lenses are adapted to field work, where the object is comparatively remote from the lens. Nine times out of ten in photographing an insect or its work at same size or at enlargements of two or three diameters we use the 11 3-16 inch lens, and if one has a separate field camera fitted with its own lens, this size alone will serve all ordinary needs.

With the second camera we use a Bausch and Lomb Micro-Tessar, size 48 mm., made especially for this kind of work. The principal desideratum is a lens so constructed that it will have as much focal depth as possible; that is, one that will bring out sharply the nearest and the farthest parts of an object, even at considerable magnification, as for example the antennæ and the feet of a beetle. The ordinary lens will not do this: the regular objective of a microscope least of all. Furthermore, for successful work of this nature the lens must contain within its mounting a diaphragm, by means of which, after focusing, the aperture may be reduced and details brought out that would otherwise be lost.

Our field camera is fitted with a set of Turner-Reich lenses, sizes 18, 12 and 10 inch.

Lighting. All our photographing, except field work, is done by artificial light. The electric arc is doubtless the best all round illumination. It is used by photo-engravers, who are professionals and ought to know. We could not employ it because we have a very low-frequency alternating current. We substituted, therefore, a Nernst lamp of approximately 1000 candlepower, and have found it adaptable and entirely satisfactory. For work with the large camera this light is carried on a stand, four feet high, the top of which is hinged and can be fastened at any angle by means of a casement window adjuster. In front of the lamp is an ordinary three-inch reading glass, which picks up the rays and delivers them on the object in sufficient concentration. By moving the lamp toward the reading glass or away from it, the beam of light may be enlarged or diminished in diameter.

Nernst lamps of this type are provided with four glowers placed close together, which are automatically warmed to the point of conductivity by a heater behind them. We found that when the lamp was tipped forward, this heater soon burned out. Therefore we removed it entirely, and use a small alcohol lamp to warm up the glowers, an operation of half a minute. After the lamp is set going a tin cover is placed over it to shield the operator's eyes. A considerable advantage of the use of this lamp as described, with the simple reading glass to pick up and concentrate the rays, lies in the avoidance of excessive heat on the object being photographed. Some heat is carried through, but not enough to be of consequence. The stand was made by the station carpenter.

Both plain and concave mirrors are used near the object to offset shadows, and to bring strong beams of light to bear, so as to bring out essential parts, as for example to illuminate and make clear the sculpturing on the wings of a beetle. The manipulation of these mirrors is an important feature in obtaining a successful negative. The usual proceeding is to depend on the direct rays coming from the reading glass condenser for general illumination of the object and its background, and on one or two concave mirrors to soften undesirable shadows and accentuate high lights. Considerable experimenting in the placing of these mirrors is often necessary and always desirable. Surprising improvements are effected by slight changes in the direction from which light rays are thrown, or by varying the comparative intensity of two sources of light. Again, some objects will show undesirable reflections with one lighting, which may be eliminated with another. The larger concave mirrors are obtainable at drug or department stores, where they are sold as shaving mirrors. One of them is 4 1-2 inches in diameter; the other 6 3-4 inches. The smallest concave mirror used was taken from a compound microscope and attached to the end of a mounting designed to carry an ordinary small bulls-eye condenser.

When used with the photo-micrographic camera the Nernst lamp is mounted on a lower stand, so as to bring it better within the field of action. The general scheme of manipulation, however, is the same. Ordinarily, use is here made of the smallest concave mirror of short focus, giving an extremely concentrated beam of light, and often one of the larger mirrors in addition, to soften shadows.

This camera with the lighting arrangements slightly altered is used for photographing small, semi-translucent objects by transmitted instead of reflected light; such, for example, as aphids or thrips mounted on slides. In this case a ground glass is interposed between the lamp and the mirror beneath the microscope stage.

Posing the Object. When a picture is desired for purposes of illustration the writer believes in the plan of posing a given insect in as life-like a position as possible, wherever this can be managed. This is not with intention of deceiving the lay reader, but because such posing usually gives a better idea of the real appearance of the insect as it is found in nature. If the insect can be posed on a natural background without merging into the background so as to be obscure, so much the better. Thus, larvæ and adults of the potato beetle carefully posed on a half-eaten potato leaf convey a truer idea to the ordinary reader than does a single beetle standing in space with each leg extended with mathematical accuracy.

Often it is quite impossible to use such backgrounds. Plain white, solid black or a neutral gray may then be used. Oftenest a white background is best. To make the proper start toward this, we have made frequent use of a simple piece of plate glass fastened at one end to the top of a common dissecting stand in such way that most of the glass has nothing beneath it. On this glass is placed the object to be photographed, and beneath it a clear white paper or cardboard, far enough away if possible that the shadow of the object will not be included in the negative. If the object is small this may be done successfully. If it is large, it may not. Pinned butterflies and the like may be posed above the plate glass by glueing to the latter a tiny piece of cork into which the pin may be inserted.

For the photomicrographic camera a similar glass stand was made by setting four pins in the corners of a one by two inch block of wood, and cementing on the top of these slender posts a small piece of plate glass.

When it is necessary to photograph larvæ that have been preserved in alcohol, it will be found advantageous to add 10 or 15% of glycerine to the liquid some hours previously. This will retard evaporation of the preserving fluid from the larva and allow time enough to make a negative before the larva shrinks, which it will do rather too promptly, unless this precaution is taken.

Plates and Developer. In our experience it is nearly always desirable and often essential to use a dry plate adapted especially to catch color values: the kind of plate usually termed ortho- or isochromatic. Many insects have shades of yellows or reds that the ordinary plate will not catch at all, or at least but faintly: for example, the potato beetle, or the twelve-spotted cucumber beetle. With ordinary plates the spots in the latter will appear very dim, while with isochromatic plates they will assume their proper brightness and differentiation, although the lighting and all other conditions remain the same. Color screens we have not used, since the ortho plates have seemed to meet our needs in each case, with our method of lighting. They may be highly desirable. The plates that we have used include the Standard Orthonon, the Seed's Non-Halation Ortho, and the Cramer Isochromatic. Our preference inclines somewhat toward the last. Using this plate in medium speed emulsion, photographing at some size, with the Zeiss Protar 11 3-16 inch lens, stopped down to 64, and using our regular Nernst light with reinforcing rays from a concave mirror, the length of exposure is one to one and one-half minutes for an object of ordinary color value. The right exposure for the other magnifications may readily be estimated from this.

Preparation for Printing. Most negatives showing an object on a white background will make better prints if the background is "painted out." By this is meant covering the background as it appears in the negative with one of the prepared "opaques," sold for this purpose, leaving only the image of the object itself unpainted. The material is thinned somewhat with water and is applied with a fine brush directly to the film side of the dried negative. The finest and smallest size brush will be needed for working up close to the image, while a larger brush may be used for blocking in the remainder. A convenient retouching stand can be made by fastening a piece of glass about 12 x 16 inches square in a simple frame, and supporting this at a moderate incline, so that light will be admitted from beneath. A reading glass is of much assistance in tracing the outline of the object. A print from a negative that has been thus painted out will invariably be better and cleaner cut, even though the original background appeared fairly dense in the negative. Where extraneous objects show in the negative this process of elimination is doubly valuable.

Prints for Half-Tones. Most prints today that are not intended

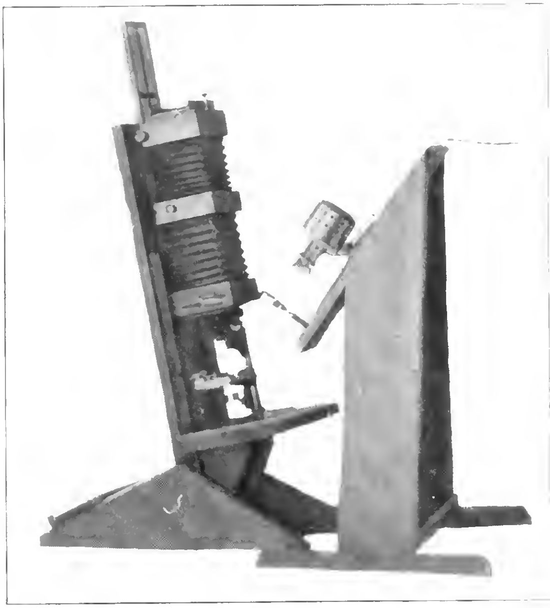


Fig. 1.

Fig. 2.

Fig. 1. Camera used for photomicrographic work.
Fig. 2. One-half of the background has been painted out with opaque; note the contrast.

especially for half-tone reproduction are made on a developing paper, such as Velox or Azo. Ever since these papers were first introduced the claim has been made that they are inferior for half-tone reproduction to the older process of printing-out papers, such as Solio. To test the matter, the writer selected a lot of negatives and made a duplicate set of prints, one set on Velox and one on Solio. These were submitted to the head photographer of a large engraving establishment, who was invited to select the print in each case that would make the best half-tone. In most cases the man declared that there was no reasonable preference. A few were decided in favor of the Solio, and some in favor of the Velox. The matter seemed to resolve itself thus. The developing papers have been improved since they were first devised until for many negatives they quite equal the printing-out papers. Their management is so easy and speedy that one does not hesitate to make additional prints from a given negative when the first one seems at all capable of any improvement, and thus a good set of prints is apt to be secured. The printing-out paper, on the other hand, will hold more detail in the very thin and the very dense portions of a negative than can be held with the developing paper.

Unless, however, the half-tone is to be of fine screen, and printed on good paper, the minute additional detail will likely be lost; and in that event the well-executed Velox print may give a better effect than the Solio.

In the case of any print showing an insect at magnifications of three or more diameters, the writer thoroughly believes in the scheme of making a small print showing the insect's natural size, and placing this adjacent to the enlargement. It conveys a better idea of the true appearance of the actual insect than any hair-line can do, and is vastly better than dependence on a legend beneath saying "greatly enlarged" or "x 5."

President F. L. Washburn: Any discussion on this paper?

W. H. Goodwin: As an introduction I will say that I have been experimenting with photomicrographic work for four years and have done considerable photographic work for almost fifteen years. I would like to add a few points to Mr. O'Kane's paper on photographing insects.

In photography, especially when using the ordinary plates, blue in every case photographs much lighter in color than it appears to the eye, while the reds in a photograph appear as black and much darker than one would expect. Isochromatic or preferably orthochromatic plates have dyes incorporated in the emulsion which make them less sensitive to the blues, and more sensitive to the other colors of the spectrum. They do not show more than half of their color value, however, until the ray filter of greenish yellow color is placed on the lens. It prevents many of the blue rays of light from reaching the orthochromatic plate and allows the other colors to be registered more nearly as they appear to the eye. Some stunts in photography may be performed by the selection and use of proper filters and plates; red can be photographed so it appears as white, blue as black, and green, yellow and brown may be readily differentiated.

By selecting the proper filter, the colors which ordinarily give no great amount of difference in monochrome on the ordinary plate become widely different in appearance when a spectrum or orthochromatic plate is used in place of the ordinary plate. There are a number of makes of color filters on the market: the most complete set, which is inexpensive, is made by The G. Cramer Dry Plate Company. With regard to photo dry plates I have finally settled on five or six different kinds of the Seed brand, because they give much clearer and snappier negatives than any of the many other makes I have used. Some of the others apparently give slightly better color differentiation but they also have faults which more than overbalance their good qualities. There are many things to be considered, especially little details which are ordinarily overlooked.

The difference in the distance of the plate and ground glass screen from the lens, often gives indistinct out-of-focus negatives; coarse ground-glass or lack of care in focusing; the use of large stops when small ones should be used; incorrect exposure; or overdeveloped negatives and many other things must all be considered. Extremely fast lenses often prove undesirable, because of their lack of depth of focus. Theoretically lenses of the same focal length, but of different speed, when stopped down to the same aperture, should have the same depth; but in practice the speed lens fails.

With regard to prisms for photographic use, I have been advised by expert engravers and lens makers, not to use a prism, because even in the best prisms, there is always a certain amount of aberration which cannot be eliminated and it often makes part of the image appear indistinct. This defect occurs in prisms costing as much as $1800, and in using the cheaper kinds, many slightly indistinct photographs are the result. When the plates vary considerably in thickness the same trouble will be experienced. The use of impure chemicals or solutions will also give the worker all kinds of trouble.

I use pyro for developing plates as it is a flexible developer which gives negatives with excellent detail, without any of the dense, harsh, contrasty effects which always attend the use of hydrochinon. Acetone sulphite may be used to advantage in place of potassium bromide with some makes of photographic plates, if one desires especially contrasty results without the loss of fairly good detail. If this is used with care the results obtained will be similar, although the temperature of the developing solutions may be varied considerably and any one who has ever developed photographic plates in warm weather will appreciate it as a preventive of chemical fog.

I have used a single arc light, with condensers, for illuminating subjects on dark days. It is one of the very best sources for artificial lighting when properly diffused and controlled. I find, too, that the ground glass on a micrograph camera, must be ground very fine and more luminous images are obtained if it is coated with a very thin film of vaseline on the ground side. The advantage of this becomes apparent when using the magnifier to assist in focusing.

Backgrounds are seldom satisfactory, and, after much experimenting with more than thirty different colors, or shades of colors, I found that neutral gray gave the best results in most cases. Black or white may be used under plate glass, but with black, undesirable reflections are often encountered in the negative. White or opal glass is often much superior to white paper for a background and does away with unpleasant shadows.

I would like to pass around for the inspection of Association members some illustrations of insects in natural colors: these photos are produced by a method entirely different from the usual one. I want you to observe the richness and the truthful rendition of the colors obtained by this process. This is the work of our Station Photographer Mr. William P. Beeching, Jr., and is a secret method, which he has not seen fit to divulge. I think he is wise in not doing so, especially as the process is not patented.

President F. L. Washburn: Any further remarks on this paper? The next paper on the programme is by S. J. Hunter, on "Pellagra and the Sand-Fly."

THE SAND-FLY AND PELLAGRA

(*Abstract*[1])

S. J. Hunter, *University of Kansas*

For more than two hundred years the etiology of the human disease, Pellagra, has been a subject of serious inquiry. Briefly, it may be said that the causation of Pellagra is purely conjectural. The

[1]The complete paper is in the Journal of American Medical Association, Feb. 24.

solution of this problem has at various times been proclaimed, but subsequent investigations have failed to furnish corroborative material.

Three theories have been advanced as to the cause of this disease:—the Zei-toxic theory based upon the work of Ballardini in 1845 giving corn poison due to the excessive use of corn products as the cause, supplanting the old theory of faulty metabolism; the cotton seed products poison theory of Mizell in 1911; and the sand-fly theory of Sambon, 1910. The first two rest on malnutrition, the last on the action of a parasite.

Our investigations began with the diagnosis of the first authentic case in Kansas and have had the co-operation of the attending physician, Dr. E. E. Liggett and Dean Crumbine of the School of Medicine and Secretary of the State Board of Health.

Eight cases have been found and in the vicinity of each, save one, the sand-fly was found to exist. The locality of the exception has not been surveyed. This patient, however, spent year before last in the south where sand-flies are abundant.

The lines of investigation which the writer determined to follow were transfusions on guinea-pigs and monkeys and transference of flies, exposed to Pellagrins, to monkeys and guinea-pigs. In the experiments with each exposed animal there was a check or an unexposed animal. The transfusions and inoculations gave no positive results. Temperatures of the guinea-pigs and monkeys were taken twice a day without showing any appreciable change.

The Sambon Theory is protozoal and from analogy with the etiology of malaria, the parasite of Pellagra in all probability would have to pass one stage in the body of its intermediate sand-fly host before it could resume its life in the human body. This hypothesis being true, transfusions obviously would be without results.

The only species found is *Simulium vittatum*. The patient used in the experimental work was a mother, thirty-five years of age, in the second season of the disease.

In all 1282 live sand-flies were used and this phase of the work extended from the 21st of August to the 4th of November. The plan was to divide the number of flies intended for each experiment into two lots, the one lot to be exposed to the Pellagrin and then to the subject of experimentation and the other exposed to the check.

Ten guinea-pigs and two monkeys were used and the temperatures of all were taken morning and evening daily. The number of live flies exposed to the Pellagrin and then to the monkeys was 197. A part of those exposed to the Pellagrin were reserved for fixation and sectional microscopic examination in the laboratory now during the winter period. Since the females, only, bite, the relative number of the sexes is important. In a count of 488 specimens 219 or 42 % were females.

Earlier in the season the flies did not seem to bite the patient but beginning with October 12th they attacked her, biting freely, drawing blood perceptibly from her arm. These flies were then divided, part placed in the fly proof cage with the male monkey; part with the guinea-pigs. Repetitions of the same experiment were made almost daily during the stated period.

On November 7th the male monkey became inactive, then flaccid and motionless save for a high rate of respiration at times. He grew no better, was finally chloroformed and autopsied, and his cellular pathology is now being studied.

It is our purpose to use a larger series of experiments dealing especially with *Rhesus* monkeys in greater numbers, in continued endeavor to ascertain the validity of the Sambon parasitic theory of Pellagra. When once the susceptibility of the animals under experimentation is determined, it would seem that evidence for or against the theory ought to accrue.

President F. L. Washburn: Any discussion of this paper? Mr. Hunter, you state that in the report of Sambon he credited *reptans* with being the cause of trouble in Europe, and you also state it is only reported from the northern part of North America. How, therefore, would you account, according to his theory, for cases in our Southern States?

S. J. Hunter: Mr. President, the other species, both biting, might carry it.

Miss Mitchell: Mr. President, in the first place, how do you account for the sporadic case which arises where no other pellagrin has been? Do the flies come from long distances?

S. J. Hunter: One of the theories is that they are very short flighted insects. In fact, one experimenter has shown that pellagrins are within so many feet of the water. He has gone so far as that.

Miss Mitchell: Then how do you account for cases in such cities as in Baltimore? Flies don't come in the city and bite. There are cases in Baltimore which originated there, and cases in New York city which originated there, and, so far as we know, the individuals have never been out of the city.

S. J. Hunter: Then that is a very strong point against the Sambon theory, because that is one of Sambon's tenets, that it never attacks city workers.

Miss Mitchell: Regarding the sand-fly occurrence in cities, I can remember a good many cases of sand-fly annoyance in this city, away from any apparent source where they might breed. There have been several notes published on that in the proceedings of the Entomological Society of Washington.

President F. L. Washburn: Do you have pellagra here in the city?

Miss Mitchell: There were no endemic cases. Three have been brought in from outside.

Adjournment.

(To be continued)

Proceedings of the Tenth Annual Meeting of the American Association of Official Horticultural Inspectors

The Tenth Annual Meeting of the American Association of Official Horticultural Inspectors was held at Washington, December 28th, 29th, 1911.

For convenience, the business transacted at the meeting will be reported first, which will be followed by the papers and discussions.

PART I

The first session was held in the Cabinet Room, New Willard Hotel, Thursday evening, December 28th. The meeting was called to order at 8 p. m., by President Franklin Sherman, Jr., with T. B. Symons, Secretary. Among the inspectors present were:

E. W. Mendenhall, Columbus, Ohio, H. A. Surface, Harrisburg, Pa., L. M. Peairs, Manhattan, Kansas, T. J. Headlee, Manhattan, Kansas, S. J. Hunter, University of Kansas, A. F. Conradi, Clemson College, S. C., E. Lee Worsham, Atlanta, Ga., F. L. Washburn, Minneapolis, Minn., J. G. Sanders, Madison, Wis., E. W. Berger, Gainesville, Fla., G. M. Bentley, Knoxville, Tenn., Z. P. Metcalf, Raleigh, N. C., W. C. O'Kane, New Hampshire, H. T. Fernald, Amherst, Mass., B. H. Walden, New Haven, Conn., W. E. Rumsey, Morgantown, W. Va., E. N. Cory, College Park, Md., O. G. Babcock, College Park, Md., J. B. S. Norton, College Park, Md., and T. B. Symons, College Park, Md.

The visitors present were:

A. C. Morgan, Bureau of Entomology, Washington, D. C., E. R. Sasscer, Bureau of Entomology, Washington, D. C., G. A. Runner, Bureau of Entomology, Washington, D. C., W. A. Hooker, Office Exp. Station, Washington, D. C., James F. Zimmer, Bureau of Entomology, Wash., D. C., A. P. Morse, Wellesley, Mass., W. B. Wood, Bureau of Entomology, Wash., D. C., D. J. Caffrey, New Haven, Conn., O. C. Bartlett, Amherst, Mass., W. S. Regan, Amherst, Mass., Leonard S. McLaine, Amherst, Mass., D. M. Rogers, Boston, Mass., L. H. Worthley, Boston, Mass., E. D. Ball, Logan, Utah, H. P. Wood, Dallas, Texas, W. S. Fisher, Harrisburg, Pa., H. B. Kirk, Harrisburg, Pa., William Firor, Athens, Ga., Fred E. Brooks, French Creek, W. Va., A. F. Burgess, Melrose Highlands, Mass., P. J. Parrott, Geneva, N. Y., F. C. Stewart, Geneva, N. Y., E. P. Felt, Albany, N. Y., E. D. Sanderson, W. Va., H. C. Severn, N. Dak., C. L. Marlatt, Dept. of Agriculture, Wash., D. C., Dr. Perley Spaulding, Dept. of Agriculture, Wash., D. C., Dr. Haven Metcalf, Dept. of Agriculture, Wash., D. C., J. H. Cox, Wash., D. C., M. J. Elrod, Missoula, Mont., E. Blakerlee, Wash., D. C., W. J. Price, Blacksburg, Va., W. Dwight Pierce, Bureau Entomology, Dallas, Texas, A. B. Gahan, College Park, Md.

The Secretary submitted his report showing the progress of the Association during the past year under the Constitution and By-Laws adopted at the last annual meeting. He reported that the inspectors of twenty-nine states had joined the Association. As Treasurer, he reported a balance of $16.27 in the treasury.

STATEMENT

T. B. Symons, in Account with American Association of Official H. Inspectors

By receipts from members		$73.00
March 2, To Hope Willis, stenographic report	$25.00	
March 2, To Thomas & Evans, programs last meeting	7.75	
April 5th, Public Printer, House reports	9.48	
Dec. 20th, W. H. Holliday, printing programs	2.50	
Printing separates U. S. Agr. Committee's report	9.50	
Bill for stamps	2.50	56.73
Balance for year		$16.27

The Report was accepted.

The Report of the Committee on National Legislation followed:—

REPORT OF COMMITTEE ON NATIONAL LEGISLATION

Mr. Chairman and Members of the Association:

Since the submission of the Report of this Committee citing a brief history of the effort to secure this legislature, and the present status of same before the Association of Economic Entomologists yesterday, your Committee has held several conferences with representatives of the National Nurseryman's and Western Nurseryman's Associations, and U. S. Department of Agriculture, and are now pleased to report an agreement by all parties on the Bill now before Congress, with the following amendments:—

1. That it be stated in the Bill that same be enforced by a Board of five members to be chosen by the Secretary of Agriculture from the Bureau of Entomology, Plant Industry and Legal Department.

2. That it be stated in Bill that a hearing be given parties interested before quarantine be established, and that the issuing of a permit be made mandatory after the rules and regulations are complied with.

3. That the word "general" be added before the word "nature" in line four, Sec. 3, of Secretary's circular, giving copy of law.

4. That the word "imported" be added after the word "any" in line five, Sec. 4, and the word "original" or its equivalent be added in same section before the word "case."

5. That "new to the United States" or its equivalent, referring to pests not generally established in the United States, be added after the word "insect," in line 3, Sec. 6.

6. That same addition as in No. 5, be added after the word "infestation," line 4, Sec. 7.

The understanding of the agreement was that the meaning of the above amendments be carried out in proper legal terms, a copy of new Bill with amendments to be submitted to all parties as soon as possible.

Your Committee recommends that this Association endorse the Bill as amended, and that individual members do all in their power to aid in securing its passage by the present Congress.

Respectfully submitted,

T. B. Symons,
E. L. Worsham,
E. D. Sanderson,
Committee.

It was moved and seconded that the Report of the Committee be accepted and endorsed by the Association.

The report of the Committee was adopted. (The bill as amended has been introduced as H. R. 18000.—Ed.)

President Sherman called upon representatives of the nurserymen present for a few remarks. They spoke as follows:

Mr. William Pitkin, Rochester, N. Y.

Mr. President and Gentlemen:

I appreciate the opportunity that you offer me in representing the nurserymen, to speak here to-night, although I do not know that I can say very much after the exhaustive report made by Mr. Symons, which I think very well covers the conference we had late this afternoon.

Personally, and as representing the nursery interests, I am very glad to be able to arrive at some basis that will be mutually satisfactory to all interests concerned in this matter. We have had no quarrel with the members of this Association, collectively or individually. We have had some little discussion back and forth between my friend Mr. Symons and myself and others,—but we have differed in our opinion,—and I believe an honest difference of opinion on both sides. I certainly credit him with an honest opinion and I hope he extends me the same credit. We have agreed, I think, pretty well all the way through and the principle of this matter is that the nurserymen desire protection and certainly have been as much interested and are directly benefited by protection more than any other branch of business or any other body that would be affected by this legislation. As stated, I am glad we have been able to get together and formulate some basis which would be satisfactory all around, and I hope that the proposition as presented by Mr. Symons will secure the approval of this Association, of the Department of Agriculture and of Congress, and I believe the other members of the Nurserymen's Committee who are not here will agree with those of us who are here, and have taken this action, and will feel that this Bill should be supported. Certainly those of us who are here will do all we can to secure the active support of the other members of the Committee, and to get this Bill through and this long disputed question settled and out of the way. I think that as far as I can see, that the Bill as outlined will afford protection to the general public, and the public is entitled to protection and should have it. I think it will be a basis under which the nurserymen can do business and do it safely, and without undue risk, and that is all that we want.

I think that the law can be administered so that it will not be any hardship to anyone, and that is all that we want, and I will be very glad to do all that I can to help along the good cause.

Mr. W. P. Stark, Louisiana, Mo.

Mr. Chairman and Gentlemen:

I want to say Amen to what Mr. Pitkin has said.

It makes me very happy to see you gentlemen all smiling and happy. We feel the same way. A year or so ago we were having a little scrap by the way with Professor Marlatt, but I think he is just as happy as any of the rest of us right now.

At the St. Louis Convention, in my recommendations there, I advised and worked for something of this kind, and I feel that your work and our work will be crowned with success, and I am very sanguine that this Bill, as mutually agreed upon, will soon be on the Statute Books, and I am sure that there is no class of men with whom you labor, who are in heartier sympathy with your work and appreciate it more than do we nurserymen. The fact is we could not get along without you.

I want to pledge my support personally and officially to co-operate with you gentlemen to get this Bill on the Statute Books, and I think it was you, Sir, who suggested that the man from Missouri could be a help. I am sure, Sir, that he will be a help. He is an ardent nurseryman and if you will pardon my personal pride, I want to say that in Missouri we expect to see him President. Thank you.

W. H. Wyman, North Abington, Mass.

Mr. President, and Gentlemen of the Association:

It gives me great pleasure to be here this evening and to look at your honest faces. I can say from my experience with the gentlemen of your Association, and there are quite a number of them here to-night, that I have come to respect very profoundly the honest efforts put forth by the gentlemen of your Association. I have been extremely interested in this work of securing national legislation along the lines suggested by the Bill, as brought to your attention to-night.

I have believed all the way along that when we got together and looked each other in the face, and got each other's ideas, we should not be far apart. Did you ever realize or stop to think that the great trouble with the races is very largely due to the fact that they do not understand each other? If we had one common language with the races, the wars would be practically no more. When we get together and understand each other's position, then we can arrive at conclusions, such as we have arrived at here this afternoon and this evening.

I feel very sanguine that the nurserymen of America will stand by this Bill and do everything in their power to support it and to secure its passage at the coming session. I cannot add any word to what has already been said.

I wish to add this word of appreciation of the work that is being done by the Department of Agriculture along many lines,—not only along the lines we are having to contend with in Massachusetts, but many others, and we want to sympathize with you in all your efforts and to thank you for what you are doing not only for the nurserymen, but behind the nurserymen, the great public, which we are always endeavoring to serve. First and foremost, we must think of the people at large, the general public, and in the law that is to be recommended to Congress by your body, I believe we are serving the interests of all.

It was moved and carried that a vote of thanks be extended the visiting nurserymen.

The Committee on Affiliation was continued and requested to submit a report at the next meeting. The members of this Committee are T. B. Symons, E. D. Sanderson and S. A. Forbes.

Upon motion by Mr. Headlee and seconded by Professor Surface, and carried, the President was authorized to appoint a Committee to consult with chiefs of the U. S. Bureau of Entomology and Plant Industry, and wait upon the Postmaster General, with a view of securing his co-operation in preventing miscellaneous plants and trees being carried through the U. S. Mail Service without due inspection and certification. President Headlee has appointed H. A. Surface, E. D. Sanderson and G. G. Atwood on this Committee.

REPORT OF AUDITING COMMITTEE

Mr. Chairman:

Your Committee reports that it has examined the books and vouchers of the Treasurer and found them correct.

(Signed) H. T. Fernald,
F. L. Washburn,
Committee.

REPORT OF COMMITTEE ON RESOLUTIONS

Mr. President and Gentlemen:

Your Committee on resolutions herewith presents its report.

(1.) Resolved that this association extends its thanks to the legislative committee for its efforts in urging the passage of an efficient national inspection law.

(2.) Resolved that this body hereby urges its members individually to work up sentiment in their respective States in favor of the speedy passage of the federal inspection bill just endorsed by this association, and by the representation of the national and western association of Nurserymen.

(3.) Resolved that it is the sense of this organization that every effort be made by inspectors to improve and perfect the inspection service in their respective States.

(4.) Resolved that this association hereby urges the practice of employing inspectors who are adequately trained in plant pathology as well as entomology, or in some other way securing the services of the plant pathologist for the inspection work.

(5.) Resolved that this society express its regret that among its most useful members, John B. Smith, is now too ill to attend its sessions, extend its sympathy to him in his affliction, and hope for his speedy and complete recovery.

(6.) Resolved that this body extend its thanks to its officers for the excellent program and arrangements, and to the Department of Agriculture and National Museum for use of facilities.

Respectfully,

T. J. Headlee,
J. G. Sanders,
E. L. Worsham,
Committee.

REPORT OF COMMITTEE ON NOMINATIONS

Mr. President and Members:

The Committee on Nominations submits the following report:

For President, Dr. T. J. Headlee of Kansas.
" Vice President, Prof. H. Garman of Kentucky.
" Secretary-Treasurer, Prof. T. B. Symons, College Park, Md.

For additional members of Executive Committee, Dr. J. B. Smith, G. G. Atwood, N. Y., and Prof. A. J. Cook, Cal.

Respectfully submitted,

H. A. Surface,
H. E. Summers,
S. A. Forbes,
Committee.

By motion the Secretary was authorized to cast the ballot for the election of the members nominated. The ballot was cast and the members nominated were elected.

The President announced the following names as members of the Legislative Committee:—

Mr. T. B. Symons, E. L. Worsham, H. A. Surface.

This concluded the business transacted at the meeting.

PART II

The Secretary was asked to take the chair, while the President delivered an address, as follows:—

PRESIDENT'S ADDRESS

Franklin Sherman, Jr., *Raleigh, N. C.*

At the last meeting of this Association, held in Minneapolis, you did me the honor (in my absence you will observe) to elect me as President of this Association for the present term,—and as such it falls to my lot to open this session with some remarks. But I cannot claim for these few rambling thoughts the dignity of a Presidential address. In our previous meetings the general matters of policy in our horticultural inspection work have been gone over time and again until I almost despair of bringing to your attention anything new or even interesting. I shall try not to see how many subjects I can suggest, but how few,—depending on the meeting itself to develop others.

Matters of importance will come before us in the reports of the Committee on National Legislation and the other standing Committees, and the discussion of the papers, and the Questions for Discussion should, as heretofore, be matters of keen interest.

There can be no doubt that one of the matters of chief interest and concern to most of us in the east at least, is the inspection of incoming stock from foreign countries for Gipsy and Brown-tail Moths. Yet, surely all of us have had the experience of making costly and inconvenient trips to make an inspection which was really quite useless. In this manner we spend much money and time that really gives no tangible return. How far should we go in these inspections? Should we inspect everything that comes to a nurseryman from abroad? In North Carolina bulbs, herbaceous plants and conifers are the classes of stock most frequently brought in and I must confess that to inspect these sometimes seems like a waste of time and funds. May we not decide among ourselves what is worth while to inspect and what not? Let us not forget, however, that if a state relaxes and should happen to be the first to become infested it would look bad, even if the infestation were in no wise due to the relaxation. The official who inspects *everything* can with more justice say that he has left no stone unturned.

To what extent need we concern ourselves about fraudulent practices among nurserymen? Is it, or is it not, our business to indicate the size of the nursery and the character of its stock? We all know of cases where a man with only a small area of poorly cultivated stock will advertise through the press or his agents that he has a larger nursery, and a larger quantity and better quality of stock than we are able to locate in our inspections. Is this our affair or not? I put this question impartially to the attorney of our State Department of Agriculture and he told me that our duties had nothing to do with it,—that our duty only concerned the condition of the stock as regards insects and diseases. I should like to know the practice in other states, and in those cases where the inspectors do concern themselves in matters of this kind it might be of interest to know whether the laws demand it, or whether this duty is voluntarily assumed. We cannot doubt that openness in this matter is in the interest of honesty, so there is no thought of criticism in this suggestion. If there is a real moral obligation resting on us to make these matters public we should at least know whether our laws require it or not. Is it the business of anybody else to guard the public in matters of this kind,—or is it a matter in which no one has a specific duty and which must be left to take care of itself?

I must admit that I feel that there is a tendency to make our inspection systems top-heavy with a multiplicity of laws, rules, regulations, etc. I fear that in our zeal to cover every conceivable point of weakness we are liable to fritter away our energies and time on details which are after all, not essential, and especially is this so when such a mass of routine detail is undertaken by those of us who have limited funds and limited assistance.

Is it well for us even to pretend to guarantee that the purchaser shall receive trees that are wholly free from scale, crown gall, etc.?

The nearer we can come to it the better, and the purchaser who pays a first-class price is justly entitled to receive trees which are not infested,—but when our certificates so explicitly state that "no evidence of San José Scale, etc., is found," is not the customer (if he really gives any attention to the certificate at all) led to believe that the state has guaranteed this stock, and that he need not worry about these trees? Is it entirely best either for ourselves or our fruit-growers, to encourage them in the belief that "this nursery has been examined and there is no scale or other trouble in it, therefore this young orchard which I am setting out is making a clean start?"

Even though we adhere to the old system of certificates (and I am not sure that there is any better) we should certainly hammer it into the minds of our constituents that our systems are not perfect, and let them know that it is their business to watch the trees carefully after they are put out,—that no system of state inspection can take the place of watchfulness on their part, and that no matter what help the state may give or try to give, it is self-help upon which each should be prepared to rely.

But our Association is not concerned merely with the inspection of young stock in nurseries—the work of inspecting growing or bearing trees in the orchard also claims our attention, and as we are all pretty well settled in our habits or determined in our minds regarding the inspection of *nurseries*, I think that we might profitably discuss in some detail the methods and results of *orchard* inspections. Here, as in nursery inspection, we shall find the *extent* of work varying with the amount of money and force of inspectors available, but if we can compare the methods followed, the pests sought for, the methods of following up the inspections by advice, letters, etc., we can surely reap great benefit.

Surely we are all glad to see the variety of papers on the present programme, and especially those which will instruct us regarding some of the recently introduced pests or ones liable to be introduced into the United States or Canada. And let me hasten to say that this good programme is not in any degree attributable to your President—I think that our active and efficient Secretary must be the one responsible for this treat.

The appearance of these papers on recent introductions or pests liable to be introduced suggests this thought: would it be in order for us to request or suggest that the U. S. Department of Agriculture prepare a Bulletin in which all these new or threatening pests (whether disease or insect) be figured, and that the stages to be sought for by nursery inspectors be shown so far as possible in natural colors in their natural location on the plants concerned? Such a publication might be exceedingly useful both to nurserymen and inspectors, and would certainly help to put these two parties into more sympathetic relations in the search for their common enemies.

Alas! after having drawn up an outline of what I had to say, a copy of the programme reached me which showed that practically all of my thoughts and queries were already provided for, and many more besides. We will, therefore, do well to proceed with the business of the Association at this, its Tenth Annual Meeting, which will, let us hope, be one of great pleasure and profit.

SOME RECENT NEW IMPORTATIONS

By C. L. Marlatt, *Bureau of Entomology, U. S. Department of Agriculture*

It is not necessary nor is it possible to report fully on importations of new pests during the last few years. To emphasize the need of protection at the earliest possible moment, a few recent records, or recent destructive work of older importations, may be noted.

CONDITION OF IMPORTED NURSERY STOCK, 1910–1911

Fewer brown-tail moth nests were received on imported stock during the season just ended (1910–1911), largely owing to the agitation in this country and the more strict supervision by foreign governments, and doubtless particularly to the natural fluctuation in the numbers of this pest abroad. These nests are, however, still coming in, some 100 nests being reported as received in New York State and 2 in Ohio. Reports have not been received from other states. The danger from this condition is perhaps even greater than when the nests are coming in more abundantly. The infrequent finding of these nests will naturally lead to a laxity of examination and result in an even greater risk of infested material being passed.

The Department's connection with the work is the same as before. The voluntary reports received from the customs officers and the railroad companies have been transmitted to inspection officials of the several states. These reports are by no means complete, and can not be complete under existing conditions.

The inspection notices sent to the Bureau of Entomology by the customs officials of the various ports of entry for the last fiscal year (July 1, 1910, to June 30, 1911) indicate over 6,000 different shipments and some 90,000 separate parcels. This, however, includes bulbs, orchids, and greenhouse stock, as well as nursery stock proper. The total annual value of all plant importations in recent years has been a little over two million dollars, and the latest customs statistics available indicate that less than one fourth of this relates to nursery stock, namely, trees, shrubs, and ornamentals, including seedlings. Roughly, therefore, one fourth of the total number of shipments should be subject to careful examination. The standard trade in greenhouse materials and bulbs is subject to comparatively little risk of introducing new dangerous pests.

One of the worst features of the situation is the importation by department and five-and-ten-cent stores of foreign ornamental nursery stock, which very often is not reported, and which state inspectors have the greatest difficulty in tracing. Nursery stock from abroad is also sent to this country to be sold under the hammer at various auctioneer establishments in large cities, and in both of these cases it is almost impossible to trace such stock or make any adequate inspection of it. In this city, such stock has been examined by agents of this Bureau under difficulty and without any real authority, and has in several instances been found infested with dangerous insects.

FOREIGN IMPORTATIONS INTO THE DISTRICT OF COLUMBIA

The conditions of commercial importations consigned to Washington either direct or in bond, and the current inspection work of the Bureau of Entomology relating to fruits, seeds, and plants imported by the Department of Agriculture, may be interesting as illustrating more pointedly the dangers which are common to the whole country.

Customs advices relating to 63 commercial importations to the District of Columbia have been received this year, and so far as possible these plants have been inspected. There is, however, no law for the District of Columbia which authorizes such inspection, and any examination made must necessarily be by the courtesy of the importers. This has sometimes been refused or is often grudgingly given, and at best has been without any special effort on the part of the importers to facilitate or promote thorough inspection. The worst feature of such imported stock is the masses of cheap ornamentals which are brought in and sold by department stores or under the hammer by auctioneers; and this condition applies to most of the other large cities of this country. In one instance of the present year an auction firm was courteous enough to allow the Department to destroy a large quantity of young spruce trees imported from Holland and which were badly infested with the spruce aphid, *Lachnus juniperi* Fab., an insect not known to occur in the United States.

PLANT IMPORTATIONS BY THE U. S. DEPARTMENT OF AGRICULTURE

In the case of the importations of new stock, plants, or seeds by the Department of Agriculture, all such material coming to Washington is thoroughly inspected by officers of this Bureau, and if need be, disinfected or destroyed. Furthermore, all the lots of material which the Department prepares for distribution are again inspected and, if necessary, fumigated before being sent out. In this way, 750 different shipping orders have been inspected for the Bureau of Plant Industry, and many of these lots have been fumigated.

In the case of the importations by the Department of Agriculture this double inspection and fumigation, with usually a considerable period under quarantine, is believed to safeguard such material and to reduce to a minimum the likelihood of the introduction of new insect pests. As illustrating what may be brought in by such material and which in the case of private importers must often escape detection, it may be noted that more than 20 different pests have been intercepted on the importations by this Department, many of these new to this country, and with very unpleasant possibilities. These include such things as weevils infesting seeds, grasshoppers with wild grasses, grain insects, the mango seed weevil, a moth reared from mango seeds, scale insects, aleyrodid species (insects related to the white fly), a peach seed weevil from Siberia, *Anthonomus drupariam*, already a very injurious pest in Europe, and if introduced into this country will probably be even more destructive than the plum curculio; a cecidomyiid (related to the Hessian fly) on Lotus introduced as a fodder plant; several scale insects; eggs of a leafhopper in cuttings of persimmon and peach from China. The latter, judging from its relationship to known pests, is capable of very great destruction to all sorts of orchard and ornamental trees. The eggs in this case are inserted under the bark, and to the ordinary observer would pass absolutely unnoticed.

The record of importations of new pests given above is the best possible argument for the passage of a national plant quarantine and inspection law.

RECENTLY ESTABLISHED PESTS

Perhaps the most destructive comparatively new insect pest is the alfalfa leaf weevil, which has already caused tremendous damage in Utah, and threatens to extend throughout the great alfalfa growing region of the middle West. It was evidently brought to this country from Europe on some imported goods, not improbably with the packing of nursery stock.

Dr. J. B. Smith, of New Jersey, has called attention in his recent report (1910), p. 344, to the discovery of the European red tail (*Dasychiria pudibunda* L.) in New Jersey. The caterpillar of this moth is capable of being a very troublesome pest, and is somewhat related to the tussock moth. In Europe it is a general feeder and on the authority of Doctor Smith frequently entirely defoliates forest areas, and is there recognized as a first class pest, ranking with the gipsy and browntail moths. Its life habits are such that it is easily transported with nursery stock, and one of Doctor Smith's inspectors, in fact, found a cocoon from which an adult was bred, in stock imported from France during the winter of 1909–1910.

Mr. J. W. Chapman, of the entomological laboratory of the Bussey Institution, at Harvard University, has reported on the occurrence of the European smaller elm bark beetle (*Scolytus multistriatus*), infesting in very large numbers the old historic elms of Cambridge, Mass. This insect works in company with the wood leopard moth, and the two together have fairly well destroyed the magnificent elms in and surrounding the campus at Harvard University. The writer, this summer, witnessed the uprooting of the enormous moribund, or dead trunks, of these famous old trees, the cost merely of the removal of which was about $30 per tree. Similar injury, charged to the leopard moth only, is reported by Britton and Cormie for the coastal region of Connecticut. [Bul. 169 (1911), Agr. Exp. Sta.] There seems to be no reason to doubt that this Scolytus is firmly established, and it looks very much as though these two insects together would be in the end almost as disastrous to elm in this country as the chestnut disease has been to the chestnut in the forests and parks of New York and adjacent states.

What bids fair to become a very important apple pest is the apple seed chalcis (*Syntomaspis druparum* Boh.), which has been made the subject of special study by Mr. C. R. Crosby, of the Entomological Department of Cornell Experiment Station (Bul. 265, April, 1909). This insect passes the winter in the larval stage in the apple seeds and can be very easily distributed by apples or apple seeds to all parts of the country. It is a well-known European pest and very likely came to this country with apple seeds imported from France, there being considerable import of such material for growth of seedling stock in this country. The investigations conducted by the Bureau of Entomology in Pennsylvania last year have demonstrated that this insect has spread in destructive numbers into orchards in that state, and in some orchards at least one third of the crop was destroyed by it.

Among the newly established insect pests of subtropical fruits, perhaps the most important is *Pulvinaria psidii*, which is one of the worst pests in southeastern Asia on citrus and other subtropical plants. This insect has in recent years been introduced with nursery stock into Florida, and has already been widely distributed by one of the leading nursery firms of that state. It is now known to occur into several localities in Florida, and has been particularly damaging on fig trees at West Palm Beach, Miami, and some other points.

The *Aleyrodes howardi*, related to the white fly, has recently become established on the east coast of Florida, having been brought over on nursery stock from Cuba, where it seems to be a native.

The oriental scale pest (*Conchaspis angraeci*) has become established on figs at Miami and possibly elsewhere in Florida.

The mango seed weevil (*Cyrptorhynchus mangiferæ*) has come in very commonly in mango seeds imported for planting during the past year. A warning circular has been issued on this insect, and it is to be hoped that it has not escaped in Florida. Two important mango scale insects have been brought in on shipments of trees to this country, and are still in existence in Florida, and it is doubtful whether they will be exterminated.

Mr. Woglum's eastern explorations during the past year, which have been so successful from the standpoint of the introduction of predaceous enemies and parasites, have fully demonstrated that the white fly is an introduced insect, its native home being the citrus region lying south of the Himalayan mountains, extending from India eastward across China. In this region, Mr. Woglum not only found the white fly commonly but also some of the fungous enemies of this insect, which are now established in Florida, and also control by parasitic and predaceous enemies.

The records above given sufficiently emphasize the risk which always attends foreign plant introductions, and particularly where such are new and come from regions which have been hitherto more or less commercially isolated.

DANGEROUS FOREIGN DISEASES LIABLE TO BE IMPORTED ON PLANTS

By Dr. Perley Spaulding, *Office of Forest Pathology, Bureau of Plant Industry, U. S. Department of Agriculture*

This paper will deal very largely with but two diseases from which this country is in very immediate danger at present. These are the white pine blister rust and the potato wart disease. Besides these will be mentioned only tree diseases, as the speaker is more familiar with this type of trouble than with those of other kinds of plants. The horticultural inspector is especially interested in the field characters of these various diseases.

The chief field characters of the white pine blister rust are:

(1) A swelling of the main stem usually where the first branches are given off. This swelling usually begins very abruptly at the point of insertion of the branches upon the main stem and tapers gradually downward. It may also extend upwards in the stem and also outwards in the lateral branches in very marked cases. This disease is characterized by the swelling being almost exclusively in the bark tissues, not in the wood of the stem; that is, if a sharp knife be taken and a suspected tree which has this type of swelling is split carefully down the middle through the swelling, it will be seen that the bark in the swollen portion is from one to several times thicker than the normal bark of the same tree, but the wood of the stem is not swollen at all.

(2) Trees three or four years of age are very apt to have a stunted appearance. The tree very often consists of a bare stem bearing an abnormally thick tuft of needles at the top and without lateral branches. Oftentimes, too, the growth in height is decidedly less than that of healthy trees.

(3) A coarse yellow mottling of the bark of the stem and of young needles is a rare but very characteristic symptom of this disease. It has been found by the speaker but twice: once in a lot of trees set out in the field and once in trees in the greenhouse.

(4) Older trees, five to ten years or more of age, which have had this disease and have borne fruiting bodies in preceding years have an abnormally thick scaly bark upon the stem at the affected parts. Healthy young trees never have scaly bark before they are from 15 to 20 years of age. The occurrence of scaly bark upon stems of less than this age is a very good symptom of this disease.

(5) Finally may be mentioned the actual presence of fruiting bodies upon the affected stem. These fruiting bodies are so characteristic that no one need to be confused by them. They are also so well described in my publications that they will not be mentioned further.

This disease is caused by a fungus which has an alternate stage of growth upon the leaves of *Ribes*. The disease can not spread from pine to pine, but is produced upon healthy pines only by the spreading of the fungus from diseased *Ribes* leaves to the pines. This gives a very fair chance for controlling the disease so far as it has yet been introduced into this country. While the disease affects our eastern white pine especially, it is not limited to that single species. It also is known to attack two of the western white pines and it presumably may attack all of them. The danger from importations then is not limited to the eastern section of the country, but is more or less general throughout the country. As has been stated in my publications upon this disease, several millions of young white pines which were affected with this disease have been imported into the eastern part of this country. Ninety-five per cent or more of the total number of diseased trees which have been imported have come from a single German nursery. The importations from this nursery have for the past two years been reduced to almost nothing, that is there have been only one or two importations each year from this nursery. The disease, however, has been imported from a number of French nurseries.

The great danger at present is in the continued irresponsible importation of diseased plants without the horticultural inspectors being aware of such importation. The disease is known to have been present in the country since 1903 upon diseased trees, but in every instance where these early importations have been found, *Ribes* have been absent from the immediate vicinity of the affected trees, so that the disease has not spread. This is entirely good luck, however. The speaker's experience in making inspections has proved beyond any doubt that a single inspection of a diseased lot of trees never can be expected to result in the removal of all affected trees, that is, repeated inspections must be made. This soon costs more than the total value of the entire shipment of seedlings.

The second disease from which we are in great danger is that known as the potato wart. This disease is already prevalent in Newfoundland and one or two small adjacent islands. Canada has already quarantined against the movement of potatoes from these islands to the mainland. This means that the United States is bound to receive all surplus potatoes from this district. This disease is characterized by a transformation of the developing tubers into irregular warty black masses which have no resemblance to the original potato. The value of the tuber is entirely destroyed. The most serious feature of this disease is that the organism causing it may live in the soil of an infected field for at least six years without a single crop of potatoes being grown during that time. This practically means that a field once infected will remain infected. Should this disease become established in this country, the potato industry will ultimately be doomed so far as we can judge at present.

A second European blister rust has been imported into this country already. This is the one occurring upon Scotch pine, known as *Peridermium pini*. So far as we can judge, this is the most prevalent of the European diseases of this character. It affects not so much the younger trees as it does the older ones, although it is serious where it does attack the young trees. A specimen of this was sent to the speaker by one of the keenest of the Eastern nurserymen. This tree had been in his nursery for three years, and was originally imported from Europe.

Still another disease which has entered this country already is caused by one of the Japanese cedar apples. It was imported into the State of Connecticut upon the Japanese cedar and was there discovered by the Connecticut authorities. This has its alternate stage upon the Japanese pear and the quince. The pear industry of an entire province in Japan was threatened with extinction by this disease until the connection between the fungus upon the pears and the cedar apple was determined. The removal of cedars from the vicinity of the orchards apparently has quite largely controlled the trouble. It is not known at present whether this particular disease will attack American species of pear or of cedar, but this disease is one which should be watched until some definite information about it is obtained.

Another disease, known as the European pine twister, caused by one of the blister rusts known as *Caeoma pinitorquum*, may be considered dangerous. This attacks especially young trees varying in age from newly germinated seedlings up to 20 and 30 years, and in exceptional cases even 40 and 50 years of age. This has its alternate stage upon the European aspen and is apparently very prevalent throughout the European countries. The attacks of this disease where the branches are not killed, result in a twisted growth from which it receives its name. It results in the crippling of the tree so that in future years it is practically useless for timber. This disease is one about which little is known in connection with American species. It is not known to attack American species in either stage, but until definite information upon this point is obtained this should be kept from entering the country.

Finally may be mentioned the European oak mildew, which has been causing very considerable alarm throughout Europe because of its extreme attacks upon the European species of oak. It was first noted in 1907 in France, in 1908 it was prevalent throughout Europe except in the northern countries. It was so virulent in its attacks that in many places the entire undergrowth and lower branches of large trees to a height of about six feet were white with the mildew upon the leaves. The origin of this disease is not known at present, and until this is known this disease should be especially watched for in importations.

In these remarks the speaker has confined himself largely to tree diseases, as information upon the diseases of other classes of plants is not immediately available.

Mr. Headlee of Kansas: This is a long list of troubles for which the inspector must look, and personally I am in need of available information touching their relative importance. A publication taking up their recognition marks under different conditions, their virulence, their life economy, and their frequency on incoming stock, which could be used as the inspector's handbook, would greatly increase the efficiency of the service and afford correspondingly greater protection.

Member: Mr. Headlee's suggestion for a hand-book is just what I have had in mind. I notice that out of six diseases, three or four of them are on the Conifer. I think that a little hand-book of colored illustrations will give the inspector something else to look for besides the San José Scale, because you can find that too easily. We want something we cannot find so readily.

Mr. Fernald of Mass.: I had a little personal opportunity to see the white pine blister rust, but not enough to cause me to become very familiar with it, and I have had an opportunity to look over some of the papers which have been published on the subject, both in this country and in Europe, but there is one point which I have not seen brought out very definitely or very positively, and it might be of interest to have that brought up at this time. Exactly how much damage as regards the life of the tree does this disease cause? Even when we find it at the age of three years or thereon and trees of ten years of age, which still have the disease, does it ultimately kill the tree, or does it result in a crippling merely of the tree, or what can we expect of it, if it is left to take care of itself?

Mr. Spaulding: As a general thing so far as my experience goes, it kills all trees. Those trees that live to an advanced stage are rather exceptional. Usually quite a number of affected trees die the first year, and two or three cases live over until the next year, and they decrease still more the next year,—but there may be some vigorous cases that live longer, up to possibly twenty years of age; but the significant fact there, is, according to a French writer,—that when a tree reaches an age of twenty or thirty years, it is almost sure to be broken over by the wind, so that unless the tree entirely outgrows it, it is finally killed. It only attacks, so far as we know, one-year-old wood. It may attack old trees.

The meeting then adjourned.

(To be continued)

PROCEEDINGS OF THE ATLANTA AND WASHINGTON MEETINGS OF THE COTTON STATES ENTOMOLOGISTS

For the purpose of considering the various cotton boll weevil quarantine regulations now in force in the various states with a view of securing uniformity, the Association of Cotton States Entomologists met at Atlanta on December 5 and 6, and at Washington on December 29. The following resolutions and recommendations were unanimously adopted:

RECOMMENDATIONS IN REGARD TO GENERAL PRINCIPLES OF LAW

I.—Legislative enactment to provide for quarantine under an official Board of not over five to constitute a responsible body, which shall be charged with formulation and administration of all quarantine regulations against insect pests and plant diseases.

The law should provide competent State Entomologists of proper training and experience.

II.—All specifications of dangerous insects, plant diseases, etc., and all regulations relating thereto, shall be adopted and published by said Board, and shall be subject to change upon proper public notice and announcement.

III.—Law should provide for suitable means of prosecution of violators of regulations and fix penalties therefor, including fine or imprisonment, and confiscation of material.

IV.—Law should give police power to authorized parties administering quarantine.

The report of the Committee appointed for the purpose of formulating a schedule of articles to be restricted and exempt, was read and each item discussed. The following resolutions were adopted:

RECOMMENDATIONS FOR QUARANTINE RESTRICTIONS APPLYING TO ARTICLES ORIGINATING WITHIN QUARANTINE AREA

1. Seed cotton.
2. Cotton seed.
3. Seed cotton sacks, cotton seed sacks, and cotton pickers' sacks, any of which has been used within eight months for any of the purposes indicated.
4. Cotton seed hulls, between August 1 and December 30.
5. Spanish moss and corn in shuck between October 1 and June 30.

6. Living weevils, or weevil stages, or weevil work, in possession of any person outside of the infested territory except a qualified Entomologist.

7. Household goods containing any of the foregoing during the period of quarantine applying to each.

The following resolutions were unanimously adopted at the Washington meeting, December 29, 1911:

That the Entomologists of this Association take concerted action with regard to the cotton leaf caterpillar, by sending all reports of the occurrence of the pest as soon as received, to W. D. Hunter, of the Bureau of Entomology, which reports shall be compiled and issued in circular letter on the first of the month following, or oftener.

That it is the sentiment of the Association of Cotton States Entomologists that the establishment of a cotton free zone of any width whatever, is entirely impracticable and unfeasible, and would result in an economic upheaval, regardless of any known method of taxation or reimbursement.

That a brief of the resolutions adopted at the Association of Cotton States Entomologists at the Atlanta and Washington meetings be printed in the JOURNAL of ECONOMIC ENTOMOLOGY.

That the Secretary be instructed to give to the press the resolutions adopted at the Atlanta and Washington meetings.

The Chair was instructed to appoint an executive committee, composed of three members of this Association. This Committee shall fix the place and time for the next meeting of this Association.

A. F. CONRADI,
Secretary.

INSPECTION AND CERTIFICATION OF FRENCH NURSERY PRODUCTS

By C. L. MARLATT

Attention has already been called in this JOURNAL by Dr. Howard to the French nursery inspection law of 1910.[1] The official journal of the French republic, of May 13, 1911, publishes, over the signatures of the president of the republic, the minister of agriculture, and the minister of finance, a decree dated May 1st, 1911, governing the charges for the inspection of nursery products for insect pests and plant disease; and giving the classification, and provisions for the

[1] Journal Econ. Ent., Vol. 3, p. 499, December, 1910.

appointment, of the different grades of inspectors provided for in the nursery inspection law just referred to.

The law of 1910 consists of Article 9, of the general budget and provides that the cost of inspection by authorized agents of the minister of agriculture shall be collected from the establishments which have asked for such inspection. This cost is apportioned, as follows: A fixed annual tax of 25 francs is assessed on each nursery establishment which has requested examination and certification of its stock; and the additional expense is apportioned to such nursery firms according to the value of the stock which is to be certified. Provision is also made for the assessment and collection of the latter item of the tax in case voluntary reports from these firms are not submitted.

Regulations are published indicating the conditions and methods under which any nurseryman may have his stock inspected. The government, however, does not assume any responsibility for itself or its agents in the matter of inspection and certificates, in so far as to guarantee the acceptance of the latter by foreign countries.

This inspection service is divided into two sections: one, relating to plant diseases; and the other to insect pests. Provision is made for three classes of inspectors. The chief inspectors are the two officers of the department of agriculture in charge respectively of the departments of plant diseases and insect pests. These officers have the general direction and control of the service in their respective departments. The actual work of inspection is carried out by subordinate officials under two titles: first, temporary agents, or inspectors, who are to visit the various nursery establishments and conduct the inspections; and, second, minor temporary agents, if such be needed, who are to act as local aids to the inspectors proper. Inspectors of each of these two classes are provided for both plant diseases and insect pests. The provisions as to qualification of these inspectors, namely the educational requirements and practical experience, indicate a fairly high standard.

The working details for carrying out the inspection, as indicated by these recent decrees, call attention again to the weakness of the law of 1910, namely, that there is nothing obligatory in the inspection service, making it necessary for all nursery companies in France to be examined and certified. Such inspection and certification is only made on demand where the exigencies of the business of the firm seem to require it. It is therefore apparently very possible for much nursery stock to be accumulated from non-inspected nurseries for export.

DUTCH INSPECTION SERVICE

[The following excerpt from a letter received through Dr. L. O. Howard and published at his suggestion, will be of interest to many entomologists and nursery inspectors.—Ed.]

"The nurserymen of Holland, for obtaining the certificates for their shipments abroad, are by the Chief of the Phytopathological Service required: 1. To have their nurseries once or more than once duly inspected during the last season of growth. 2. To have the stock before shipment another time examined and, if necessary, selected.

"Both inspections of the grounds, and of the consignments, are executed by my officers. In consequence the delivery of the Certificates does not depend on the inspection only of the nurseries; also the stock ready for shipment is examined.

"For each consignment approved a certificate is delivered similar to the following:

[Duty stamp.] *No.*

The undersigned, ...,
at .... declares that the
....
marked ....
containing ....
....
....
grown in ....
are destined for ....
....
and that, after due examination, the State Entomologist and Phytopathologist of Holland has found them free of San José Scale, peach yellows, rosette, or any other dangerous insects or plant diseases, that might be transferred on nursery stock to other nurseries or to the orchard;

No nests of Brown Tail Moth have been found in the nurseries.

....

CERTIFICATE.

The State Entomologist and Phytopathologist of Holland at Wageningen affirms the justness of the preceding declaration.

Wageningen..............

[Service stamp.] ....

State Entomologist and Phytopathologist of Holland.

"This form is chosen on account of our Stamp-act. A declaration undersigned directly by myself would be submitted to a higher stamp duty. Now the certificate consisting of a declaration of the nurseryman, which is confirmed by the Chief of the Phytopathological Service, the cost of the stamp is relatively small.

"Thus, on the certificate of our Phytopathological Service, mention is made of the names of the consignor and of the consignee; then of the nature of the package, the number of boxes or bales, and their marks and contents. Besides the stamp for which duty is paid (printed at the top of the certificate) and the stamp of the Phytopathological Service (printed by myself or my substitutes at the bottom of the paper) a number is put on the certificates. Being prepared in this way the certificates are undersigned by myself or by one of my two authorized principal assistants. A facsimile of these signatures is inserted in the number of the JOURNAL OF ECONOMIC ENTOMOLOGY, mentioned above.

"The certificate bearing upon the complete consignment, each box or bale, belonging to it is labelled with a so-called copy certificate of the following type:

COPY-CERTIFICATE OF EXAMINATION OF NURSERY STOCK.

To whom it may concern :

This is to certify that the nursery grounds of

....at.............., Holland,

were inspected by my officers for the Season 19../19.., that the growing stock gave no indication of any species of insects designated as dangerous pests by the commission, and was apparently healthy in every respect.

(Signed)

DR. J. RITSEMA BOS,

State Entomologist of Holland.

"The certificate delivered for the complete consignment is often directly forwarded by the nurseryman to the consignee; but now and then it may be subjoined to the invoices.

"Sometimes a Dutchman delivers stock originating from foreign countries (for instance from Belgium) and expedites it from a foreign (f. i. Belgian) harbour. Such stock not being examined by the officers of the Dutch Phytopathological Service, now the nurseries from which it originates, being inspected by them, none of the above mentioned papers are subjoined to the consignment. Consequently for assuring himself that a shipment consigned by a Hollander really comes from Holland and has been controlled by our Phytopathological Service, the American expert should look after the official certificate duly provided with stamps, number and signature and after the copy-certificates attached to each of the boxes or bales. Only when either of the declarations are present, it is certain that the stock is inspected by our Phytopathological Service and that the nurseries, from which it originates, are continually supervised by this Service.

"Of course we always are mindful of maintaining the good renown our Dutch certificates enjoy in America, and therefore no trouble is spared in the execution of the inspections. But at the same time I should be pleased to observe, that the American authorities by looking after the declarations belonging to each consignment from a Dutchman should ascertain for themselves the origin of the shipment in question.

"It may be possible, that some copy is lost from a box or bale, but this will not be the case with all copies of the shipment, and anyhow the original certificate belonging to the whole shipment must be present.

"I always will be obliged for the communication of all contravention of the rules mentioned above.

"Might some alteration be settled either in the text of the copies or in that of the certificate itself. I hope to inform you at an early date."

With many kind regards,

Yours very truly,

J. Ritsema Bos.

NOTE ON THERONIA FULVESCENS

By J. M. Aldrich, *Moscow, Ida.*

A reperusal of some back numbers of the Journal leads me to offer a belated note on the above species as a parasite of *Neophasia menapia*, the white butterfly of western pine and fir. Fiske and Thompson (Journal, 2: 455) mention *fulvescens* as "the most common parasite of the gypsy moth native to America," but add that it has been recorded both as primary and secondary in some of its host relations. At the time of the publication of that item I intended to add the following, but postponed action until it was for the time forgotten.

Neophasia menapia was for some years after its discovery an excessively rare butterfly, only a few specimens finding their way into collections. Later it was found once or twice in swarms in the western forests, and again it seemed to disappear. In this period I came to Idaho in 1893. Two years later it began to be noticeably abundant near Moscow, Idaho, and in 1896–7–8 it caused much loss in the forests of the northwest by completely defoliating pine and fir timber in considerable areas, while in all the intervening forests it was very abundant also. At this point *Theronia fulvescens* attracted my attention as a parasite of the butterfly, material reared by me from pupæ of the latter being determined by the Bureau of Entomology. The parasite reached its maximun in 1898, at which time it swarmed in the woods in late summer in incredible numbers. In places the air was full of them, and they made a very perceptible humming sound like a swarm of bees. At the University of Idaho, about seven miles from the forest, it was abundant, and on one occasion I collected 40 specimens by picking them off the walls of the administration building while going once round it—and this seven miles from where any of them matured.

The next spring the extermination of *menapia* seemed complete all over the northwest. In ten years afterward I think I saw only one specimen alive. Only in the last two or three years is it "coming back," and we seem to be at the beginning of another cycle of abundance.

I secured no other parasite of *menapia*, and *fulvescens* was present in millions, from which it would appear that the previous fluctuations of *menapia* may have been caused in the same way as the one described.

On account of the burning of my notes in a university fire, I am obliged to trust to memory, and it is possible that the year of extermination may have been 1899.

The parasite died out at once, and was not seen again for several years. It may have other hosts here, but no other caterpillar is abnormally abundant in our forests, so the numbers of the parasite of necessity fell at once almost to zero, on the disappearance of the principal host. I have never seen another case so striking of the effect of parasitism on both host and parasite. I have made no observations on *fulvescens* as a secondary parasite.

SOME ECONOMIC METHODS A HUNDRED YEARS OLD

By Harry B. Weiss, *New Brunswick, N. J.*

In going over some old works on entomology, I was impressed by the similarity of some of the methods in use a hundred years ago and those of today. By this, I do not mean to imply that we have not gone forward in that length of time, but, rather that in many cases, we are still following the basic principles of the old methods.

When our grandfathers were troubled by wire worms, it was customary to bury beneath the soil, slices of potatoes stuck on skewers. These were pulled up every day and the larvæ thereon killed. These baits of course were stuck alongside of the infested plants. For fields overrun with injurious larvæ, it was recommended that the infested land be ploughed up and a flock of ducks or other poultry or a drove of pigs turned in, and drenching a field with stable urine was supposed to kill all grubs in addition to acting as a fertilizer. Without going into details, I may mention the present day use of poisoned baits—fall and spring ploughing and heavy applications of kainit or nitrate of soda, all of which have their uses in controlling injurious insects.

For aphids on beans, the plants were topped as soon as the lice appeared and the cut-off portions either burned or buried and against the hop plant louse, women and children mounted on step-ladders were employed to rub the infested leaves between the thumb and forefinger, hard enough to kill the lice but not enough to injure the tissue. Concerning an insect like the cockchafer, I found a note to the effect, that in 1785 a French farmer employed a number of children to collect these insects at two liards a hundred, with the result, that fourteen hundred were turned in at the end of several days. As we all know, hand collecting is still resorted to, but we have evolved better methods for controlling aphids, than that of the thumb and forefinger.

Against cattle flies, the herdsman kindled fires, the smoke of which drove them away and it is said that the cattle, when badly infested, would run towards the smoke. Now, of course, the market is full of fly mixtures, but we are still using smoke and various preparations as deterrents. I recall being at a small park along Lake Erie, one night several years ago and the place was covered with a pall of smoke, originating from piles of burning leaves. It was either that or mosquitoes. It is needless to state that modern mosquito extermination methods hadn't reached there at that time.

Coming to household pests, particularly the bed bug, the following formula must certainly have been effective.

"Reduce one ounce of corrosive sublimate and one ounce of white arsenic to a fine powder; mix with one ounce of muriate of ammonia, two ounces each of oil of turpentine and yellow wax and eight ounces of olive oil. Put all these into a pipkin placed in a pan of boiling water and when the wax is melted, stir the whole in a mortar till cold." I suppose this combination was to be used as are insect powders of today. For fleas, the old English preventive is quoted:

> "When wormwood hath seed, get a handful of twaine
> To save against March to make flea refrain;
> Where chamber is swept and wormwood is strown,
> No flea for his life dare abide to be known."

Probably this was a household rhyme, memorized during childhood.

For killing house flies, solutions of the following were placed in saucers; corrosive sublimate, King's yellow (a sulphide of arsenic), and Quassia. Going back to traps again, when earwigs became troublesome in the garden, snares were set. These consisted of ox hoofs, hog hoofs, bowls of tobacco pipes and lobster claws. These were stuffed with straw and attached to sticks, the sticks being stuck in the ground adjacent to infested plants. At the approach of daylight, the earwigs were supposed to crawl into these receptacles and allow themselves to be shaken out and killed later. It certainly must have looked curious to see such an array as the above, stuck around a garden.

For controlling grasshopper nymphs, a drove of two or three thousand sheep could be driven on the infested land, thereby trampling many to death and as for a first class pest like the Brown Tail Moth, during the year 1782—in many parishes near London, subscriptions were opened and the poor people employed to cut off the webs at one shilling per bushel. These were then burned under the supervision of church-wardens, overseers and beadles of the parishes.

From the foregoing, we can at least get an inkling of how the people of a hundred years ago stood in relation to some insect pests.

ASSOCIATION OF APIARY INSPECTORS OF THE UNITED STATES AND CANADA

On December 30th, 1911, in Washington, D. C., there was formed a temporary organization of the above name with a view to increasing the efficiency of apiary inspection and to bring about a greater uniformity in the laws and more active co-operation between the various inspectors.

A committee on permanent organization was formed to report at a meeting to be held in Cleveland, Ohio, in December, 1912, in connection with the meeting of the Association of Economic Entomologists. Professor Wilmon Newell, College Station, Texas, is Chairman of this Committee.

A standing committee was also appointed on legislation for the purpose of drawing up a law incorporating the necessary and desirable features. The undersigned was appointed Chairman of this Committee.

All apiary inspectors and official entomologists of the United States and Canada who are interested in the advancement of apiculture are invited and urged to join in this movement for an increased efficiency in the fight against the brood diseases. For the present it was decided to levy an assessment, $1.00 per year, on each member to pay necessary expenses. It is hoped that arrangements may later be perfected for affiliation with the Association of Economic Entomologists. Requests for membership and the assessment may be sent to the undersigned.

Respectfully,

Dr. Burton N. Gates,
Amherst, Mass.,
Chairman.

E. F. Phillips,
Bureau of Entomology, Washington, D. C.,
Secretary.

JOURNAL OF ECONOMIC ENTOMOLOGY
OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

It may surprise a number of our subscribers to note that with this issue the Journal appears under new auspices. The change is more nominal than real. The management of our Official Organ has been transferred from a voluntary, private company to the Association of Economic Entomologists. The change was made solely for the purpose of putting the publication upon a better business basis. It is now backed by the entire Association. There will be no material change in the general policy of the Journal.

The recent conferences at Washington appear to have resulted in a practically unanimous agreement respecting a National Quarantine Bill, a problem which has been before entomologists, nurserymen and fruit growers for some years. The bill, in an amended form (H. R. 18,000), has been introduced and we are assured that the prospects of its passage are excellent. This is a matter, as all entomologists well understand, of great importance to agricultural interests of the country. It is surprising that some such bill was not enacted years ago. The East, in this respect, is decidedly behind the progressive West.

The Association of Economic Entomologists is much larger than the relatively small group of workers which assembled in earlier days. Conditions eminently satisfactory then are inadequate at the present time. We would call attention to the discussion at the closing session relative to the desirability of holding sectional meetings and our relations to affiliated organizations. Even with the strict adherence to time limitations, it was necessary to abstract a number of valuable papers, while the time then available was not sufficient for a full and thoroughly satisfactory discussion. This latter is one of the most valuable features of our gatherings and can be secured only by more protracted sessions or else by a greater division of subject matter. We have had for some years a Horticultural Inspectors' Association, and last month witnessed the organization of an Apiary Inspectors' Association. These represent only two of the special interests legitimately classed under Economic Entomology. We have in addition, forest entomologists and city entomologists concerned primarily with shade tree pests, not to mention specialists working upon various groups, or those with common interests because of climatic or geographical conditions. No one man can hope to cover the entire subject in an exhaustive manner, and most will probably find greater profit by limiting the time spent at meetings to a few problems of paramount interest. The Association might well have several general sessions, possibly the entire mornings, the afternoons being broken up into special groups which might be designated as sections and presided over by officers of affiliated societies, by vice-presidents or even chairmen named informally. The main point is to assemble those interested in any special subject and provide for a full and free discussion and at the same time avoid a conflict of interests so far as practicable. Certain of these groups would necessarily vary from year to year and would be determined in large measure by the character of the papers submitted. No party would be better qualified to inaugurate this change than our Secretary, who could easily group the papers and submit a proposition for a few special sessions if conditions warranted, at the next annual gathering. We believe that some such modification would do much to unite allied interests and result in the continuance of one strong organization, with congenial sections or subdivisions. This is essential to a well supported official organ and in the long run must prove more satisfactory than a number of independent small organizations supported by entomologists restricting their activities to special lines.

Reviews

Ixodidæ. By L. G. Neumann, Das Tierreich, 26 Lieferung, pp. XVI–169, 76 figs., R. Friedländer & Son, June, 1911.

After a long delay, presumably chargeable to the publishers, Professor Neumann's monograph of the ticks has been issued. The main criticism to be made is of the fact that the work is not up-to-date; in fact, the publication is really about three years behind, as 1908 is the last year given in the references to literature. Professor Neumann is probably in no way responsible for this delay nor for the very poor binding of the fascicle.

Professor Neumann is generally considered a very conservative systematist, hence the conservatism shown in this publication is to be expected. The classification as given in the present work is practically the same as that proposed by Neumann in an earlier work. The author prefers to treat the ticks as a family rather than to place them in a superfamily as done by Banks and several other authors. The family is divided into two subfamilies Ixodinæ and Spelæorhynchinæ. The former includes all of the forms usually considered as ticks and the latter contains one genus and one species, *Spelæorhynchus præcursor,* a peculiar bat parasite from Brazil. The subfamily Ixodinæ is divided into sections, Ixodini and Argatini corresponding to the families Ixodidæ and Agasidæ of other authors. The section Ixodini is divided into four tribes, Ixodaria containing the genus Ixodes; Rhipicephalaria containing the genera Rhipicentor, Margaropus and Hyalomma; Amblyommataria with the genera Amblyomma, Aponomma, Dermacentor and Hæmaphysalis. Few systematists will agree with this classification in all respects though it is not vastly different from the arrangement proposed by some other workers. It will be seen from the above list of genera that Neumann in this publication, as in earlier works, divides his subfamily Ixodinæ into ten genera. In these ten genera he recognizes 206 valid and 170 doubtful species. He divides 26 of these species into 66 subspecies. A considerable number of species has been described since the preparation of the manuscript for this treatise.

The monograph contains tables for the differentiation of the genera and species, as well as the higher groups, and fairly complete synonomy under each species. The systematic arrangement of the hosts of ticks with the list of the species of ticks found thereon will be found very useful. This list is, of course, incomplete owing to the many host records added in the last few years. Mention of the stages of ticks found on each host would have been a valuable addition to this list. The specific descriptions given are too brief in many cases to be satisfactory, and additional illustrations would have added materially to the utility of the work. Descriptions of the immature stages would also have been a valuable addition.

The standing accorded a number of species by Neumann is questionable. But a very few of these points, however, will be mentioned owing to the fact that these matters have been cleared up in publications, by various other authors, issued since the manuscript of the paper under review was completed. Neumann's variety *inchoatus* of *Ixodes hexagonus* is a synonym of *I. canisuga* Johnston as has been pointed out by Banks. *Dermacentor parumapertus* is without doubt a distinct species and not a variety of *Dermacentor variabilis*. *D. occidentalis* is clearly a distinct species and not a variety of the European *D. reticulatus*. *D. nigrolineatus* Packard, as Mr. Banks has pointed out, is a distinct species of Dermacentor and not a Hæmaphysalis as considered by Neumann. There is no doubt that Packard's *chordeilis* is a valid species of Hæmaphysalis. Neumann places the genus Boöphilus as a synonym of Margaropus. Since reviewing Part II of Nuttall and Warburton's monograph of the Ixodoidea (JOURNAL OF ECONOMIC ENTOMOLOGY, Vol 4 pp. 564–565) I have had an opportunity of studying a good series of both sexes of *Margaropus lounsburyi* in comparison with specimens of the North American fever tick. To say the least, the question as to what generic names should be used for our North American fever tick and other closely allied forms is a debatable one. The females of *annulatus* and *lounsburyi* do not seem to present good characters for separating them into two genera. The males of the two forms, however, show striking differences. Nuttall and Warburton and Dönitz place *annulatus* in the genus Boöphilus—the genus established for this species by Cooper Curtice in 1891—and *lounsburyi* in the genus Margaropus, while Neumann considers that both species belong to the same genus (Margaropus). Banks holds the same view as Neumann. Many economic workers will probably accept the ideas of each of these groups of systematists and if some unity of opinion is not secured we may expect to find the common use, in literature, of both generic names for the cattle tick.

On the whole, the work under review will be found very useful and should be on the shelves of every student of this group of animals.

F. C. BISHOPP.

Current Notes

Conducted by the Associate Editor

D. E. Merrill has been appointed assistant in entomology at the New Mexico Agricultural Experiment Station and College.

G. P. Weldon has resigned as field agent at Grand Junction, Colo., to become deputy state entomologist, with headquarters at Fort Collins.

Mr. L. M. Peairs, formerly assistant entomologist at the Kansas Agricultural Experiment Station, has accepted a position at the University of West Virginia, and will carry on instruction and experimental work in economic entomology.

The announcement has been published that the Second International Congress of Entomology will be held at Oxford, England, August 5–10, 1912. Dr. Malcolm Burr, 11 Chandos Street, Cavendish Square, London W., is secretary of the executive committee.

According to *Science,* Professor Newstead has returned to England from Africa, where he has been studying sleeping sickness in connection with the commission from the Liverpool School of Tropical Medicine.

Colonel William C. Gorgas, well known for his important practical work in abolishing mosquitoes in Havana and in the Canal Zone, has been elected president of the Ninth Congress of American Physicians and Surgeons, which will meet in Washington in 1913.

Mr. J. M. Swaine, lecturer in biology at Macdonald College, P. Q., has been appointed assistant entomologist of the Dominion Experimental Farms at Ottawa, and will have charge of the work on forest insects.

Professor J. H. Comstock, professor of entomology in Cornell University, gave an illustrated public lecture before the Entomological Society of America at the Cosmos Club, Washington, D. C., on Wednesday evening, December 27th, the subject being "On Some Biological Features of Spiders." Professor Comstock has recently been elected an honorary fellow of the Entomological Society of London.

Mr. E. W. Rust, A. B. (Stanford), formerly of the Southern California Laboratory at Whittier, arrived in Peru on December 6th, 1911, under contract with the Peruvian Government for a year and a half, as first assistant entomologist. His address will be Piura (Piura), Peru, S. A. The government entomological force in Peru now consists of Mr. C. H. T. Townsend, Entomologo del Estado; Mr. E. W. Rust, Primer Ayudante al Entomologo del Estado; and Mr. F. G. Sommerkamp, Assistente. The work on cotton plagues is being pushed, and it is proposed to erect a laboratory building the coming year.

F. W. Terry, for seven years assistant entomologist of the Hawaiian Sugar Planters' Experiment Station at Honolulu, T. H., and a member of this Association, died November 7, 1911, of pneumonia, at Roosevelt Hospital in New York City. Mr. Terry once spent several months in Hongkong while some insect parasites were being procured in the East Indies.

Mr. L. H. Worthley, for several years assistant forester of Massachusetts in charge of the gypsy moth work, entered the employ of the Bureau of Entomology January

1st, and on the 4th sailed for Italy, where he will join Mr. W. F. Fiske and Mr. H. S. Smith, who are investigating the gypsy moth parasites in Europe, and also making an investigation and collection of the parasites of the alfalfa weevil. Mr. Worthley will make observations on the gypsy moth and study field conditions in Europe.

The Porto Rico Board of Agriculture has been organized with W. V. Tower, formerly of the Porto Rico Agricultural Experiment Station as entomologist, and C. E. Hood of the Bureau of Entomology as assistant. Mr. Tower will enforce quarantine regulations against importations, and the construction of three fumigating houses has been authorized. Mr. Hood will attempt to introduce the natural enemies of the white grub into Porto Rico.

Congressman J. Hampton Moore has introduced in the House of Representatives a bill (H. R. 14210) appropriating $80,000 for work against the chestnut blight disease. This appropriation is to be placed in the hands of the Secretary of Agriculture, who is expected to work in co-operation with various state authorities, and $10,000 is to be expended in studying the relations of insects to the spread of the disease. A similar bill has been introduced in the Senate by Senator Penrose.

At the twenty-second annual Meeting of the Western Association of Nurserymen, held at Kansas City, December, 13th and 14th, 1911, papers were read by Prof. S. J. Hunter, on "Interstate Co-operation" and by Dr. T. J. Headlee, on the "Relation of the Agricultural College to Nurserymen."

Professor A. J. Cook, who has recently been appointed horticultural commissioner of California, has announced his program of operations, which includes a campaign to free the nurseries of the state of all pests. Professor H. S. Fawcett of Florida has been engaged to take charge of work for the suppression of fungous fruit diseases, and Professor H. A. Weinland will be sent to Honolulu to attempt the eradication of the Mediterranean fruit fly, which it is feared may be brought to California from the Hawaiian Islands.

Mr. T. C. Barber, who has been in charge of the laboratory for the investigation of sugar cane insects of the Bureau of Entomology at New Orleans, resigned on January 1st to accept the position of Director of Branch Stations of the Sugar Planters' Experiment Station at Tucuman, Argentina. He has been succeeded by Mr. T. E. Holloway of the Bureau.

Mr. E. S. Tucker, of the Bureau of Entomology, who has been located at Dallas, Texas, resigned on January 1st to accept the position of Assistant Entomologist in the Louisiana Experiment Station at Baton Rouge.

Mr. A. H. Jennings, formerly of the Sanitary Department of the Isthmian Canal Commission, who came into the service of the Bureau of Entomology on August 1, 1911, will be located in South Carolina during the coming season and engaged in an investigation of the possible transmission of pellagra by insects. Mr. W. V. King will be associated with Mr. Jennings in this work.

Messrs. Andrew Rutherford and E. H. Strickland, Carnegie Scholars, of England, who have conducted studies at the Bussey Institution and at Cornell University respectively for some months, left New York early in January to attend an agricultural conference in Trinidad, West Indies. They will return to the United States in a short time. After a brief inspection of the work against citrus insects in Florida, they will proceed to Dallas, Texas, where they will be associated with the section of Southern Field Crop Insect Investigations throughout the season.

Mr. M. M. High, engaged on truck crop and stored product insect investigations, working on the onion thrips at Knox, Indiana, during the summer, is studying the same problem, together with others, at Brownsville, Texas.

Mr. Thomas H. Jones, engaged in investigations of truck crop and stored product insects, has resigned from the Bureau of Entomology to accept a position with the Sugar Producers' Experiment Station, located at Rio Piedras, Porto Rico.

Mr. John E. Graf has been appointed agent in the investigation of sugar beet and truck crop insects at Compton, California.

Mr. Warren Knaus, who for many years has been recognized as an authority on certain families of the Coleoptera, has been appointed inspector of apiaries on the staff of the State Entomologist of the University of Kansas.

Mr. Harry B. Kirk, of the Division of Zoölogy, Department of Agriculture, Harrisburg, Pa., has accepted a position as assistant in entomology at the Agricultural Experiment Station, New Haven, Conn., and will begin his work there about February 15th.

Mr. Henry F. Judkins, a graduate of the class of 1911 and a former laboratory assistant in entomology of New Hampshire College, Durham, N. H., has recently been appointed assistant to Professor W. C. O'Kane in the work of suppressing the gipsy and brown-tail moths in New Hampshire.

Notice was issued in January by Professor Burton N. Gates for a convention of apiary inspectors of the Northeastern United States and Canada, to he held at Amherst, Mass., February 7th and 8th. The preliminary programme announced addresses by President Kenyon S. Butterfield, Dr. E. F. Phillips of Washington, Arthur C. Miller, Rhode Island, E. J. Crane, Vermont, Charles Stewart, New York, A. W. Yates and W. E. Britton, Connecticut, and B. N. Gates, Amherst, Mass. We hope to give an account of this convention in a later issue of the Journal.

Mr. J. L. Webb, formerly of the Division of Forest Insect Investigations, Bureau of Entomology, will, after February 1, 1912, be engaged in rice insect investigations in the Division of Southern Field Crop Insect Investigations, Bureau of Entomology. His address will be Crowley, Louisiana.

Irving W. Davis, a graduate of the Massachusetts Agricultural College in 1911, has been appointed, we learn from *College Signal*, instructor in pomology and entomology at Middlebury College, Middlebury, Vt.

Mailed February 26, 1912

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

WANTED—Riley's 5, 7, 8, 9. Have for exchange or cash: Ins. Life, Vol. I, Nos. 3, 4, 10, Vol. II, Nos. 1, 2, 3, 4, Div. Ent. O. S., Nos. 6, 7, 25, 31, 15 cents each, postpaid, Science '04–'10 incl., Pop. Sci. Mo. '07–'09 incl., 50 cents per vol.

A. W. Morrill, Phœnix, Ariz.

WILL SELL FOR CASH a complete set of Illinois Geological Reports, or will exchange for technical entomological writings, those dealing with parasitic insects preferred.

J. E. Hallinen, Interlaken School,
Laporte, Ind.

WANTED—To correspond with those desiring to exchange life-history series of important insects for economic collections.

W. E. Hinds, Auburn, Ala.

WILL PAY CASH or exchange for parts 9 and 10, Vol. IV, Insect Life.

H. F. Wilson, Bureau of Entomology,
Washington, D. C.

WANTED—Bulletins Bureau of Entomology, new series, Nos. 2, 15, 21, and Technical series, Nos. 1, 4, 5, 6, 7. Will pay cash.

James F. Zimmer, Bureau of Entomology,
Washington, D. C.

WANTED—Exp. Sta. Record, Vol. 3 No. 4 and Vol. 4 No. 5; Trans. of the Am. Ent. Soc. Vols. 2 and 3; Proc. of Ent. Soc. of Philadelphia, Vol. 2; Ann. Repts. Ent. Soc. of Ontario Nos. 2, 3, 7, 8; Papilo, Vol. 2 Nos. 2, 3 and 7, Vol. 3 No. 1. Will pay cash or exchange.

R. W. HARNED,
Agricultural College, Miss.

Cash for Insect Life: I, 5; III, 11, 12; IV, 7-8, 9-10; V, complete; VI, complete; also VI, Nos. 1, 2, 3; VII, 4; General Index. Bu. Ent. O. S. Buls.: 2 copies—1, 2, 3, 5, 8, 12; 1 copy—4, 9, 10, 11, 14, 16, 18, 20, 30, 33.

F. C. BISHOPP, Box 208, Dallas, Texas.

I offer in exchange for rare lepidoptera or coleoptera from the U. S. of N. A. specimens of the introduced species of Mantis—Tenodera sinensis; also, specimens of the rare beetle—Polyphylla variolosa.

Philip Laurent, 31 East Mt. Airy Ave., Philadelphia, Penn.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4, 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS,
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

A bi-monthly journal, published February to December, on the 15th of the month, devoted to the interests of Economic Entomology and publishing the official notices and proceedings of the American Association of Economic Entomologists. Address business communications to the Journal of Economic Entomology, Railroad Square, Concord, N. H.

TERMS OF SUBSCRIPTION. In the United States, Cuba, Mexico and Canada, two dollars annually in advance. To foreign countries, two dollars and fifty cents ($2.50) annually in advance. Single copies, fifty cents. To members of the American Association of Economic Entomologists, one dollar annually in advance. 50 cents extra postage to foreign countries.

MANUSCRIPT for publication should be sent to the Editor, E. Porter Felt, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. Burgess, Melrose Highlands, Mass.

Vol. 5 APRIL, 1912 No. 2

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Published by
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
Concord, N. H.

Entered as second-class matter Mar. 3, 1908, at the post-office at Concord, N. H., under Act of Congress of Mar. 3, 1879.

CONTENTS

[1] Withdrawn for publication elsewhere.

[2] Paper not received in time for publication.

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 5 APRIL, 1912 No. 2

Proceedings of the Twenty-fourth Annual Meeting of the American Association of Economic Entomologists—(*Continued*)

Morning Session, Thursday, December 28, 10 A. M.

PRESIDENT F. L. WASHBURN: The meeting will please come to order. The first thing on the program is the discussion of the President's address. Do you care to say anything upon the address? Evidently not. We will go on with the program. The first paper will be read by Mr. Johanssen, entitled, "Wire Worms in Corn and Potatoes."

WIRE WORMS IN CORN AND POTATOES

By O. A. JOHANSSEN, *Orono, Me.*

(*Withdrawn for publication elsewhere*)

PRESIDENT F. L. WASHBURN: Any discussion of this paper?

W. C. O'KANE: We had one experience with wire worms in our Horticultural Department at Durham, N. H., this year, and I should like to have some one explain it. The Horticultural Department started out on some tests with potatoes, on land that had been in sod for forty years. Some of the plots were manured with common barnyard manure; some were not. The wire worms were abundant throughout the whole. The manured plots showed severe injury from wire worms; the unmanured plots showed very little.

PRESIDENT F. L. WASHBURN: Any other point to be brought out in connection with this paper? I understand, Mr. Johannsen, that you got negative results with Sherwin-Williams' soil fumigant. We had the same experience in Minnesota, and I understand that Sherwin-Williams have given it up. They tell me this—that it doesn't amount to very much.

The next paper will be presented by Dr. T. J. Headlee:

THE TIME WHEN WHEAT SHOULD BE SOWN TO ESCAPE THE FALL BROOD OF HESSIAN FLY

By Thomas J. Headlee, Ph.D., *Head of the Division of Entomology and Zoölogy in the Kansas State Agricultural College and Experiment Station*

This is a phase of the Hessian fly problem which has received more or less attention from every student of that subject, and I should not presume to take the time of this association were it not for the fact that I believe it still to be an open question, and one in need of fundamental study.

There can be no doubt that the seasonal periodicity so characteristic of animals and plants generally is exhibited in both the Hessian fly and its host plants—that there is a period of time in the fall during which, under normal conditions of food supply, the emerging flies have the best possible opportunity to perpetuate their kind and that there is likewise a period during which wheat placed in the soil stands the best chance to produce the maximum yield. This period may be designated as the normal time of fall-brood fly emergence and the normal time for wheat sowing respectively. The problem of determining when wheat should be sown to escape the fall brood of fly involves the explanation of the relationship existing between the normal period of fly emergence and the normal period of wheat sowing. Fortunately, experimental tests of the former have been made and recorded in several parts of the country and of the latter in the state of Ohio. One sowing experiment at Columbus[1] continued for nine years gave a normal wheat sowing period of about five and one-half weeks, beginning September 6 and extending to October 15. Another sowing experiment at Wooster,[2] continued also for nine years, gave a period of four weeks, beginning August 31 and ending September 29. The investigations of Webster[3] have shown that the end of the injurious fall brood of fly is reached by September 25 at Columbus and September 20 at Wooster. Thus the normal period of fly emergence is seen to close one to three weeks before the normal period of wheat sowing comes to an end. These normal periods for parasite and host vary in time of occurrence with the latitude and with altitude. This variation is, of course, due to the changes in the climate characteristic of different latitudes and altitudes. To go deeper, we may say that within the limited area covered by the work of Webster and Hopkins, temperature is, in the light of our present knowledge, the only climatic factor sufficiently variable to bring about such large differences.

[1] Bul. 136, Ohio Expt. Sta., p. 13, 1902.

[2] Bul. 231, Ohio Expt. Sta., p. 6, 1911.

[3] Webster, F. M., Bul. 107, Ohio Expt. Sta., p. 275, 1899.

Relation of Time of Seeding to Yield, Columbus, Ohio.

Date of Seeding	1879	1880	1883a	1883b	1884	1886	1887	1888	1889	1890	
8-(22-25)			24.1		35.8		31.7	12.8		16.8	
8-(29-31)				40.0	51.8	41.2	31.6	11.2		16.8	
9-(6-10)	33.2	32.5	34.9		55.6	32.3	28.3	12.1	34.9	19.1	
9-(13-17)	30.3	33.0		42.4	57.2	35.0	31.3	26.6	26.9	20.2	
9-(20-24)	36.4	33.5	34.2	44.7	53.2	38.6	27.8	26.6	27.4	20.9	Date of Safe Sowing
9-(27-30)	32.7	29.5		47.1	54.6	42.1	26.1	26.1	42.4	22.5	
10-(4-8)	26.2	26.2	34.7		56.9	36.5	32.7	28.2	47.3	26.5	Date of Sowing to obtain Maximum Yield
10-(11-15)				38.0	44.4	38.0	30.6	33.0	33.8	22.6	
10-(18-20)					43.6	29.9	20.9	20.8		23.0	
10-(25-27)					35.6	18.9		27.7			

Relation of Time of Seeding to Yield, Wooster, Ohio.

Date of Seeding	1902 Valley	1903 Mealy	1904 Mealy	1905 Mealy	1906 Mealy	1907 Mealy	1908 Mealy	1909 Perfection	1910 Gypsy	Nine year Average	
(8-31)-(9-1)	25.00	30.66	17.33	26.16	39.33	21.83	40.17	36.17	16.92	28.17	
9-(7-8)	26.80	28.00	19.92	22.76	42.75	30.00	45.08	35.50	21.75	30.28	
9-(14-15)	25.50	34.33	23.92	17.58	48.75	31.75	46.75	35.50	26.08	32.24	
9-(20)											Date of Safe Sowing
9-(21-22)	28.50	36.83	24.33	20.50	47.66	31.58	47.12	38.67	26.08	33.61	Date of Sowing to Obtain Maximum Yield
9-(28-29)	25.50	30.66	24.33	18.92	47.08	33.50	46.25	38.58	24.58	32.16	
10-(5-6)	25.50	26.91	19.33	14.26	36.58	28.42	38.17	35.08	23.58	27.54	
10-(12-13)	22.10	21.00	19.87	13.76	33.33	25.08	33.50	36.08	23.42	25.35	
10-(19-20)	15.50	15.25		10.50	28.08	17.08	25.25	31.25	22.54	18.38	
10-(26-27)	9.33	12.41		8.58	25.16	11.25	24.17	15.67	23.33	14.43	

Although almost every writer on Hessian fly has recommended the employment of late sowing as one of the means of control, no important attempt was made to understand the underlying cause for the observed fact until the work of Webster in Ohio and Indiana. Through the medium of widely scattered seedings made throughout the normal period of wheat sowing, Webster was able to show a distinct ratio between the dates of the disappearance of fall brood and the latitude, and this ratio was determined as about one day for each one fourth of a degree—the fall brood disappearing one day earlier for each one fourth of a degree north and one day later for each one fourth of a degree south of a given point. One year later, Hopkins[4] confirmed in West Virginia the latitude ratio obtained by Webster in Ohio and showed that wherever altitude was sufficiently variable to bring about difference in climate, there existed a ratio between the disappearance of the fall brood and the height above the sea. He showed that a difference of 100 feet in altitude made a difference of one day in the time of disappearance of the fall brood—one day earlier if 100 feet higher and one day later if 100 feet lower than a given point. Although Hopkins did not attempt to state these ratios in the form of a law, he set them forth for the first time with sufficient clearness to merit such a designation. In substance he said, under normal climatic conditions the date of the disappearance of the fall brood of Hessian fly and consequently the date of safe sowing of wheat varies with latitude and altitude, being one day earlier if north one fourth of a degree or higher by 100 feet, or one day later if south one fourth of a degree or lower by 100 feet than a given point. This ratio may well become known in Hessian fly annals as "Hopkins Law of Latitude and Altitude."

The universality of this law may be tested by applying it to determine the date of safe sowing over the fly-infested parts of the United States generally. The writer purposes to test it in the light of studies made in Kansas. During each of the last four years, a series of stations has extended from the north to the south boundary of the state through the eastern edge of the great central wheat belt. During each of the last three years, a parallel series has extended through the western edge of that portion of the wheat belt infested with fly.

The individual stations of the eastern series are located from north to south at Marysville, Manhattan, Marion, Sedgwick, Wellington, and Caldwell. The individual stations of the western series are located from north to south at Norton, Smith Center, Wilson, Great Bend, Pratt and Sawyer. During the first two years, representatives of the Bureau of Entomology participated in securing and handling

[4] Hopkins, A. D., Bul. 67, W. Va. Expt. Sta., 1900.

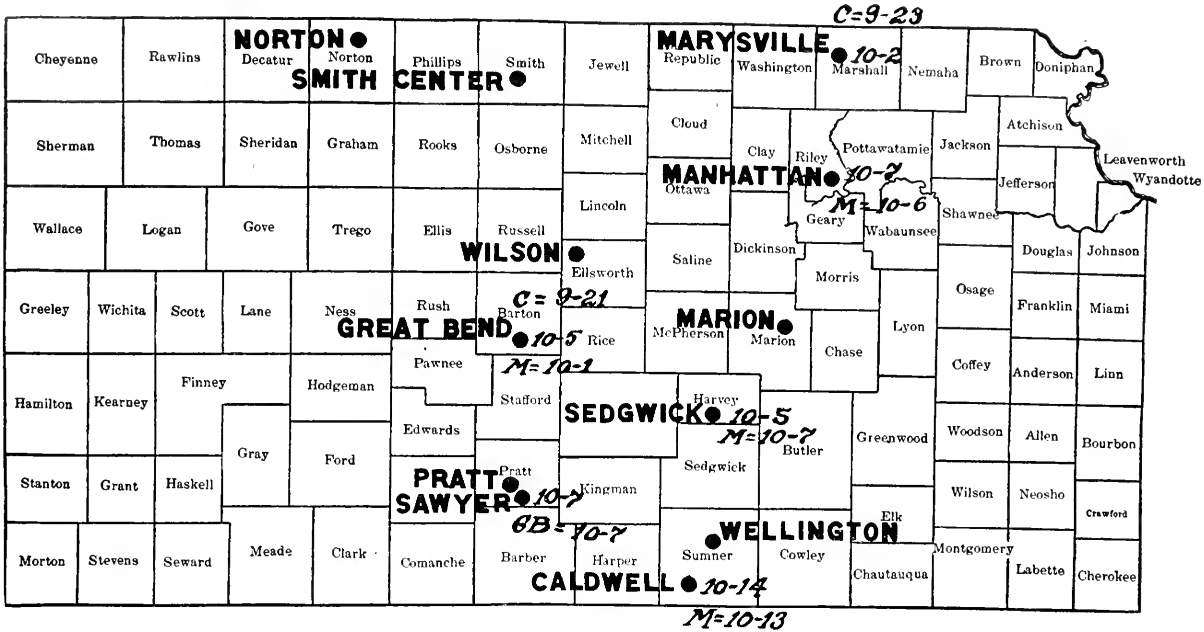


Fig. 1. Map of the State of Kansas showing sowing stations of the last four years. (The territory represented is 400 miles long by 200 miles wide.) C = Theoretic date of safe-sowing figured according to "Hopkins' Law of Latitude and Altitude" from Columbus, Ohio. M = Theoretic date of safe-sowing figured according to "Hopkins' Law of Latitude and Altitude" from Marysville, Kansas. • = Location of sowings and average date of safe-sowing as determined from experimental sowings.

the stations, but since that time, the stations have been secured and managed by the Kansas State Experiment Station, representatives of the Bureau taking such data as they desire. Taking the experimentally-determined safe-sowing date of Marysville (latitude 39° 49′, altitude 1153 ft.) as October second, the theoretic safe-sowing dates for Manhattan (latitude 39° 11′, altitude 1012 ft.), Sedgwick (latitude 37° 56′, altitude 1375 ft.), and Caldwell (latitude 37° 4′, altitude 1107 ft.) for which we have the averages of two or more years of sowings, are October 6, October 7, October 13, respectively, while the actual dates determined by the average of two or more years of experimental sowing are October 7, October 9, and October 14. Likewise taking the experimentally determined safe-sowing date of Great Bend (latitude 38° 22′, altitude 1843 ft.) (in the western series where only two stations have as yet given promising results) as October 5, the theoretic date for Sawyer (latitude 37° 29′, altitude 1913 ft.) would be October 8, while the actual date by one year's test is October 7.

The correspondence between theoretic and actual date is close enough that Hopkins' law may be said to apply to the eastern series and western series when considered as separate units. Here, as in the case of Ohio and West Virginia, the only factor of climate sufficiently variable within the limits of the individual series to produce such variation in time of safe-sowing in relation to latitude and altitude is temperature.

For the purpose of further testing the universality of this law, let us take the date of safe-sowing at Marysville as October 2. Applying the law, the theoretic date of Great Bend (latitude 38° 22′, altitude 1843 ft.) is found to be October 1, whereas two years sowing tests shows the actual date to be October 5. No such discrepancy as this appeared between the actual and theoretic dates in Ohio and West Virginia according to Hopkins. For the purpose of further testing the law, taking the safe-sowing date at Columbus (latitude 40°, altitude 800 ft.) experimentally determined as September 25, we find that the theoretic safe-sowing dates for Marysville and Great Bend are September 23 and September 21 respectively, whereas the actual dates by experimental sowings are October 2 and October 5 respectively. The actual date at Marysville is 9 days and at Great Bend 14 days later than the theoretic. Evidently, this difference is the indication of another powerful factor.

When we review the factors of environment known to retard Hessian fly, which do not vary enough to produce a material difference in Ohio and West Virginia, or in the individual stations of either the eastern or western series, but which do vary enough to make large

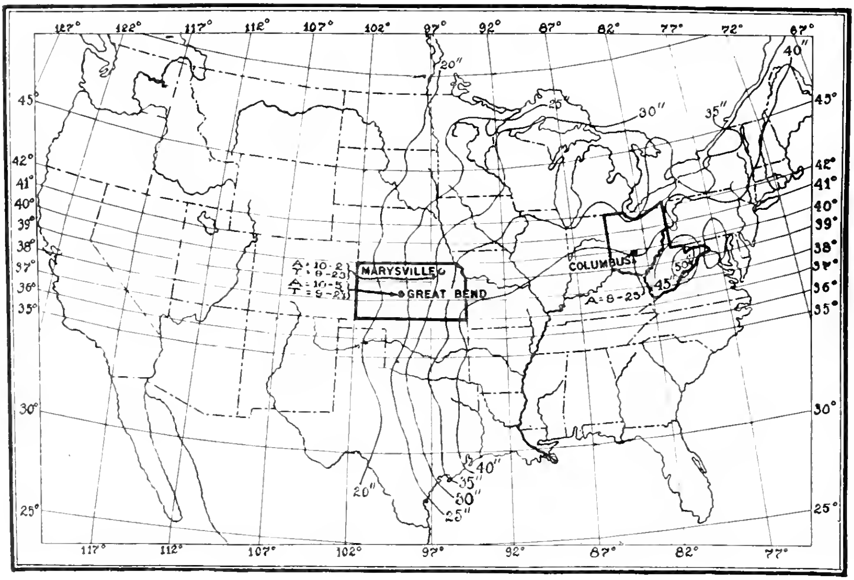


Fig. 2. Map of the United States showing the discrepancy between the theoretic and actual date of safe-sowing in relation to normal annual precipitation. A = Actual date of safe-sowing as determined by sowing experiments. T = Theoretic date of safe-sowing figured according to "Hopkins' Law of Latitude and Altitude" from the actual date of Columbus.

differences between Ohio and the eastern Kansas series and between the eastern and western Kansas series, moisture stands out alone. The following table well serves to bring out the existence of a ratio between the difference existing between theoretic and actual date of safe-sowing and the difference in normal annual precipitation. The ratio appears to be about one day to the inch—one day earlier if one inch greater and one day later if one inch less.

Correlation between Safe-sowing Date and Normal Annual Precipitation

Place	Actually determined safe-sowing date	Theoretic safe-sowing date, taking Columbus as Sept. 25	Difference between actual and theoretic safe-sowing date	Normal annual precipitation
Columbus, Ohio	Sept. 25	....	....	40 in.
Marysville, Kans. ..	October 2	Sept. 23	9 days	30 in.
Great Bend, Kans. ..	October 5	Sept. 21	14 days	25 in.

Of course, it is quite probable that this ratio between normal annual precipitation and the date of safe-sowing may not hold where the precipitation reaches more than forty inches, but it is evident that it must be taken into consideration when the rainfall is forty inches or less. Hopkins' law of latitude and altitude must be modified to include the operation of moisture as well as of temperature.

Even after the entomologist has by means of experimental sowings determined the normal date of safe-sowing in his territory, his work is not done, for there have been and will be cases when for lack of moisture or something else, the fly will be retarded, and, coming out later, infest the wheat sown on the safe-sowing date just as seriously or more seriously than sowings made either before or after. To avoid this, the entomologist should adopt as the normal safe-sowing date the average of dates on which the sowings of several years have been found absolutely free from fly and should, when an outbreak is anticipated, keep a close watch on fly emergence. The date of safe-sowing as shown in the following table follows within a day or two the maximu emergence of the fly.

Relation of Maximum Emergence to Date of Safe-sowing

Place	Date of maximum emergence	Date of fly-free sowing	Difference
Wilson, Kans.	10-10-'08	10-12-'08	2 days
Manhattan, Kans.	10-4-'08	10-5-'08	1 day

The field men can thus check up the progress of emergence and warn the grower if the normal fly-free date is likely to prove too early or materially later than necessary.

President F. L. Washburn: Any discussion of this paper?

F. M. Webster: The results of Doctor Headlee's investigations are really not so surprising, but as a matter of fact, the exact influence of humidity on Hessian fly has never before been so thoroughly investigated. There is a vast difference between the country east of the Mississippi river and that west of it. There is a difference between the humidity of eastern Kansas and that of western Kansas, so that Doctor Headlee has a grand opportunity to study this problem. I do not know of any state in the union that offers the same conditions.

While the data he has given from Ohio is not that for which I am responsible, nevertheless I think that he has done a most excellent and creditable piece of work, and I see no reason whatever for criticizing the accuracy of the results as given. As a matter of fact, we have a modification of these conditions in southern Michigan and northwestern Ohio. The influences of Lake Michigan and Lake Erie exert a very considerable influence on the appearance of the fall brood of Hessian fly. As a matter of fact, the farmer in Michigan, as far north as Lansing at least, can sow his wheat no earlier than can the farmer a considerable distance south of the Ohio line.

We have on record results of wheat sowings made in northern New York in co-operation with the New York Experiment Station, southward into South Carolina, where we worked in co-operation with the Agricultural Experiment Station at Clemson College. West of the Alleghany mountains we have the record of a series of wheat sowings made in extreme northern Michigan where Hessian fly does not occur, southward to central Georgia where our experiments were carried out in co-operation with the state entomologist. Besides these we have a vast amount of information obtained by myself and the men working under my direction throughout northern Indiana.

This mass of material is awaiting the completion of some other work on this species before being published. Not only do I think Doctor Headlee correct in his statements, but I would even go farther and strongly suggest that the absence of Hessian fly in some parts of the country is due to these same influences.

When Hessian fly was destructively abundant at Great Bend, Kansas, it required an expert to detect its presence at Dodge City where wheat is grown throughout and beyond this area and has been for the last 25 or 30 years. When wheat is ruined by Hessian fly in Sumner County, southern Kansas, 20 miles south of Arkansas river in Oklahoma, a good entomologist may find one or two individuals for each hour's search.

There is a great deal of work to be done on this problem, and while government entomologists can work over an area embracing a half dozen states, we do not have either the time or the men to work out problems as carefully within the boundaries of a single state as Doctor Headlee is able to do.

There is another point that always presents itself in connection with these Hessian fly problems. The effect of rainfall on the emergence of Hessian fly in autumn is pretty well known, but there are so many other factors entering into the problem of evading Hessian fly attack that the farmer gets befuddled and is likely to disregard all, or a great deal, of advice given him. A good farmer will often raise a crop of wheat side by side with a neighbor who loses his by Hessian fly attack, so that there comes a point where the question ceases to be an entomological one and becomes strictly agricultural.

Another thing, in the East we never find Hessian fly breeding in grasses. In Kansas I have found it developing as abundantly on *Agropyron smithii* as upon wheat.

T. J. Headlee: I realize that the amount of data, on which the new point that I have to present is based, is so limited that the point must largely be taken as in the nature of a suggestion. I would, however, say that I have some negative data that I am not submitting in this paper.

A. D. Hopkins: Mr. Chairman, it is naturally very gratifying to have this verification of my theory on this subject. I might state that in Bulletin No. 67 of the West Virginia Agricultural Experiment Station, August 1900, entitled, "The Hessian Fly in West Virginia and How to Prevent Losses from its Ravages," I discussed the theory on pages 242 to 246, under the head of "A Law of Definite Normal Rate of Difference in the Periodical Phenomena of Plants and Animals." I will read the three paragraphs in which the essential features of the theory are specified.

"First, that, under similar conditions of land surfaces other than altitude, there is a definite normal rate of difference in time in periodical phenomena of plants and animals for all differences in latitude and altitude.

Second, that, under normal conditions, the rate of the average difference in the dates of the beginning or ending of such phenomena is not far from one day for each fifteen minutes of latitude, and one day for each 100 feet of altitude.

Third, that the dates of commencing or ending of a given period vary with the season,—the weather and local physical conditions, such as exposure and character of soil,—but that the rate of difference under each condition is the same."

This is founded on evidence furnished by natural phenomena which can be observed by any one and which reflect the combined influences that numerous and complex elements exert on plants and animals, such as temperature, humidity, character of soil, exposure, and a number of other factors. The relative difference in any given phenomenon is demonstrated by the relative activity of plants and animals in the spring. When activity begins in any given locality, as for example the opening of the buds, it will do so under the influence of the combination of factors prevailing there.

Therefore, if we note, in any given season, the appearance of a phenomenon at any given place, we can prophesy within a few days of when the same phenomenon will occur at another place, north or south or east or west at varying altitudes, if we know the latitude and altitude. I have verified this over and over again. I have much data, from Maine to Florida and from Washington to the high mountains of West Virginia, secured on railroad trips, which all tends to show that there is a principle here which can be utilized and that it has a broad practical application, not only in the control of insects, the study of life histories of insects, but for the planning of farm operations.

The fact of it is, farmers have recognized and utilized the principle. I remember when I was a boy that the farmers in the community where I was reared planted their corn when the dogwood was in bloom and the new leaves on the white oak were the size of squirrel feet. They had determined, from long experience, that, when the corn was planted at that time, they had the best results. The dogwood and the white oak served as the index. Therefore, we have, all through the country, every spring, similar indexes which can be recognized and utilized as guides to the proper time to do things. During the present year we conducted extensive demonstrations in the control of barkbeetles over quite a large area in northeastern Oregon. The area is practically in the same latitude, but there is quite a difference in altitude. Now, our normal period for the ending of control operations is July 1st, because after that date, under average conditions, the beetles begin to emerge from the trees. So we stopped operations on July 1st, but I kept one of the Agents there to make continuous observations until in August. He found that, while July 1st was the proper date to cease operations at about 4,000 feet because at that date the beetles were emerging and attacking other trees, at 3,000 feet higher up in the mountains it was just thirty days later when they were emerging and attacking the trees. Therefore, control operations could have been continued thirty days longer if we had acted on that principle. Farther south here, of course, we would have had to discontinue the work much earlier. This is simply one example of the practical application of the principle.

President F. L. Washburn: Anything further on this very interesting and practical subject?

T. J. Headlee: Mr. Chairman, I realize that in some branches of our science there is too much of a tendency to theorize on a small amount of data, and that is vicious, but, at the same time, in our economic entomological work, I have come to feel that there is not enough theorizing,—that we work, perhaps, too long, on one subject before we say anything about it. The result of that method is this—that the younger men who are ready and eager to take up these important subjects are not stimulated to do so. It seems to me, if the older men in these lines of work would, from time to time, set forth tentatively results that they have obtained, they would stimulate a vast amount of work along their lines and that, in the aggregate, we would accumulate knowledge more rapidly than by the methods we are now using. I realize, of course, the danger of doing too much theorizing. I should say that it would be very unwise to publish these speculations in our bulletins, except probably the technical bulletins, but that to furnish them to our journals, which are for entomologists only, might materially advance our science.

President F. L. Washburn: The next paper will be read by Mr. R. I. Smith.

THE CORN BILL BUG (SPHENOPHORUS CALLOSUS)

By R. E. Smith, *West Raleigh, N. C.*

(Withdrawn for publication elsewhere.)

President F. L. Washburn: Any discussion of this paper by Mr. Smith?

T. J. Headlee: I would like to ask Doctor Smith whether, in the course of his breeding work, he took into consideration the effects of temperature and moisture?

R. I. Smith: I have kept no records of that, but anticipated that, in working up the results, I would have access to the Weather Bureau records, which were kept within a mile and a half of where I worked, West Raleigh, North Carolina. I didn't keep any records myself. I knew at the time that question was coming up, and they ought to have been kept, but I wasn't in a position to do it.

F. M. Webster: With reference to Mr. Smith's paper, I would only call attention to the fact that *Sphenophorus callosus* is naturally a swamp inhabiting insect. Moisture appears to be an important factor in its development, as we find it destructive almost, if not entirely, in the lowlands.

We, of course, knew that Mr. Smith was working on this problem as well as ourselves, so that we have worked together as best we could. The difference in the situation under which Mr. Smith worked and under which we were working is this, that while very much of his work of was necessity carried on indoors, our investigations have been almost without exception, carried out in the fields. For this reason, we did not think best to withold the results of our investigations for publication until we had gone over the same ground covered by Mr. Smith. Our publication went to press some time ago, and I cannot on the spur of the moment recall all of the matter it contains, but I do not think that where our work has overlapped there is any material difference between the results obtained.

There is one point with reference to this species that is too interesting in view of what was said yesterday with reference to priority. We have here a case where the perfect insect has never been described. The term "callosus" means rubbed, and refers to the rubbed or caloused spaces on the back where the velvety covering has been rubbed off. Beetles taken directly from the cells in which they have developed are covered entirely with a reddish brown coating, which under the microscope has a velvety appearance.

Now if the perfect insects were to be described, the description would be rejected, and that of the imperfect individual retained solely on the score of priority.

R. I. Smith: Mr. President, allow me to say this. Professor Webster just stated that my work had to be carried on in a room about twelve feet square, with wire on all sides, and just the roof to protect me from the sun, and I tell you it was pretty hot down there this summer,—about 102 in the shade for a month or two. But it seemed to me that, under those conditions, it was as near field conditions as possible and still have the work in the laboratory where we could manage it. Of course, I couldn't get any such accumulation of records in the field as he did. My laboratory afforded perfect circulation, and air and moisture conditions were as near field conditions as possible. I didn't want to take the time, but Professor Webster said that he had forgotten what was in his paper, and as he handed me a copy of it to look over there are one or two points I wanted to tell Professor Webster, and if he wishes I will tell them publicly.

F. M. Webster: Go ahead.

R. I. Smith: One statement that I noticed in your paper was in regard to the variation in the size of the eggs, and you stated there was great variation, which, of course, I found out from measurements, and you stated that your men thought the variation was due partly to enlargement of the egg before hatching. I found nothing of the sort this summer. Possibly my records for larval development being much longer were because of being under abnormal conditions.

E. A. Schwarz: The name of *Sphenophorus callosus* has manifestly been derived from the peculiar structure of the pronotum. In many of the genera allied to Sphenophorus two forms occur:—one, being covered with a more or less evident pruinosity and the other without this pruinosity. This can be most readily seen in our common palm weevil of Florida, *Rhynchophorus cruentatus*, but the form without the pruinosity cannot be called abraided. In some of our species of Sphenophorus the pruinosity is much more pronounced and acquires the nature of an argillaceous coating, but even this is more or less absent in many specimens. Regarding the flight of Sphenophorus I have seen *S. costipennis* flying in great numbers along the river at

Detroit, Michigan, in the early spring of the year. Further, I have seen *S. parvulus* in great numbers attracted by the white walls of the Capitol in Washington, where they had flown from the surrounding grassy lawn; *S. ochreus* was seen by Mr. Hubbard and myself flying about in great numbers on July 4th on the shores of Great Salt Lake, Utah, and finally every visitor to Florida can see hundreds of specimens of *Rhynchophorus cruentatus* flying about in the evening of any warm summer day.

President F. L. Washburn: Anything else to be said on this paper?

The next paper on the programme is by the chair, on "Grasshopper Work in Minnesota." Doctor Ball will you take the chair?

GRASSHOPPER WORK IN MINNESOTA DURING THE SEASON OF 1911

By F. L. Washburn, *Experiment Station, University of Minnesota, Minnesota.*

In the western third and half of the southern part of Minnesota grasshoppers of various species have been increasing to such an extent that serious losses have been occasioned. It is not to be understood that the entire grain output of Minnesota has been materially lessened by the ravages of these pests, although in 1910 it was estimated that two-thirds of the flax crop was destroyed, but individual farmers living in the districts above specified lost from 20% to 90% of their crops, and in some cases their entire crop of grain was destroyed. All grains have suffered, as well as timothy, corn, young trees in nursery row, garden products, and particularly flax.

The greatest destruction has, in every case, been in proximity to large tracts of land which have been, perhaps, in tillage some years ago, and have been allowed to revert to natural conditions. Such tracts are the direct cause of all the trouble which we have experienced. It is true we have in Minnesota a grasshopper law which, supposedly, effects the plowing of such dangerous land when infested with grasshopper eggs, but, as a matter of fact, the law is ineffective through faulty wording, and it is utterly impossible for counties to plow this land. For instance, in one township alone in a western county we know of at least 8,000 acres of land which calls for the plow and does not get it. Through the ineffectiveness of this law the owner cannot be forced to plow, and at the rate of $2.50 an acre it would cost this county over $16,000 to take care of reverted land in this single township.

Conditions became so serious in this state that the entomologist secured an appropriation of a few thousand dollars for two years' work in an effort to discover the best method of controlling this pest. With this money four men were paid to be in the field all of last summer. The work of these men was largely directed by Mr. M. P. Somes, of Iowa, and under his oversight a large amount of work has already been accomplished. The efforts of these field workers were directed along certain definite lines. Headquarters were established at Fergus Falls in the Red River Valley, and there, through the courtesy of city officials, we were given a laboratory, and also secured near the city a piece of land for experimentation.

The laboratory work consisted largely of breeding, studying the moults and the raising of parasites, and upon our experimental ground we planted grain crops to test thereon the efficacy and safety of a poison spray to be referred to later. We also secured the co-operation of many farmers of intelligence in the matter of this spraying.

An important feature of the work, and one which took almost the entire time of the leader, and also a large share of the time of one of the other workers, consisted in answering calls of individual farmers who needed advice or encouragement or both. This has taken much time and much money, as one will readily realize, and we have determined that another season this part of the work would have to be discontinued. We are willing to meet and discuss the question with groups of farmers, when such meetings are called for this purpose, but we found that often farmers who had no special occasion for our help, summoned us frequently, although quite indifferent to what we had to say and to our advice. This was not, by any means, always the case, and I believe that, in spite of the large expense occasioned by this variety of work, much good was accomplished by our individual visits.

The attitude of the farmers and citizens generally was one of interest and showed a co-operative spirit, at the same time many instances were met with which were discouraging. This, I believe, is particularly true among those renting farms, who took the attitude that it was not worth while to make any effort, or that, perhaps, the grasshoppers would not be so bad another year, or, they were leaving to go to, what seemed to them, more promising fields, or they doubted the efficacy of the treatment advised, or they thought, some at least, that the state should bear all expense in treating individual farms. We found some criticism and lack of sympathy on the part of real estate dealers, who felt that their business interests were being interfered with by what looked to them like undesirable advertising. In one case, reported upon by Mr. Somes, where a hopperdozer with its victims was displayed in a public street, to show the efficacy of this treatment, interested and misguided citizens ordered the machine and dead hoppers to be removed.

About seventy-nine Orthopterous species were collected and named during the summer's work, which must not be regarded as representing our entire Orthopterous fauna. Of these species, as you will readily imagine, only a comparative few were strikingly injurious, namely, *Melanoplus bivittatus*, *M. atlanis*, *M. femur-rubrum* and *M. differentialis*, to which harmful species we may possibly add *Stenobothrus curtipennis*, and, to a lesser extent, *Camnula pellucida*.

A note-worthy fact in connection with our operations this year is the extreme abundance of *M. bivittatus*, which easily led in numbers of individuals in almost the entire tract referred to above. From being secondary in economic importance three years ago, it has taken the lead this year as being the most abundant of injurious forms. As a fact accessory to the abundance of grasshoppers in Minnesota the past three years, and particularly the past two years, it is to be remarked that two Meloid beetles, *Macrobasis unicolor* and *Epicauta pennsylvanica*, were extremely abundant and injurious in our state during the early part of the summer. Mr. Somes ascribed the abundance of these beetles this year to the abundance of grasshoppers in the preceding year, and I believe his theory in this connection is a good one.

While experimenting with a poison spray we have at the same time urged farmers to use the old-time hopperdozer, personally showing them in many cases how to make the same, and have also been advocating late fall plowing, poison baits in gardens, but particularly to protect the latter, the placing of flocks of turkeys, which not only have an insatiable appetite, as you know, for grasshoppers, but are a profitable adjunct upon any farm. Many farmers believe that a grasshopper striking the drenched sheet at the back of the hopperdozer, or falling into the pan and then getting out, is not killed, and we have been in the habit of assuring them that the slightest drop of oil upon an insect of this kind will kill, and that each one of these grasshoppers is doomed. Mr. Somes' observation this summer would seem to indicate that that statement must also be qualified, and that it must be acknowledged that although short-winged forms or wingless stages that are wet with the oil undoubtedly perish, inasmuch as the oil reaches the spiracles, many long winged forms do not die because of the protection to the spiracles afforded by the wings.

We have not advised the burning over of fields alive with young hoppers, believing the same to be dangerous and of questionable utility in a country where a hay crop is an important feature. We encourage co-operation, and we have especially advised action against grasshoppers, and vigorous action, when they first appear, even if it interferes with other farm work, for we find that whatever plan we follow as regards this pest, that they are much more easily handled, as would be expected, when they are young, than when they have developed their wings.

Our field workers reported only partial success with poison baits, represented by poison bran mash and Criddle mixture, but have, in the course of their work, hit upon a rather unique poison, which they have courteously called the "Minnesota mixture." Finding that arsenite of soda used as a spray, and combined with a little molasses, was very effective against grasshoppers, they substituted this for the Paris green used in making the Criddle mixture. They used the following formula:

Sodium arsenite 1 pound; horse manure 120 to 150 pounds; cheap molasses 1 pint. The arsenite of soda was dissolved in the water then added to the manure, stirring it well.

This is cheaper than the Criddle mixture and can be used in the same way. It forms a very attractive bait for grasshoppers. It was tested upon poultry to see whether these animals, in picking grain from such material, would be injured. Two roosters were fed upon it for some time with no bad results. Incidentally, it may be said that flies are attracted to this mixture in enormous quantities, and are killed by the hundreds in feeding upon it. After this mixture had been exposed for a day in the experiment with the roosters over a quart of dead flies was found on the floor of the shed containing the poultry. This observation might be of value to those who are making a fight against the house fly, and it has been suggested that spraying piles of horse manure exposed in barns and livery stables with a solution of eight ounces of sodium arsenite in about twenty gallons of water, to which has been added about a half pint of molasses, would be a useful measure against the house fly.

Our most prominent work has been done with a poison spray. Aware of the success of arsenite of soda used as a spray in South Africa, I determined to try it in Minnesota, thinking its use might be applicable to large tracts in the Red River Valley which call for treatment. Without going into the details of our experiments in this line, both on a small scale and over large areas, I wish to say that we have been more than pleased with the results, and firmly believe that if made properly and used in the right way, it is our most efficacious means of keeping down the numbers of these pests, which will always be more or less troublesome in the newer, less cultivated districts. We found that 3 pounds of commercial arsenite of soda; 1 ½ gallons of molasses, in 180 gallons of water, made a mixture which was fatal to hoppers and did not in any way injure crops. We used, in most of our experiments, field sprayers which covered 23 feet at one time. We used approximately 50 gallons per acre, at a cost of about 30c, this estimate based upon the retail price of arsenite, namely, 22c per pound. The location of the water supply is an important feature in the cost of labor. Further, we believe that when vegetation is quite rank an acre would call for something more than 50 gallons. This poison did not kill immediately,—from 24 to 36 hours elapsing before the insect gave up the ghost, but it is to be noted that a partial paralysis was the immediate result of partaking of the poison. The insect was immediately made sick and ate nothing.

We received from various farmers of intelligence congratulations upon this method, and statements of their success in using it.

Of course, the question at once occurs to the practical farmer as to whether this is dangerous to stock. We have made tests along this line, and while it must be remembered that any poison is detrimental and frequently fatal if taken in too large amounts, we feel convinced from our experiments, that, as ordinarly used by a farmer bearing the above fact in mind, no bad results will happen. A Holstein bull was fed with forage poisoned with this spray in the above proportions, being fed about 15 pounds of this each day for ten days, and showed absolutely no symptoms of poisoning. On the other hand we observed unpleasant symptoms in a young heifer fed with the same kind of forage, and later, when this same animal was turned upon a grass plot, where the grass has been drenched with poison applied, (through an error of an assistant), three times as copiously as it should have been, after eating ravenously of this over-poisoned forage, rapidly developed symptoms of arsenical poisoning and died. As you will readily see, these conditions would never arise in actual farm practice.

As regards fall plowing it is possible that we will have to qualify recommendations in that connection, and the advice that we have given to this end in years gone by may represent an example of the general acceptance and promulgation of certain remedies, the thoroughness of which has not been properly tested.

In the first place, farmers for the most part will not plow in the late fall. They have large tracts of land to handle, and, as a rule, feel that they must begin their plowing immediately after the crop is off the ground. This is before egg-laying takes place. Our field agent, Mr. Somes, doubts the efficacy of the plow unless it is followed by the harrow. He claims that more real good results from cultivation with a harrow, since that has a tendency to break up the egg masses and expose the eggs to the effects of bleaching and drying, and rendering them more easily accessible to their natural enemies. He further claims that at the time the young hatch the enveloping capsule has become soft and jelly-like, and that the young grasshopper may easily push up through that toward the surface in cases where the capsules are inverted by the plow. He further does not believe that the alternate freezing and thawing of the eggs causes the death of the same, since, being close to the surface, they must be subjected to that in Minnesota every season. He has further exposed to alternate freezing and thawing this winter newly hatched grasshoppers, twenty, according to his report, having been frozen and thawed twice with no mortality, except in the case of one individual, which probably perished through rough handling. In spite of his belief, as here cited, I still hold that turning the eggs under deeply must materially lessen the number of grasshoppers which would naturally emerge the following season, and, plowing being in accord with farm practice, I shall continue to recommend it until we know of something better.

Under the head of Natural Enemies I have not listed all of the known predaceous insects or vertebrates known to attack and destroy grasshoppers,—they are all very well known, I am simply citing certain findings of our own during the summer just passed.

I have always held that *Trombidium*, the so-called red mite, does no serious injury to the grasshopper when fastened to its wings and other parts of its body, or, at any rate, we have observed grasshoppers loaded with mites, ovipositing so frequently that we are convinced there is no material lessening of their numbers through the attacks of the mites upon the adults. But the adult mite in the spring, has been seen to actually feed on the eggs of the grasshopper, and wherever grasshopper eggs are found in abundance my men found there also the red mite very abundant. Small larvæ were found in the vicinity of egg masses by Mr. Somes, which were not reared, but which were believed to be Meloids, and possibly belonging to the genus *Epicauta*. Two flies were reared from Melanopli in our laboratory at Fergus Falls, *Muscinus stabulans*, which was distinctively parasitic with us, and the Sarcophagid, *Helicobia helicis*. This latter fly may have been a scavenger in connection with our work. Mr. Somes also reports the presence within grasshoppers of what appears to be a Syrphid larva. This died before being reared to maturity. Hairs worms were found in abundance in the bodies of *M. bivitattus* and *M. differentialis*. Many predaceous beetles of the genera *Harpalus*, *Pterostichus*, *Calosoma*, *Amara* and *Pasimachus* were observed feeding upon the adult and eggs. Several different genera of Asilid flies were observed attacking various species of grasshoppers in the field.

Among vertebrates that prey upon grasshoppers in Minnesota we have a wonderful ally in the black tern, which, in flying over the grain fields and grass lands in the prairie country, consumes a large number of grasshoppers. In two cases, in two different localities farmers claimed that these birds practically saved their crops. In both cases their farms were located in a marshy area, and during the period in summer when the marshes are dry the terns naturally turn to the feed offered by the grain fields and meadows.

The following Orthopterous species were collected and named:

Tettix granulatus
Tettix granulatus var. variegatus
Tettix hancocki
Tettix obscurus
Paratettix cucullatus
Tettigidea parvipennis
Eritettix tricarinatus
Orphulella speciosa
Dicromorpha viridis
Chloealtis conspersa
Stenobothrus curtipennis
Gomphocerus clepsydra
Ageneotettix scudderi
Opeia obscura
Mecostethus lineatus
Arphia arcta
Arphia (tenebrosa) pseudonietana
Arphia carinata
Chortophaga viridifasciata
Encoptolophus sordidus
Camnula pellucida
Hippiscus tuberculatus
Hippiscus rugosus
Hippiscus zapotecus
Dissosteira carolina
Spharagemon aequale
Spharagemon collare
Spharagemon wyomingianum
Mestobregma cinctum
Psinidia fenestralis
Circotettix verruculatus
Pseudopomala brachyptera
Hypochlora alba
Hesperotettix pratensis
Hesperotettix speciosus
Schistocerca alutacea
Melanoplus scudderi
Melanoplus dawsoni
Melanoplus blatchleyi
Melanoplus atlanis
Melanoplus spretus
Melanoplus femur rubrum
Melanoplus gladstoni
Melanoplus extremus
Melanoplus angustipennis
Melanoplus packardii
Melanoplus luridus
Melanoplus collinus
Melanoplus differentialis
Melanoplus infantilis
Melanoplus femoratus
Melanoplus bivittatus
Melanoplus minor
Phoetaliotes nebrascensis
Scudderia curvicauda
Scudderia furcata
Amblycorypha oblongifolia
Conocephalus ensiger
Conocephalus nebrascensis
Orchelimum glaberrimum
Orchelimum longipenne
Orchelimum nigripes
Xiphidium fasciatum
Xiphidium saltans
Xiphidium nigripleurum
Xiphidium strictum
Xiphidium brevipenne
Xiphidium ensiferum
Ceuthophilus blatchleyi
Ceuthophilus devius
Nemobius fasciatus
Nemobius canus
Nemobius carolinus
Gryllus pennsylvanicus
Gryllus abbreviatus
Oecanthus fasciatus
Oecanthus quadripunctatus
Oecanthus niveus
Anaxipha exigua

We are indebted to Lawrence Bruner and members of his staff for assistance in identifying eight of the above species.

You will note in the above list that Mr. Somes collected and named one *M. spretus*, which I brought with me for your examination. It has the ear-marks of the so-called species *spretus*, and yet in looking at the genital plates I am inclined to think it resembles *atlanis* in this particular as much as it does *spretus*. At any rate the finding of this one isolated example in the midst of so many other species, *atlanis* among the rest, throws doubt upon the validity of *spretus* as a species.

The advantages of spraying early with arsenite of soda are as follows:

1. The grain is short and, therefore, more easily covered.

2. The hoppers are still in masses, hence greater effect with a small amount of poison is secured than later when they are scattered. The young hoppers travel more slowly and must eat continuously while in the poison zone.

3. Large fields, therefore, can be protected by spraying relatively few acres on edges of larger tracts. We found that wild mustard growing amongst the grain was badly burned by the spray, although the grain itself was uninjured.

The efficacy of this spraying is shown by the fact that after one application $2\frac{1}{2}$ bushels of dead hoppers were gathered from one acre of a field twenty-two acres in extent. This would mean over fifty bushels of dead hoppers in that field.

This spray did fine work on flax, one man's crop being saved, whereas that of his neighbor in the near vicinity, who did not spray, was a total loss.

In Minnesota we feel that the best time to spray is between May 15th and June 15th—practically the same period as advised for the use of hopperdozers. Hopperdozers used by the farmers cost from \$5 to \$8 for the 16 foot size, and we purchased a cheap grade of oil, varying from 7c to 10c a gallon at the supply tanks.

A MEMBER: Do you find that your farmers out there invest readily in the spraying machines?

F. L. WASHBURN: They will doubtless do so next summer. That is, a number of them may go in together. These machines cost in the neighborhood of \$90, but a large number of farmers are convinced of the value of the spray and will probably invest.

H. A. SURFACE: I should like to ask the speaker if he finds the spike tooth harrow reaches sufficiently deep to break up the pupa and egg cases or if he thinks the spring tooth harrow necessary.

F. L. WASHBURN: I think the disk harrow is more commonly used there. I should suppose the spike tooth harrow would do it more thoroughly, perhaps, than the disk harrow.

H. A. SURFACE: Do you think a spike tooth harrow would be deep enough to do the work?

F. L. Washburn: Well, you want to get down two or three inches, don't you, about that? I should think it might do.

T. J. Headlee: Mr. Chairman; I desire to comment a little on this subject, basing my remarks on work carried on in this line in Western Kansas last summer. We found the same injurious species that Mr. Washburn describes in Minnesota. We experienced so much trouble with the canvas back of the hopperdozer through the hoppers catching hold of the cloth and springing away unharmed, that we substituted oil cloth with the slick side toward the pan. We tested Criddle mixture, bran mash and the sodium arsenite spray. Our problem was mainly one of preventing the hoppers from moving from native pastures or freshly cut alfalfa into adjacent cultivated fields. For this purpose we find the poisoned bran mash broadcasted each morning over a protective strip along the edge of the field most satisfactory. Criddle mixture prepared by the usual formula was relatively unsatisfactory. Poisoned bran mash, made by mixing 20 pounds of bran dry with one pound of Paris green and bringing the poisoned bran to a stiff mash by adding three and one half gallons of water to which the juice and pulp of three or four oranges finely chopped have been added, has proven more satisfactory than that made according to the usual formula. The poisonous spray at the strength used by the Central South African Locust Bureau killed the hoppers but was unsatisfactory because when dissolved by showers it very seriously damaged the vegetation on which it had been placed.

F. L. Washburn: What strength was that, Mr. Headlee?

T. J. Headlee: That is the strength recommended by the Central South African people.

F. L. Washburn: We found that under no conditions did we injure the grain as we used it.

T. J. Headlee: I think that is a very important discovery.

A Member: I noticed, Mr. Chairman, that you stated it was not necessary to spray the whole field, but that you do "checker board" spraying.

F. L. Washburn: That is when the hoppers are young and they are bound to get on to it. Small checker work, you understand,—not a big square.

A Member: You spray then what percentage of the actual field?

F. L. Washburn: Possibly not more than twenty-five per cent.

M. H. Swenk: Mr. Chairman, I note on the programme that Professor Bruner is down for a discussion on this subject, and he expected to be present, but events transpired that prevented, and I take this opportunity to express his regrets in the matter and extend his greetings to you.

The conditions that Professor Washburn explains for Minnesota were largely the conditions which obtained in eastern Nebraska this year, with the exception, however, that one species greatly predominated, and that species was the one which he finds only in the southern part of Minnesota. In eastern Nebraska,—I mean by that the eastern one-third of the State—this species occurred in the cultivated fields almost to the exclusion of the other species. In the corn fields perhaps one specimen in five would be either *Melanoplus femur-rubrum* or *M. bivittatus*, but no more than that, and of these two *femur-rubrum* was the more abundant. We, therefore, have the unusual condition that, so far as eastern Nebraska is concerned, we have but one species to fight, and that is *differentialis*. This species occurred, however, in tremendous numbers in some portions of the State of Nebraska, and a great deal smaller crops were obtained because of the the presence of that insect. I happen to have with me a couple of very poor prints which will show something of the injury. One of these I want to pass around. It shows a photograph of a very poorly kept orchard. That is perhaps the reason the hoppers abounded there. But this photograph was taken the latter part of July, and the trees had been entirely defoliated, while the grasshoppers even got to eating the bark off the trees until large strips on the branches were denuded of their bark as well as of the leaves. Now, in western Nebraska, we found, that instead of three species, at least fifteen species occurred in the cultivated fields, and of these, at least six occurred in destructive numbers. But there it was *bivittatus* which predominated. In the more southern counties *differentialis* was very abundant, *atlanis* was also very abundant and *femur-rubrum* was abundant in the lower valleys. In addition to these, we had several other species of which there was untold numbers coming into the cultivated valleys from the adjacent or surrounding hills. These hills have never been cultivated, and the acreage so greatly exceeds the acreage of cultivated lands that there is no way which has occurred to us in which to solve the problem of getting rid of these pests. The use of the hopperdozer, the use of nearly all the poisons which we could think of, and even cultural methods, have no apparent effect upon the hordes of grasshoppers, principally *bivittatus*, breeding in this higher land and coming down into the valleys as they grow older.

We noted, in Nebraska, the same conditions of an abundance of blister beetles. In fact, one farmers' convention, called together for the purpose of discussing the grasshopper plague, partially resolved itself into a convention for the discussion of blister beetles, especially when several farmers stated that they had lost their entire crop of potatoes from this cause. The predominating species there was the three-striped species, and this did great injury in certain parts of the State in alfalfa fields, occurring there in swarms and extending over square rods until the alfalfa was simply loaded down with them, and they often destroyed large portions of the field. Westward, the spotted species and one other predominated. We found the conditions very similar to those described by Professor Washburn. We have not experimented as yet with the sodium-arsenite treatment. We shall do that next year. But we did work very thoroughly with poisoned bran mash, using Paris green as the arsenical constituent, and found it very satisfactory in most cases.

GRASSHOPPER CONDITIONS IN COLORADO

By C. P. Gillette

This paper is in no true sense a discussion of the paper by Professor Washburn but rather a companion article setting forth the grasshopper conditions in Colorado.

During the summer of 1910, northern Colorado experienced the worst grasshopper outbreak that I have witnessed since coming to the State over twenty years ago. The grasshoppers that were most abundant were, *Melanoplus bivittatus*, *M. differentialis*, *M. atlanis* and *M. femur-rubrum*, and in about the order named. It was the first year that I have ever known *differentialis* to be as abundant in northern Colorado as *bivittatus*, which is nearly always our most destructive species.

The crops suffering most from the attacks of grasshoppers in Colorado have been alfalfa, grain crops, sugar beets, potatoes, and garden crops. There is no doubt but what the injury to the alfalfa exceeds that of all of the other crops combined. It is common for the farmers in northern Colorado to cut three crops of alfalfa each summer. In the worst infested sections during 1910, only two crops were harvested and the second of these did not exceed one-half of an ordinary crop.

As a result of the severe injuries during 1910, a bill was framed which passed the 18th General Assembly with scarcely a dissenting vote, providing means for the control of farm pests, including grasshoppers and other injurious insects, rodents, weeds, and plant diseases. The bill is commonly known as the Pest Law and provides for the organization of districts, not to exceed thirty-six square miles in extent, where at least fifty-one per cent of the property is owned by holders who have petitioned for the formation of the district and who have designated someone to act as inspector in the district and who also is expected to enforce regulations that are furnished by the State

Entomologist for the control of some particular pest or pests. The inspector is paid his per diem and expenses out of the County treasury and is at all times under the control of the State Entomologist and County Horticultural Inspector.

No pest districts have been formed, as yet, probably for two reasons. In the first place, the law did not go into effect until August of the present year and, in the second place, the grasshoppers in northern Colorado have not been at all abundant during the past summer and fall. This seems very strange as the eggs were deposited in unusual numbers during the fall of 1910 and seemed to go through the winter in excellent condition so that the young hoppers appeared in extraordinary numbers during the month of May. From the time of hatching until the time for egg laying, the latter part of August and during September and October, their numbers rapidly grew less, so that comparatively few of the egg pockets were deposited the past fall.

The great diminution in numbers of grasshoppers during the summer is hard to account for. I have noticed in former years a similar condition, namely, that when the grasshoppers become unusually abundant we are almost certain to have a great reduction in numbers in the immediate future. Apparently, this reduction has been due chiefly to outbreaks of the grasshopper fungus, *Empusa grylli*, which, however, has not been very common the past summer, although it is accountable for the destruction of a great number of grasshoppers in northern Colorado during the present year. Farmers have been of the opinion that the red mites (*Trombidium* sp.) have been largely responsible for the destruction of grasshoppers; but from my observations in the field I have never been able to convince myself that these mites were of any considerable importance either in the destruction of the adult grasshoppers or their eggs, and these mites have not been more abundant upon the grasshoppers during the past summer than usual. The blister beetles (*Macrobasis unicolor* and other species) have been common but not unusually abundant throughout the infested sections. Dipterous parasites (?) Sarcophagidæ, have been reared in considerable numbers from the dead hoppers but we are not convinced that these flies attack the living grasshoppers. So I shall have to confess my inability to assign any satisfactory explanation for the great reduction in numbers of our grasshoppers in 1911.

The methods of control that we have been recommending and that have been most successful are, first, a thorough harrowing of alfalfa fields, ditch banks and roadsides, where the eggs are mostly deposited, at some time during late fall, winter or early spring. I recommend that the harrowing be repeated several times for the purpose of thoroughly breaking up the egg pockets and bringing the eggs to the surface of the ground, where they are quickly killed by the action of the sun, probably aided by frequent freezing and thawing. Wherever it is possible to do so, I recommend deep plowing followed by thorough harrowing and packing of the soil. In the alfalfa fields, our best summer remedy seems to be the use of the hopper-dozer in one form or another. The most popular dozer in northern Colorado is a long box about one foot on each side with the top and back open and covered with a screen. Along the front side of the box is a tin or sheet-iron apron or shield against which the grasshoppers jump and are carried down to a narrow opening at the bottom of the apron, through which they enter the box, being attracted by the light at the top and back.

In potato fields and about market gardens and orchards arsenic-bran mash has been found to be quite efficient. We have not been very successful in the use of arsenical sprays upon vegetation which is being eaten by the grasshoppers.

We have been carrying on a series of experiments during the past year, for the purpose of determining more accurately and completely the full life histories of our more destructive species, with special reference to the egg-laying habits.

Considerable work is being carried on with various remedies also for the purpose of determining which are most efficient and practical to recommend for use upon the farms of this locality. This work has been in charge of Professor S. Arthur Johnson, who will report upon his investigations sometime in the future.

Adjourned.

Thursday, December 28th, 1.30 P. M.

Meeting called to order with President F. L. Washburn in chair.

President F. L. Washburn: A paper by Mr. W. D. Hunter, on "The outbreak of *Alabama argillacea* Hbn. in 1911."

W. D. Hunter: Mr. President and Members of the Association: let me make the statement that this name, *Alabama argillacea*, is nothing more nor less than a name for the cotton caterpillar leaf worm. I shall restrict myself entirely to the manuscript.

THE OUTBREAK OF ALABAMA ARGILLACEA IN 1911

By W. D. Hunter, *Bureau of Entomology*

Undoubtedly one of the most interesting entomological occurrences of 1911 in the United States was the great outbreak of *Alabama argillacea*. After nearly a quarter of a century during which this insect attracted practically no attention it suddenly appeared in extreme abundance. In the south the present generation of cotton planters has had but little experience with it and in many localities it was feared as a serious addition to the list of cotton insects. In the north the appearance of large numbers of moths and the injury to fruit aroused similar fears. Among entomologists the outbreak was almost as unexpected as among the laity, as the general impression has been for some years that it was unlikely that the great invasions of former years would ever be repeated.

In many respects the outbreak of 1911 was similar to those which occurred in earlier years and which were described fully in the reports of Comstock and Riley. This similarity extended to the time of the first defoliation, the gradual progression northward, the flight of large numbers of the moths in northern localities in September and October and the comparative immunity from damage of small local areas throughout the territory where defoliation was generally complete. Nevertheless, there are certain interesting features of the outbreak in addition to the fact that it was entirely unexpected. In 1895 Mr. E. A. Schwarz pointed out that great changes which had taken place in the cultivation of cotton in the United States had reacted upon the cotton caterpillar and that the inevitable result would be a lessened probability of future outbreaks. The observations of entomologists who in more recent years have been connected with the investigation of the cotton boll weevil have tended to corroborate Mr. Schwarz' idea. There have been local outbreaks of some severity but no general defoliation comparable to those of the '70s and earlier decades until the great one which took place during the year just past. So great was the change that the cotton caterpillar came to be considered, to a certain degree, a beneficial insect in regions where the boll weevil occurs and the desire was expressed by many planters that it might be possible actually to increase the numbers of the insects present for the effect it would have towards reducing boll weevil injury.

As has been indicated, the outbreak of 1911 was not forecasted in any definite way. There was practically no defoliation in the cotton belt in 1910 nor during at least three preceding seasons. In fact, there was no indication of the outbreak until it had begun. The earliest seasonal records in 1911 were from Brownsville, Texas and two points not far away in Mexico. In the vicinity of Brownsville as early as May 20th the defoliation had begun and by the 10th of June the great majority of the fields had been stripped of their foliage. From Matamoras in Mexico reports of very early defoliation have been received. The same is true of localities in the state of Durango, Mexico. Although these records unfortunately are rather meager they seem to indicate that the insect became extremely abundant very early in the season in the northern states of Mexico. Whether this infestation was the result of flights from more southern localities or of the sudden increase of local colonies is beyond determination at this time.

In the eastern part of the cotton belt the earliest record of the occurrence of the cotton caterpillar was at Oswego, South Carolina on July fifth. At that time it was exceedingly scarce and in fact did not assume large numbers until the 20th of September.

From the locality near the Mexican border in Texas the infestation radiated rapidly northward and eastward beginning about the middle of June. The flight of the moth did not seem to carry it a great distance in a northward direction. It seemed to obtain an abundance of food after a short flight and was not compelled to make a series of movements.

By the middle of July defoliation began in Louisiana and Mississippi but was not near complete until more than a month later. In North Carolina the earliest occurrence of which we have any record furnished by Mr. Franklin Sherman, Jr., was on August 10th. On September 19th large swarms of the moths appeared at the electric lights in the city of Washington and the invasions seemed to continue until October 29th. These observations were made by Messrs. Schwarz and Pergande who naturally took great interest in it on account of their work on the insect many years before. Mr. Schwarz informs the writer that he does not remember any equally heavy flight of the moths in Washington since about 1882. This northward flight was apparently the result of a development of the fourth or fifth generation of the insect. It is somewhat remarkable that the appearance of the moths in large numbers at lights occurred practically simultaneously at Washington, D. C., Clarksville, Tennessee and Dallas, Texas. This may possibly indicate that there was a heavy inflow of the moths from South America at about this time.

Our conclusions regarding the origin of the outbreak of 1911 is that it started from two infestations. One, apparently unimportant, in the eastern part of the cotton belt, and the other of much greater importance, which began in northern Mexico. The filling in of the intermediate territory in the Mississippi Valley, however, can hardly be explained satisfactorily on the theory that these two invasions increased and eventually coalesced. In fact the general heavy infestation which became noticeable throughout the south early in September can only explained on the assumption that an invasion of moths from across the Gulf of Mexico took place shortly before that time.

With the sudden increase in the moths there arose an enormous demand for arsenicals. In former years it became the regular practice of cotton planters to contract for stocks of Paris green or London purple exactly as they did for other plantation supplies. For many years these stocks accumulated and the planters came to believe that it was unnecessary to procure the poison. At the time of the invasion of the boll weevil in Texas many of the large planters had heavy stocks of Paris green with which they carried on experiments against the new pest. In 1904–5 through the agitation of a charlatan, Paris green, as a remedy of the boll weevil, attracted considerable attention. This resulted in exhausting the poison held in the hands of the planters. This was the situation at the time of the outbreak of 1911. Suddenly an unprecedented demand for Paris green and other arsenicals arose. In a few weeks the larger factories throughout the United States were running day and night and in some cases shipping car loads to remote southern points by express. From the city of New Orleans within two weeks time about 800,000 pounds of arsenicals were shipped into the Mississippi Yazoo Delta.

The history of the activity of *Alabama argillacea* is rather complete from 1793 down to 1881. The discovery of the effectiveness of Paris green and the changes in plantation methods, to which reference has already been made, seemed to have caused the cotton worm problem to become of minor importance. At any rate, the available records of the history of the insect since 1881 are of such meagerness as to contrast strongly with full accounts of the earlier years. In order to place on record the history of the pest since the publication of the Fourth Report of the Entomological Commission, the writer has been at some pains to obtain records from numerous sources. Unfortunately the information obtained is exceedingly incomplete. They may be summarized as follows:

1882 to 1890, practically no records found. 1890 seems to have been a year of unusual abundance. This was especially indicated by the appearance of the moth in great numbers in Canada. In 1895 there was also a flight of the moths in regions as far north as Evanston, Illinois, but no special accounts of injury in the south are to be found. In 1900 there was a more or less general defoliation in the coast counties of Texas. In 1904 a late outbreak occurred in Texas and Louisiana but apparently did not extend east of that state; in 1907 in restricted localities in Texas and, to some extent, in Louisiana. To summarize, for thirty years the insect did not occur in sufficient numbers to attract attention except in six seasons. It is not surprising therefore that the planters had generally come to look upon the species as merely of historical interest.

In the rather extensive early literature regarding the cotton worm frequent references are made to a theory that was propounded in 1846 to the effect that outbreaks are to be anticipated at intervals of 21 years. This theory was proposed after the great outbreaks of 1783, 1804, 1825 and 1846, which, as will be noted, mark regular 21 year periods. In 1846 it was confidently predicted in the press in the south that the next outbreak of the moth would occur in 1867. That year displayed no alarming outbreak of the moth, somewhat to the discomforture of the believers in the theory of 21 year cycle. The following year, however, 1868, witnessed one of the most extensive defoliations that has been placed on record. Really, therefore, it may be considered that the outbreak of 1868 is in the regular 21 year sequence. Twenty-two years from 1868 marks the last of the outbreaks prior to 1911 of which we have any record. It is very striking to note that the outbreak of 1911 is exactly 21 years after that of 1890. Among the eight great outbreaks of *Alabama argillacea* which have been recorded, extending from 1783 to 1911, there is only one which does not fit into the 21 year cycle theory. This is the one which occurred in 1872–3. The writer confesses that he is inclined to discredit the theory and is considerably surprised to find that there seems to be but one marked exception. Probably the matter may be explained as a series of coincidences but this is not quite satisfactory on account of the great regularity in the series.

The most interesting feature of the invasion of 1911 from the entomological standpoint is the effect that it had upon the boll weevil. In one way the caterpillar acted very decidedly against the weevil but in another way it favored it. The injurious effect was the result of defoliation of the plants. This allowed the light and heat of the sun to reach the infested squares on the ground and naturally cause the death of many of the weevils in their immature stages. Moreover, the defoliation caused the complete cessation of the growth of the plant so that no fruit was available for the weevils that succeeded in emerging from sheltered conditions on the ground. On the whole the effect of the defoliation was extremely disastrous to the weevil. In fact, this important check coming as it did at the end of a series of three consecutive seasons in which the climatic conditions were very unfavorable for the weevil was a very important factor in the production of the remarkably large cotton crop of 1911.

The other effect which the cotton caterpillar had upon the weevil was to increase the extent of the dispersion movement in the late summer and fall. The defoliation was generally practically complete at the normal time of the height of the dispersion movement. The weevils would arise from a field and fly to another which they would find defoliated and then set out upon a series of flights that in many cases undoubtedly carried them far beyond the limits they would have reached if normal cotton had been available. Consequently the most extended northward flight of the weevil on record has been found to have occurred in 1911.

As the result of the effect upon the weevil and the fact that the height of the outbreak did not occur until comparatively late in the season, it cannot be claimed that the invasion of 1911 was especially injurious to the crop.

A factor of the situation in which the cotton planters, if not the entomologists, are especially interested is whether there is likely to be another outbreak during the coming season. From *a priori* considerations it seems probable that such repetition is likely to occur. At any rate the chronology of the insect shows a distinct tendency towards series of two or three years in which the damage gradually culminates. On this basis it might be supposed that the invasion of 1911 will be followed by a heavier one next year. Of course, any prediction is extremely hazardous as much depends upon the climatic conditions that may occur between now and spring. The writer has under way studies which may throw light on this subject and for the present will be compelled to withhold a definite prediction as to what may be expected.

President F. L. Washburn: Any discussion of this paper?

Wilmon Newell: Mr. President, I would like to ask Mr. Hunter what, in his opinion, would make the outbreak the coming year less serious than the present one.

W. D. Hunter: Extreme fluctuations in temperature will undoubtedly be the principal factor, and unquestionably a certain degree of humidity. I think, in all probability, the case will be very similar to that of the boll weevil, in which the humidity during the winter months is one of the very important factors in the survival.

Wilmon Newell: You think that high humidity during the winter will be in favor of the insect?

W. D. Hunter: Exactly.

President F. L. Washburn: Does that insect come to maturity on anything other than cotton?

W. D. Hunter: That brings up an old question debated much in the early days. The conclusion arrived at from numerous observations and breeding experiments was that there was absolutely no other food plant. One fact that caused the theory of another food plant to be propounded, was the occurrence of apparently unrubbed specimens in the late fall and early spring. We have two records of unrubbed adults captured at Racine, Wisconsin, one on the 15th of February and one on the 23d of February. I think those cases are explained, however, on the peculiar structure of the wing scales, which are of such a nature as not to be easily rubbed off, as in most moths.

FRANKLIN SHERMAN, JR.: Our first outbreak of it in North Carolina was reported from the 10th to the 15th of August, northeast of Raleigh, and during the two weeks following that time, from the middle to the last of August, we had a dozen reports of it from that section of the State. Two weeks later we got a lot from the cotton growing section of North Carolina, so that during the season we had it practically through all of our cotton growing sections. During eleven years this is the only year in which we have had general destruction by the cotton worm in North Carolina. In the fall of 1905 there was an outbreak in two or three counties in the east central portion of the State.

CORNELIA F. KEPHART: Mr. President, it might be interesting to you to know that up in New Hampshire we had two correspondents send in specimens of this insect, and they claimed they were flocking around in great numbers.

H. A. SURFACE: Mr. President, I was going to say, as a matter of record, that there was quite a flight of these insects northward, I should say, that from the twentieth of September until the second or third of October they were reported throughout Pennsylvania, as one writer said, "countless multitudes, so as to fill the air as by a snow storm," and thousands were sometimes found under a single electric light, and we had them sent to us from almost every county in Pennsylvania.

B. P. MANN: Gentlemen, in looking around, I think I am the only entomologist present connected with the investigation carried on by the United States Department of Agriculture in the early days, and at that time, from 1876 to 1881, we had a little flight of the cotton moth exactly in the same way as we had this year. The air was so full that finally we got to making observations on the food of the cotton moth, and we didn't pay any attention to the moth itself. It was more directed to finding out the food plant of the cotton moth outside of the cotton belt. Well, that went on for years. There were two parties, one led by Dr. C. V. Riley, who advocated the theory that the cotton moth was a native of the United States and had a food plant outside of the cotton belt, and the other party led by Prof. A. R. Grote, who contended that the cotton moth was not a native of the United States and that it had never hibernated in the United States. In the course of time, Professor Grote proved to be exactly correct. The cotton moth never hibernates in the United States and never has any other food product to feed upon outside of the cotton plant. Well, that makes the Northern flight of the cotton moth much more interesting than we ever thought.

E. A. Schwarz: Many years ago, when the cotton worm moth investigation was carried on with vigor the theory prevailed that the moths hibernated within the cotton belt of the United States, Prof. A. R. Grote, alone, maintaining the opposite view. During the winter of 1879–80 I had been sent on a mission to find hibernating cotton moths or their chrysalids. I went throughout the whole width of the cotton belt, even extending my trip to the Bahama Islands without finding any trace of hibernating moths or chrysalids. Nor has anyone else been able to find any hibernating cotton moths within the United States. In short Professor Grote's opinion has now been generally accepted: viz., that the cotton moth comes to us from some part of tropical America, and probably from some part of Brazil. Of later years I have been in Cuba where cotton is indigenous, but not cultivated to any extent. Here the boll weevil and the cotton stainers (*Dysdercus*) are common enough, but the larva of *Alabama argillacea* is extremely rare and only on one spot could it be collected in moderate numbers: viz., on the hills overlooking the little watering place of Cojimar where a small cotton patch has been planted as an experiment. Subsequently I visited the eastern part of Guatemala where the cultivation of cotton is carried on in a very limited scale without finding the caterpillars; nor did I find any trace of them on the isolated cotton trees at Tampico and Victoria, Tamaulipas. The few perennial cotton trees to be found along the Canal Zone, Panama, were also free from the caterpillar. The Mexican cotton belt at Torreon seems to be protected from the invasion of the cotton moth by its arid climate, and that, the same region is free from the cotton boll weevil, is, in my opinion, only due to its isolation, the nearest weevil infested region being several hundred miles distant.

The migration of the cotton moth north of the cotton belt in the United States has years ago been a familiar sight and numerous references thereto can be found in our literature of about 30 to 35 years ago. At that time the theory prevailed that the cotton moth had some other food plant within the northern states. This theory has long since been abandoned and the northward flight of the cotton moth whenever it occurs, is a most remarkable and unique phenomenon in the domain of entomology. In former years very little attention was paid to the duration of such flights but in the present year the duration of the flight has been watched at Washington, D. C. It extended from September 19th to October 19th as will be more fully found to be published in the forthcoming number of Proc. Ent. Soc. Wash.

President F. L. Washburn: Anything else on this paper?

H. T. Fernald: I simply wish to report that in Massachusetts we secured this species in considerable numbers on the 28th of September.

H. A. SURFACE: Just one important observation should be recorded. I found them very injurious to Salway Peaches. I found that after the fruit ripened they would insert their probosces, sucking out the fruit in a circle half an inch in diameter and they would also stain the fruit brown, a very serious damage, amounting to many dollars.

E. N. CORY: I would like to make a report from the Maryland Station of the occurrence in large numbers of this moth at Adamstown, in Frederick county, and cite a report by a correspondent that the moth was injuring crops, puncturing grapes and feeding on the juices to a considerable extent. We were unable to verify the report.

PRESIDENT F. L. WASHBURN: We will have to stop this discussion here, I am afraid. The next paper will be read by Mr. Jennings, on "Some Problems of Mosquito Control in the Tropics."

SOME PROBLEMS OF MOSQUITO CONTROL IN THE TROPICS

By ALLAN H. JENNINGS

That part of Panama which comprises the Isthmian Canal Zone lies in about 9° of north latitude and is characterized by a typically tropical climate, high humidity, heavy rainfall, and a short dry season, usually lasting not more than four months, sometimes decidedly less. A rich virgin soil is clothed by dense and luxuriant vegetation. Of a hilly, in some parts mountainous topography, it is well watered by numerous brooks, streams and rivers. The climate is equable, the temperature never rising to excessive heights, and the seasonal variation is slight. High winds and violent storms are practically absent and thunder storms, even without wind, are rare compared with their occurrence in the temperate United States. In the rainy season, when well established, precipitation is not constant; the daily rain usually occurs about noon and continues for a longer or shorter period, the nights and mornings being usually clear. The yearly rainfall is not equal in all parts of the Canal Zone; the extremes are noted at Colon and Panama, precipitation being about twice as heavy at the former place as at the latter. While least rain falls at Panama and in the country close to the Pacific coast-line, heavier precipitation begins several miles before the divide is reached at Culebra, and from the latter point to Colon, about thirty-three miles away, the rains are very heavy.

As is to be expected in a country exhibiting such conditions, the mosquito fauna is rich and includes about 125 species representing all the genera typical of tropical America. The seasonal incidence of many species is but slightly marked, breeding continues throughout the year and is only relatively reduced in the height of the dry season. In fact in some localities and with certain species, it actually increases at that time, for water courses and rivers which during the rains, by reason of rapid current and proneness to floods, offer no opportunities for mosquito propagation, become during the dry season a succession of pools or long reaches of stagnant water in which Anopheles and Culex species fairly riot in their abundance and, unless checked, are a serious menace to the population of the vicinity. Æstivation, at least as regards most species and especially those of economic importance, seems not to occur as oviposition takes place whenever opportunity in the shape of water is to be found. Economically important species are abundant, including at least nine species of Anopheles, the nearly cosmopolitan *Stegomyia calopus* and *Culex quinque-fasciatus*, and other species which are abundant and annoying pests. Only a few of these are of known pathogenic habits, but all except the most retiring of the sylvan species have to be reckoned with by the sanitarian and included in the programme of control.

The range of habits in the species is wide and extremes in specialization of form and habit are seen, especially among the sylvan species. Many are restricted to a certain type of breeding place, the water-bearing flowers of a certain genus of plants, or even to those of a single species. Others among the sabethines and culicines are less exacting and are to be found beyond the strict confines of the bush, will breed in artificial containers, and are occasionally to be found in the adult state about houses, if the latter are in reasonable proximity to their breeding places.

In connection with specialization or restriction of habit should be mentioned *Stegomyia calopus*. This mosquito is intensely domestic, is never found, except by accident, away from the immediate neighborhood of man's habitations, and will breed only in such artificial vessels or situations as it there finds. This rule is absolute and I know of no exceptions thereto having occurred. I have known this mosquito to breed in water-filled hollows in trees standing beside inhabited dwellings, these filling the same rôle as the artificial container, but never in ground water of any description. These habits entail a line of control work, totally different from that employed against Anopheles, the details of both classes of work I will discuss later.

Anopheles albimanus, among pathogenic species, is by far the most important, under present conditions, not excepting *Stegomyia calopus*. Not only is it the most abundant of the Isthmian species of the genus but its persistence in biting and in gaining entrance to habitations are greater than is the case with any other species. In addition to this, it has been shown that upon ingestion of the parasites of malaria, a larger percentage of the females became infective and able to transmit the disease than occurs with any other species of the region. The breeding places of this species show great diversity of character, though preference is shown by the mosquito for stagnant, fairly pure water, exposed to direct sunlight, with a growth of Spirogyra, which alga is a favorite food. Sewage contamination is inimical to the species when such contamination is marked. Rapidly flowing water also is unsuitable and streams with a strong current are usually quite free, except in back waters and hollows where the current is little felt. I have never taken *albimanus* in artificial containers except in one or two instances when the occurrence was evidently purely accidental. With the exception of foul or swift water they may occur in almost any collection of water, however small or seemingly unsuited to mosquito propagation. Hoof-prints, wheel-ruts, the smallest puddle or thinnest film of water seeping upon the ground from a wet hillside, particularly if the ubiquitous algæ are present, are points of danger and must be included in the control work. For an *Anopheles* the flight of *albimanus* is strong and observations, which unfortunately fall short of demonstration, indicate that, under a proper combination of circumstances, it will cover a distance of at least one mile from its breeding place. While not domestic in the same sense as *Stegomyia calopus*, *Anopheles albimanus* is closely associated with man and finds its most congenial surroundings about his habitations and in the conditions he creates in the course of agricultural, engineering and other work. This fact is correlated with the highly developed blood-sucking habit and has been an active factor in its development and in establishing the economic importance of the species.

Anopheles tarsimaculata is much less abundant and widely diffused on the Isthmus than *albimanus* and, though it is exceedingly numerous in certain localities, it is largely confined to the Atlantic seaboard. I have observed but few individuals of the species more than six miles inland, that is, away from conditions obtaining upon the low coastal plain. Where it occurs abundantly it is as great a pest as *albimanus*, which occurs coincidentally with it in the neighborhood of Colon and Gatun. It also is a transmitter of the malarial parasite and the habits of the two species are similar.

Anopheles argyritarsis is less abundant than either of the foregoing. It is known to transmit malaria, at least occasionally. It is widely distributed over the Isthmus but its numbers are never very great in any locality and it is not very frequently found in buildings. By reason of these facts, it is far less important economically than *Anopheles albimanus* and *tarsimaculata*. It is the only species of Isthmian Anopheles which breeds readily in artificial containers. In ground water it prefers the smaller collections, such as water seeping from springy hillsides and filling the smaller depressions in soft ground, also ditches carrying but a trickle of water and similar situations. It seems quite dependent upon the presence of algæ.

As an annoying pest and as a malaria carrier *Anopheles pseudopunctipennis* falls below *Anopheles albimanus*. It occurs abundantly from ocean to ocean but is somewhat more discriminating than the latter in choice of breeding places. It prefers as a rule water of greater purity and rapidity of current. The larval food, like that of *albimanus*, is by preference the soft green algae, though it does not scorn, lacking better, many places departing quite widely from the chosen type. At times its abundance is enormous, though usually far fewer of this species will find their way into buildings than is the case with *albimanus*, and its flight is less vigorous. Biting experiments with *albimanus* and *pseudopunctipennis* have shown that under identical conditions less than one *pseudopunctipennis* becomes capable of transmitting malaria to five *albimanus*.

Anopheles malefactor is widely distributed and abundant locally. It is a large handsome species, a vigorous biter, active in entering houses, but apparently does not transmit malaria, as Darling failed to infect individuals which were fed at the same time and upon the same patient as specimens of *albimanus* which became infected.

In addition to the foregoing occur *Anopheles punctimacula*, which I have never taken and is certainly rare, and *Anopheles apicimacula*, which is fairly abundant locally and occasionally. It does not often find its way into screened buildings and its breeding habits are not peculiar though a preference is shown for semi-sylvan situations with more or less shade. Temporary grassy pools formed by heavy rains or overflowing streams, waterfilled depressions in low bush, completely shaded and devoid of visible living vegetation seem to be the characteristic breeding places.

Anopheles eiseni is a strictly sylvan species and breeds in depressions in the rocky beds of mountain streams, where protection from the rapidly flowing current is afforded; also in tree holes and bamboo stumps. It is fairly abundant in favorable localities, yet I have never observed adults of the species at large by day, even in the dim light of the dense forest, nor at night when camping in the vicinity of active breeding places. I have no record of its entrance into buildings and have never taken the larvæ even a few yards beyond the edge of the forest. The relation of *eiseni* to malaria is not known as it has been impossible to collect and breed sufficient material with which to work.

A species closely related to *Anopheles cruzi* is remarkable for its habit of breeding only in water held in the leaf axils of various species of epiphytic bromeliads. In certain highly favorable localities the larvæ of this species are fairly common, though never abundant in the sense in which the term is used in connection with the commoner species. An exceedingly humid climate with heavy rainfall, fostering a luxuriant growth of bromeliads, is the only condition under which I have taken the species, which is yet to be recorded from within the strict boundaries of the Canal Zone. My material was all collected at Porto Bello on the coast, twenty miles east of Colon, and some seventy miles in the interior, near the headwaters of the Pequini River, both localities being within the area of heaviest rainfall of the region. Like the last, this species was not observed free in the adult state, even when in camp near its breeding places. Nothing is known of its relation to malaria transmission. Its rarity and the infrequency of conditions suitable to its propagation along the line of the canal render it economically negligible.

In the foregoing notes, the data relating to the transmission of malaria by Isthmian Anopheles are quoted from the published work of Dr. S. T. Darling, Chief of Laboratory, Ancon Hospital.

The division of the Department of Sanitation charged with the work of mosquito control is composed of a chief sanitary inspector and his assistant, three division inspectors, and about twenty-five inspectors apportioned among the seventeen line stations or districts. Each district inspector is held responsible for the physical condition of his station as it affects the breeding of mosquitoes and indirectly for the "malarial rate" or cases of malaria occurring each week as expressed in terms of percentage of population. In addition, he is charged with the enforcement of the sanitary regulations in his station, a matter of no small importance and even of difficulty in the case of the native towns. In the latter duties he is supported by the police of the Canal Zone, when such support is necessary. Co-operation with the local district physician in all health matters is enjoined and daily reports of malaria cases recorded at the dispensaries are sought for and obtained. Frequent inspections of the entire station are made by inspector or his assistants, these inspections including the most minute detail of all physical features to the end that breeding may be anticipated, or, if already established, be noted and remedied at the earliest moment.

The regular program of oiling is laid out by him and executed by the foremen of oilers under his general supervision and inspection, as is the work performed by other departments for the Department of Sanitation. Inspection of native and American towns for Stegomyia and Culex breeding containers is made, either by himself or assistants or by negro foremen closely checked by the inspector. The results of these inspections, the number of containers with larvæ found and of houses inspected are reported weekly to headquarters, as are the results of the mosquito catch in barracks. In this report are given the number of each house inspected, the times inspected, and number of each class of mosquitoes captured, also the total number of mosquitoes taken in the station. These and the reports of the division inspectors, who visit the stations at frequent intervals, the number of malaria cases which have occurred during the week, together with all the factors involved in the situation, are carefully considered. The result of this study is taken to indicate the condition of the station and upon it is based the program for future work.

Previous to the advent of the Americans in 1904 the Isthmus of Panama had not enjoyed the benefits of any efforts at control of the universal pest of mosquitoes and the accompanying scourges of malaria and yellow fever. Indeed, so new were the discoveries which established the connection between these diseases and their insect transmitters, that the days of active prosecution of canal work by the French had passed before the results of the discoveries became practically available to the world, for the control of such conditions as then prevailed in Panama. With the entrance of the U. S. Government upon the field, the work of controlling and eradicating the twin pests which had so long dominated this part of tropical America was taken vigorously in hand.

At first directed entirely against yellow fever, then frequently occurring in the ports of Colon and Panama, it was, when that disease had been stamped out, extended to the control of malaria and eradication of Anopheles mosquitoes in the inhabited portions of the Canal Zone. The result is that today yellow fever may be regarded as a remote possibility and malarial incidence has long been reduced to such a point that the health of the Canal Zone bears favorable comparison with that of most portions of the continental United States. I should add that in the maintenance of such desirable conditions, as far as yellow fever is concerned, an efficient quarantine has effectively co-operated with the Department of Sanitation by successfully excluding all cases of the disease.

The character of the population of a country in which the control of mosquitoes and the reduction of malarial disease is attempted, plays an important part in the success or failure of the undertaking. An intelligent and tractable population will greatly aid in the thoroughness with which mosquito control work may be accomplished, while opposite characteristics will throw many obstacles in the way of physician and sanitary inspector. It is interesting to note that the employee population of the Canal Zone is highly cosmopolitan and includes representatives of more than twenty nationalites. A large part of the manual work is performed by West Indian negroes, while a large minority of the laborers are Spaniards from old Spain, some Italians and a few Greeks. Few native Panamanians are employed, as they do not take kindly to severe manual labor and usually prove rather inefficient.

Of the laborers living in Commission quarters, the West Indians as a whole give probably the least trouble in the enforcement of sanitary regulations, owing in part to their submissiveness to recognized authority and their habits, having been taught by experience the danger of exposure to the "night air" or rather the inhabitants thereof. The Europeans from non-malarious countries, however, are restive under restraint and freely expose themselves, during nightly wanderings and otherwise, to malarial infection. Both classes have during late years shown a strong propensity to "go to the bush" and, squatting upon a patch of land, usually beyond the area of control work, build a shack, of course unscreened, and live, working intermittently for the Commission, exposed to all the unwholesome influences the country has to offer.

In the work directed against Stegomyia and house mosquitoes the inhabitants of the so-called "native towns," populated largely by ex-employees and intermittent workers, are through ignorant carelessness the cause of much trouble to the sanitary force and their premises require constant inspection. It is difficult to convince the average "Jamaica lady" or her spouse that the presence of a tin full of water and "wrigglers" upon their back porch is anything more than a venial sin. Innumerable and ingenious excuses are offered but often arrest and fine are the only means to effect reform.

No less important than the anti-malarial work but of a radically different character, Stegomyia eradication is merely a matter of painstaking, conscientious and thorough inspection of premises and their contents, the destruction of useless containers, efficient screening of water barrels and cisterns, and oiling of such receptacles as cannot be otherwise protected. If yellow fever be present, the fumigation of houses for mosquito destruction is also necessary. The measures directed against Stegomyia of course control the other, and next important house mosquito, *Culex quinquefasciatus*, and in practical work no distinction is made between them. The presence of "mosquito larvæ" of any species is sufficient cause for reprimand or fine as the case may be.

At the beginning of the work, with so gigantic a task to perform in the shortest possible time, the most energetic efforts were necessary and measures were adopted that would produce the most immediate, although temporary, results. When the situation, however, was somewhat in hand, the practice was modified and work of a more thorough and permanent character undertaken. The principle underlying mosquito control as now practiced in the Canal Zone is the gradual creation of permanent conditions inimical to mosquito propagation, while the situation is kept in hand by more or less superficial and temporary work. Prophylaxis is practiced in the careful screening of quarters and the administration of quinine, as universally as possible, to those exposed to infection.

The attainment of the ideal condition of a permanently mosquito-free territory through artificial means is manifestly impossible in such a climate as that of Panama. The battle with nature is unending and the slightest relaxation means a rapid reversion. Yet work of a permanent nature is, in the end, far more economical and leaves the sanitary forces free to carry on the fight upon the outlying portion of the controlled area, gradually forcing back the danger line and extending the zone of permanent improvement. By permanent work is meant primarily the thorough and rapid drainage of the land, either by the use of tile or by open concreted ditches, the drainage of permanent swamps and the filling in of low ground. Open ditches through earth or clay are exposed to rapid deterioration and require constant care, with attendant expense and lower efficiency.

Among the important phases of permanent or semipermanent work is the clearing away of the bush or jungle which would give shelter to mosquitoes in the vicinity of habitations. The area cleared varies with the conditions, but usually a belt approximately 1000 feet wide about inhabited buildings is desired. The cutting of grass in the same situations should be included with the work just mentioned, though this must be performed sometimes as often as once each month.

As a supplement to permanent or temporary drainage, the means on which most reliance is placed is the use of larvacides, either in the shape of crude oil or a combination of caustic soda, crude carbolic acid and resin, which is manufactured by the Department of Sanitation. Each of these materials has its faults and advantages. The oil is bulky and drifts with the wind to one end or another of the body of water, leaving a large part of the surface exposed to oviposition. When "cut" with about ten per cent. of the "larvacide," by which broad term the manufactured product is designated, it is largely used on small collections of water, such as hoof-prints, where the surface can be entirely covered and, unless floated out by inundation of the hollow, the effect is very lasting. Its bulk is a serious obstacle to its use and tanks, filled from the tank cars in which it is received, are placed at various points in each station which can be reached by rail. Barrel carts are used to transport the oil where roads exist; but in rough and broken country, pack-mules must be resorted to in distributing the supply to the oilers and in filling drip barrels. The oil is applied by means of a knapsack spray-pump and by drip barrels provided with a specially devised spout from which the oil drips slowly. These are placed at the head of ditches and small streams at a good height above the water, upon striking which, the drop spreads immediately to a thin film and floats away. This automatic method is very effective.

The manufactured larvacide possesses the advantage of very much less bulk, though this is partly offset by the fact that the entire body of the water is permeated and a correspondingly larger amount of the preparation must be used. It also is applied by spray pumps at a strength of about 20 per cent. in water. It is quickly fatal to the larvæ of mosquitoes but unfortunately also to fishes and the predaceous larvæ of dragon and damsel flies and other aquatic insects. Its effect is quite evanescent and it must be renewed at short intervals, but the thoroughness and quickness with which it does its work renders it exceedingly effective. It is not suited to use in bodies of water of large volume, though when applied to the edges of even large streams the results are excellent. Though sometimes unavoidably interrupted, the plan of oiling operation provides for the covering of all territory every seven days, and this period is sometimes shortened in case of necessity. This effectively anticipates any possible emergence of adult mosquitoes, should breeding have recommenced.

The catching by hand of mosquitoes in barracks to which they have gained access is an important aid in preventing malarial infection. Colored laborers, chosen from the oiling gangs for intelligence and reliability, are selected for the purpose. These men are armed with killing bottles charged with chloroform with which they go through the buildings, catching the resting mosquitoes, of which they secure a large percentage. The visits are made daily or at longer intervals as the degree of infestation demands. After once entering a well screened building, few Anopheles escape and if the blood-filled female is overlooked by the catcher upon his first round, she is almost certainly captured before she has reached the infective period. An adjunct to the killing bottle, in the shape of a wire gauze fly killer or "swatter." in the language of the day. is also carried by the men and is useful in securing such mosquitoes as are inaccessible to the killing bottle. Small electric torches have been used by inspectors in examining buildings for the presence of mosquitoes and are very useful, especially upon overcast days and in poorly lighted native houses. The fumigation of buildings for the destruction of Anopheles mosquitoes is not now often practiced and is resorted to only in rare cases of excessive infestation and malarial infection.

The natural checks to mosquito propagation, which are often effective in northern countries, fail as an important aid to control work where plant life is so exuberant and the multiplication of mosquitoes so prolific and persistent as is the case in Panama. Small fishes of many species, including several of Gambusia, are very abundant and occur in the smallest brooks and open ditches. Though they destroy many larvæ, they cannot effect the eradication which is essential to the work and must be disregarded, together with predaceous aquatic insects.

Special and exceptional problems are being constantly presented, due in many instances to the engineering work connected with canal construction. Swamps of large area are sometimes unavoidably created and before drainage can be effected, breeding of Anopheles has assumed formidable proportions. The gravity of the situation is also, often increased by the difficulty of applying control measures. In some instances boats of shallow draft have been employed to carry powerful force pumps capable of throwing oil many feet, the crew being armed with axes and machetes to cut away tangled undergrowth. Hydraulic fills, formed of the material from suction dredges spreads over low-lying areas, are among the most serious and difficult situations to control. Breeding is active, especially as the water drains away and evaporates, while the soft mud, often with a deceptive crust upon it, offers an almost insuperable and often dangerous obstacle to penetration of the area. Slides of earth and mud, developed in the course of excavation, often cover areas many acres in extent and are always prolific breeding places. Like the hydraulic fills, they are difficult, and even more dangerous, to venture upon.

The great Gatun lake, with its approximately two hundred square miles of area and hundreds of miles of rugged shoreline, bids fair to offer many problems as its level continues to rise. In the sheltered bays and indentations of its shore line, aquatic vegetation riots, and, as the waters inundate the tropical forest, a condition is created, ideal for the most prolific breeding of Anopheles and other mosquitoes; a tangle of living and dead vegetation, with floating debris from the dying trees, among which water plants flourish. A large part of the breeding areas formed will probably affect only scattered habitations and ranches but, wherever settlements and towns are contiguous to the permanent shore line, correction of these conditions will be imperative. It is obviously impracticable to thoroughly clear and control square miles of territory, covered with heavy timber and soon to be buried beneath the waters of the lake, but until the permanent level is reached the uncleared and shallow margins of the lake will supply myriads of mosquitoes to the adjacent regions.

In conclusion I would emphasize the fact that the sanitary organization of the Isthmian Canal Zone has prosecuted the work of mosquito control in the face of great difficulties of climate and situation. Constant changes in physical conditions have necessitated prompt and energetic action in the contrivance and application of relief measures. Heavy demands have been made upon the resourcefulness, ingenuity, devotion and physical endurance of the personnel, and upon their response to the call has largely depended the high success attained.

President F. L. Washburn: Any discussion on this paper, of the utmost interest to us all? Doctor Schwarz.

E. A. Schwarz: As with everyone that has visited the Canal Zone, I cannot but admire the efficacy of the work done by the sanitary department of the Canal Zone Commission in cleaning up the mosquitoes from the country so that yellow fever is practically unknown and malaria under almost perfect control. The common non-pathogenic mosquitoes are not obvious at all during the dry season of the year but as soon as the summer rains commence, they are just as common all over the Canal Zone as elsewhere. On a short trip up the rapid flowing Chagres River, I was not aware of the presence of any mosquitoes and at Porto Bello up to which place the operation o fthe sanitary department has not yet extended and where there are many clear mountain streams, I was never seriously troubled by the attacks of mosquitoes.

President F. L. Washburn: Any other remarks upon this paper?

Henry Skinner: Mr. President, the speaker said something about *Anopheles* breeding in depressions. I just wanted to find out whether, in a tropical country, the water would remain in such long enough to enable the mosquitoes to undergo their transformations. It might be a matter of some little importance to find that out.

Allen H. Jennings: A depression will be filled many times before it is emptied, and where the soil is fairly impervious, as it is in many cases, the water will remain an ample time; in fact, far more than long enough for the transformations to take place.

Frederick Knab: One little point I would like to call attention to, and that is the fact that the habits of the different species of *Anopheles* have everything to do with their relation in carrying malaria. Now, *Anopheles albimanus*, which is the principal malaria carrier if I have understood Mr. Jennings correctly, is to a certain extent domesticated in so far as it occurs mostly about habitations. In conversation he has informed me that he didn't find that species in the upper Chagres River, where there were no habitations. It seems on the other hand, that the species which occur in the wild play no part in the transmission of malaria,—rather a curious fact. (See p. 196 for a more extended discussion of this phase.—Ed.)

President F. L. Washburn: The next paper on the programme is by Mr. Yothers, of Orlando, Florida.

INSECTICIDES FOR USE IN CONTROLLING THE WHITE FLY

By W. W. Yothers, *Orlando, Fla.*

(*Withdrawn for publication elsewhere*)

Mr. Berger: Mr. President, we believe in Florida that these formulas, that Mr. Yothers has invented, are a decided advance in the matter of the application of oils. They have, of course, so far, been applied to citrus trees which are evergreen, and the suggestion that is foremost in my mind here, is the possible usefulness of these insecticides or spraying solutions in the North on trees in full foliage. I might add that a prominent nurseryman in Florida, who grows ornamentals, is using formula 4 and experimenting with it in the greenhouse, with apparent success. The use of these mixtures on other plants besides citrus is of course, in the experimental stage, but the outlook is promising.

President F. L. Washburn: Any other member who wishes to discuss this paper? If not we will pass to the next paper, by Mr. R. A. Cooley, of Montana, on "Orthoarsenite of Zinc as an Insecticide."

ORTHO ARSENITE OF ZINC AS AN INSECTICIDE

By R. A. Cooley, *Montana Agricultural Experiment Station*

During the past two seasons the Montana Experiment Station has had opportunity to experiment with the insectitude furnished by the California Spray-Chemical Company, called ortho arsenite of zinc, Two lots of the chemical have been used, one received in May 1910 and one in May 1911. Our observations have been concerned with its suspension qualities, injùriousness to the bark of the apple tree, and killing power with insects.

This ortho arsenite of zinc is a very finely divided, white, fluffy powder, a given weight occupying about four and one-half times the space of Paris green. If first rubbed into a paste with a small amount of water, it mixes well in proper dilutions for spraying.

A further understanding of the physical qualities of this insecticide may be obtained by referring to the accompanying photographs of glass plates, which had been sprayed with arsenate of lead (pl. 2, fig. 1), arsenite of zinc (pl. 2, fig. 2) and Paris green (pl. 2, fig. 3). All are magnified 8 diameters. It will be observed that arsenate of lead and arsenite of zinc spread equally well, adhering to the glass as many exceedingly fine particles, while the coarser granules of Paris green have settled to the edges of the droplets and could be easily removed by rain.

The manufacturers claim that the product contains "over 40 per cent of arsenious oxide," which would be about four-fifths as strong in this form of arsenic as is Paris green. Compared with arsenate of lead, it contains 40 per cent of arsenious oxide against twelve and one-half per cent of arsenic oxide (As_2O_5) required in the arsenate.

An analysis by Professor Burke of the Montana Experiment Station showed the sample to contain 0.67 of one per cent of water-soluble arsenic against 3.5 per cent allowed in Paris green and 0.75 per cent of arsenic oxid (As_2O_5) allowed in arsenate of lead. Thus, this insecticide is intermediate in strength between our two standard arsenicals, and with respect to the water-soluble forms present is better than either. We have not made analysis to determine the total arsenic present.

Suspension Qualities

Experiments conducted by Mr. J. R. Parker and reported in bulletin No. 86 of the Montana Experiment Station (1911), have shown that the addition of soap to water mixtures of arsenate of lead and arsenite of zinc has a marked influence on the rapidity of settling of these compounds. You are referred to the original record for the details of the experiments, but we wish here to compare the results obtained. Previous tests had shown that the suspension of Paris green is unaffected by the addition of soap to the water.

The method followed was to thoroughly mix known quantities of the poison in 600 cc. of water in glass cylinders. Two grams of soap in solution were added to one cylinder, while the check was left without soap. After being left for definite periods, 500 cc. were siphoned off from the top, the 100 cc. in the bottom removed to an evaporating dish, dried, and weighed. Before any settling began the bottom 100 cc. naturally contained one-sixth of all the poison placed in the total 600 cc. of water. Thus the difference between this one-sixth and the amount found in the bottom 100 cc. after settling had taken place showed how much had settled out of the 500 cc. at the top. Ten grams, dry, of arsenite of zinc and 20 grams of arsenate of lead in paste form were used in each test.

The following tables deduced from the bulletin above referred to, show the results of certain of the tests in a graphic way.

TABLE NO. 1

WEIGHT[1] AND PERCENTAGE OF SEDIMENT IN LAST 100 CC.

Time	Arsenate of lead without soap		Arsenate of lead with soap		Arsenite of zinc without soap		Arsenite of zinc with soap	
	Grams	Per cent	Grams	Per cent	Grams	Per cent	Grams	Per cent
15 Minutes.........	7.4	63.2	4.7	39.3	7.6	76.0	2.6	26.0
30 Minutes.........	9.6	82.0	5.1	43.5	9.2	92.0	3.2	32.0
45 Minutes.........	11.3	96.0	5.4	46.1	9.3	93.0	3.3	33.0
60 Minutes.........	11.4	97.4	5.2	44.4	9.5	95.0	3.3	33.0

TABLE NO. 2

WEIGHT[1] AND PERCENTAGE SETTLED OUT OF 500 CC. ABOVE THE LAST 100 CC.

Time	Arsenate of lead without soap		Arsenate of lead with soap		Arsenite of zinc without soap		Arsenite of zinc with soap	
	Grams	Per cent	Grams	Per cent	Grams	Per cent	Grams	Per cent
15 Minutes.........	5.5	56.1	2.8	28.5	6.0	71.4	1.0	11.8
30 Minutes.........	7.7	78.5	3.2	32.6	7.6	90.4	1.6	19.0
45 Minutes.........	9.4	95.9	3.5	35.7	7.7	91.6	1.7	20.2
60 Minutes.........	9.5	96.9	3.3	33.6	7.9	94.0	1.7	20.2

It is thus apparent that without soap added to the mixture arsenite of zinc settles slightly quicker than arsenate of lead, but that with the addition of soap the settling of both is retarded. This is particularly striking with arsenite of zinc. In another test, not here reported, more of this compound settled out in fifteen minutes without soap than in fifteen hours with soap.

Injury to the Bark of Apple

Professor D. B. Swingle of the Biology Department of the Montana Agricultural College is engaged in an extended study of the effects of arsenical compounds upon vegetation, and in this connection has made a series of tests on apple trees. During the season of 1910 the following compounds were used; arsenic acid, arsenic trioxide, arsenic

[1] Dry weight of arsenate of lead used, 11.7 grams (20 grams paste). Dry weight arsenite of zinc used, 10.0 grams.

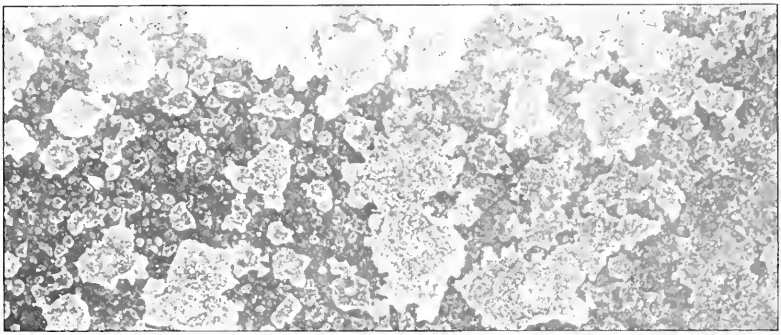


Fig. 1. Arsenate of lead.

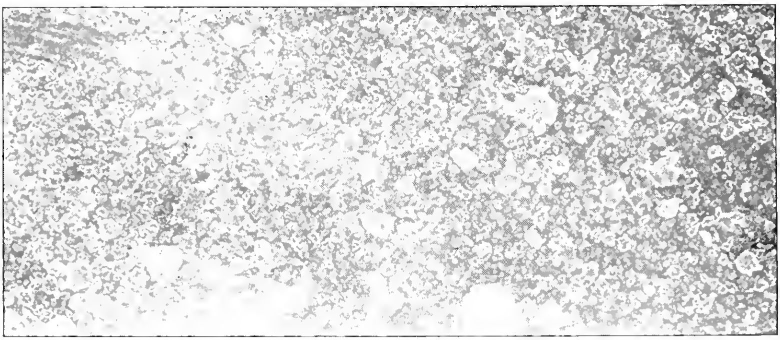


Fig. 2. Arsenite of zinc.

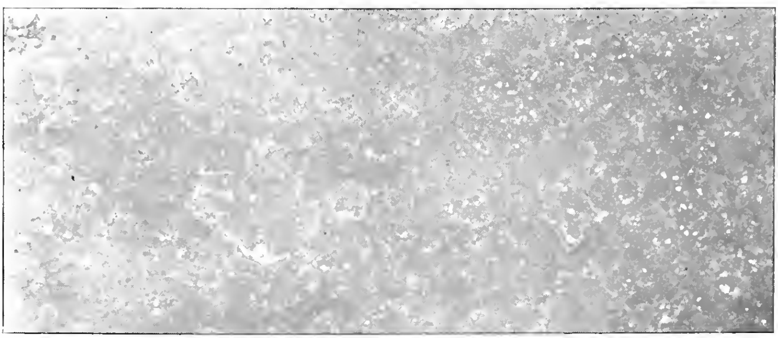


Fig. 3. Paris green.

Photographs of arsenical insecticides sprayed on glass to show the distribution of each. The larger size of droplets in Fig. 1 is not of special significance. All magnified 8 diameters.

disulphid, arsenic trisulphide, calcium arsenite, lead arsenate (a mixture of ortho and acid arsenates) Paris green (from Ansbacher & Co.,) sodium arsenite and zinc ortho arsenite from the California Spray-Chemical Company. These were applied to branches varying from one-fourth to two and one-half inches in diameter and to crowns of from three to five inches in diameter. Weighed amounts were spread on small squares of absorbent cotton, which were wrapped about the limbs in such a way that the chemicals were applied to the bark in a fairly even layer, completely encircling the limb for a distance of about four inches. These were then kept wet with distilled water during the term of the test. These bandages on the limbs were intended to roughly simulate the physical conditions, especially as to moisture, found naturally about the crown of the trees where the chemicals are known to accumulate from spraying with arsenical insecticides. In treating crowns, the earth was removed to form a shallow trench close about the tree, the chemicals, suspended in water, were poured in and the earth replaced. A part of the limbs and crowns used were wounded in various ways and to various extents.

The experiments and the results here discussed were published during the past year and you are referred to the original paper for further details. See, "A preliminary report on the effects of arsenical compounds upon apple trees." D. B. Swingle and H. E. Morris, *Phytopathology* Vol. 1 No. 3, June 1911, pp. 79–93.

Of the various chemicals used, ortho arsenite of zinc is the only one which, up to the present time, has caused no visible injury under the various conditions of the tests. In a number of instances wounds which had been made under the bandages and in the crowns for the purpose of allowing access into the circulation of the trees, thereby making the tests more severe, healed completely while continually covered by and in contact with the poison.

In strict truthfulness, it should be stated that in a single instance there was a superficial discoloration of the bark about three mm. in diameter under a lenticel. We believe this to be of no practical significance, however, when we consider that in all cases where the bark was opened by the removal of a twig, a tangential slash to the cambium, or by peeling to the wood, no injury whatever was inflicted.

Killing Power

Comparative tests have been made on potatoes for the Colorado potato beetle and on cabbages for larvæ of the European cabbage butterfly and of the diamond back moth, (*Plutella maculipennis* Curt.)

On potatoes, ortho arsenite of zinc was used at the rate of one pound to 50 gallons of water applied by a field sprayer on the Experiment

Station farm. To another portion of the field, Paris green was applied at the rate of one pound to 50 gallons of water. Arsenite of zinc at one pound to 50 gallons was as effective as Paris green and both were entirely satisfactory. At one pound to 75 gallons of water, arsenite of zinc was not entirely effective.

On cabbages the same insecticides were used and arsenate of lead also. In these experiments, which were made for the purpose of testing the practical advantage of the addition of soap to cause the insecticide to adhere, arsenite of zinc was used only in the strength of three pounds to 100 gallons of water, while arsenate of lead was used at the rate of six pounds to 100 gallons and Paris green at one pound to 100 gallons. Both of the cabbage pests mentioned were completely controlled and arsenite of zinc did no injury by burning, while Paris green distinctly injured the plants sprayed from the bottom of the knapsack sprayer used. Arsenite of zinc, then was as satisfactory as arsenate of lead and more so than Paris green.

Cost

The manufacturers intend this insecticide to be sold at 20 cents per pound retail. Pound for pound it is thus cheaper than Paris green, and considering its relatively high arsenic content, is much cheaper than arsenate of lead.

Summary

From the foregoing summary statement it seems to be apparent that neutral arsenite of zinc should have an important place among our arsenical insecticides.

1. It is finely divided and spreads well.
2. It is nearly as strong in arsenic as is Paris green.
3. It has a very low water solubility.
4. Its suspension qualities are markedly benefited by the addition of a small amount of soap to the water.
5. Under our tests it has been shown to be less injurious to the bark of the apple tree than any other arsenical compound used.
6. In killing power it compares well with the standard arsenical insecticides.
7. Its cost makes it an economical poison to use.

President F. L. Washburn: We would be very glad to hear a discussion of this paper.

President F. L. Washburn: The next paper is by Mr. Ball, of Utah, on "The Efficiency of the Driving Spray for the Codling Moth."

THE EFFICIENCY OF THE DRIVING SPRAY

By E. D. Ball, *Utah Experiment Station, Logan, Utah*

Five years ago the writer presented to this society a paper setting forth the methods used and a summary of the results obtained with the driving spray. This paper was neither comparative nor controversial. It set forth one method only and gave the results obtained through a series of years. Its aim was to acquaint the entomological workers with a method found to be highly efficient in the West and to leave it to their own good judgment as to the possibilities of adapting it to their own conditions.

Since that time, a great deal of work has been done on the subject, both East and West, and a number of papers have been published. It was, however, very unfortunate for the popularity of the driving spray that the second contribution to the subject should have been critical in manner, over enthusiastic in its claims, and founded upon results obtained under exceptionally favorable conditions.

Little wonder, then, that the further literature of the subject contained articles both controversial and severely critical of the driving spray. The writer's sympathy was, however, with the later writers, even when they included his own work in the criticisms. Besides antagonizing other workers, the "one spray and one pound of poison" slogan misled many fruit growers in the West with a resultant severe financial loss. Just how much of this loss was due to the original publication and how much to the arsenical poisoning propaganda, the meteoric career of which nearly coincided with and for the time being enhanced the popularity of this fallacious dogma, no one can tell. Certain it is that the combination resulted in financial disaster to the fruit growers in many of the western localities in which it was accepted. Let us hope that the good done in stimulating other and more accurate workers to added efforts may, in the end, counterbalance the injury thus inflicted on an important industry.

After the above declarations and considering the time that has elapsed, the author hopes that he may be allowed to present some further results obtained by use of the driving spray without thereby becoming associated in your minds with some of the extravagant claims that have been made for this method.

In the previous paper, the writer showed that the continuous use of the driving spray has reduced the number of worms per tree in the Smart orchard each year below that of the previous one until they were so few in number that it was impossible to use the orchard for further experimental work. A search was then made for a commercial orchard sufficiently wormy for satisfactory use. But by this time practically every commercial orchard in the vicinity was well sprayed.

In the meantime, in an adjoining county, a number of young commercial orchards were growing up in the midst of old, mixed and exceedingly wormy ones. Work was therefore postponed until these orchards came into good bearing. Last season three of these orchards were selected for use. They were located, in a triangle, approximately fourteen miles apart, on different sides of a valley and represented different climatic conditions. They were all extremely wormy, as the records will show, but varied in the number of worms and the number of apples per tree sufficiently to represent three different conditions of infestation.

As many of the methods used in this study have been criticised in recent papers before this society, it seems necessary to discuss method before discussing results obtained by their use. The writer has prepared another paper on the subject of "Methods in Codling Moth Study" to be presented later, which deals with these matters at length and to which the reader is referred for extended discussion of these questions.

The following suggestions and conclusions taken from this paper will be helpful in studying the results here presented.

1st. The driving spray, as presented by the writer, is a method of spraying, and not the result of the use of certain apparatus. Its three essentials are, *power* sufficient to drive into the calyx cavity, *position* above tree so as to be able to direct the spray straight into each blossom, and *perseverance* in application until every single blossom on every tree in the orchard has been properly treated.

2d. That all results presented by the writer are from that method. Comparisons have been made between sprays, but not between methods.

3d. Accurate comparison of methods is well nigh impossible, at least until considerable work has been done in standardizing apparatus and testing mechanical efficiency of nozzles, etc., under different pressures and at different distances.

4th. The driving spray method does not advocate any particular numbers of sprays; from one to five are found necessary under different conditions. It, however, does advocate a less number and a higher individual efficiency than previously employed. Likewise, it does not advocate any particular amount of poison, though, in the writer's experience, the highest efficiency has not been reached with less than four pounds of lead arsenate to 100 gallons.

5th. Two distinct systems of checking are in use. 1st, the unsprayed plot, which may be located at one end, or in the center. If at one end, it may not represent the average of the orchard. If in the center, it may endanger the value of surrounding experiments. This sort of check most nearly represents the value of spraying as against no spraying, but cannot be used when the value of a given spray on a given brood is to be measured, as it greatly magnifies the value of inefficient spraying and of all second brood results. Under this system, it is impossible to continue experiments on the same orchard through a series of years, as there will be too great inequality in distribution. 2d, the single check, so-called, distributed throughout the orchard. This method gives the most accurate indication of real orchard conditions in the first brood possible, and by banding these checks and thus destroying one-half to two-thirds of the first brood of worms, part of the remainder will scatter so that these trees will represent very nearly the condition of the orchard in the second brood. This system will not show the value of spraying as compared with no spraying. The scattering worms from the checks will tend to decrease the real efficiency of the sprays on the second brood, while the few extra worms these trees may carry more than a sprayed tree, will serve to heighten the apparent value of the spray, so that the second brood results will not be far from correct. This system also allows of the continuous use of the same orchard.

6th. Percentage of wormy fruit is a much less reliable basis of comparison than worms per tree, though neither one is entirely accurate and both should be given. Percentage of efficiency is the only method of statement by which different experiments can be compared and such efficiency can only be accurately measured by the single check system.

7th. That records founded upon picked fruit only are untrustworthy and practically valueless for scientific purposes. That postal card canvasses, etc., to determine efficiency are absolutely worthless and often misleading.

8th. That, in all tests of efficiency, absolutely accurate account should be kept of every fruit that sets on the tree and that the work of the different broods of worms should be kept separate and compared.

9th. That the number of broods and the relative importance of each brood in the total injury will greatly influence the efficiency of a given method or the importance of a given spray.

Plan of the Experiment. Each orchard as a whole was given two early sprayings, and one or two late ones, with the exception of the experimental trees. Each orchard contained at least three varieties, and on each variety two different spraying compounds were tested, each in two different strengths, making twelve duplicate tests in each orchard of each spray. The averages presented are therefore based on nine separate tests and these tests were again duplicated in four poison series, making thirty-six separate tests in all for each spray used. Three early sprays were used separately and in combinations of two, making six different spray sets besides the unsprayed one or seven sets in each orchard on each variety.

The lead arsenate (5 lbs.) was used as the standard of efficiency and the results with this poison were so high that it was thought worth while to present them to the society as indicating the efficiency of this method of spraying, even under the adverse conditions explained below.

The Orchards Used. The Stillman orchard (S) was the first to blossom and the first sprayed. It did not have enough trees of any one variety to carry on all of the tests, so that half strengths and the third spray were omitted. In addition to the varieties used in the other orchards, Rome Beauty was added to these tests. A frost took the larger part of the crop, leaving the distribution very irregular, some trees having nothing left, and some Winesaps running as high as 2,500 apples. The check trees averaged 475 apples.

The Woodbury orchard (W) was sprayed next, as in the other two orchards, the tests were carried on, on Gano, Jonathan and Winesap trees. Frost reduced the crop here even below that at the Stillman orchard. The check trees averaged 325 apples.

The Nokes orchard (N) was last sprayed and it was a little late by the time this orchard was reached, some of the earlier calyx cups closing. The Gano trees in this orchard were bearing from 1,000 to 2,200 apples, the other varieties considerably less, with an average for the checks of 700 apples.

Poison Used. The poisons used were a standard lead arsenate (L.A.) and a new compound (N. C.)[1] each used in two strengths; five pounds, and two and one-half pounds, to the hundred gallons. The N. C. did not prove efficient, especially in the two and one-half pound strength, and allowed too many worms to escape. These spread to the L. A. rows in the second brood, and lowered the apparent efficiency on the side worms. In the Woodbury orchard, where a greater amount of the two and one-half pound strength was used, and where the trees were bearing a very light crop, this effect was especially noticeable, often reducing the apparent efficiency on the total wormy to 0. This is only apparent, however, the real efficiency on side worms was no doubt as high as in any other case, as the remarkable calyx efficiency shown under these conditions indicates that very thorough spraying was done.

[1] It was through the financial assistance of the manufacturers of this compound that this spraying experiment was undertaken.

Number of Worms. In the last section of the table the average of the five unsprayed checks for each orchard is given. In the first brood the unsprayed checks in the Stillman orchard had an average of 311 worms per tree, or 48 per cent wormy. Taking the average of all counted trees as the average of the orchard and this number of worms per tree would make the average for the orchard 65 per cent.

The Woodbury orchard had 120 worms per tree in the first brood, or 50 per cent wormy, or, on the average of all trees counted, 37 per cent wormy.

The Nokes orchard had 100 worms per unsprayed tree in the first brood, or 16 per cent wormy, or, on a basis of the average of all the counted trees, 14 per cent wormy.

Counting the second brood as ten times as great as the first, which is conservative for western conditions, we would have had the following condition in these orchards if there had been no spraying done.

Orchard	Average number of apples per tree	Average per cent wormy in first brood	Expected per cent wormy in second brood if unsprayed
S.	475	65%	650%
W.	325	37%	370%
N.	700	14%	140%

Instead of this, the check trees were banded and from ½ to ⅔ of the first brood worms captured, and of the remainder, we would expect a considerable portion to scatter from the five unsprayed trees to the 600 or more sprayed ones surrounding them, and yet these unsprayed trees in the Stillman orchard were 85 per cent wormy and in the Woodbury orchard practically all wormy (92%). Of the few sound apples remaining some fell early and some few were down underneath the dense foliage of the centers of the trees and thus escaped, while most of the apples on the outside of the trees had three or more worm holes in them.

In the Nokes orchard, where the first brood was small, only two-thirds of the apples on the unsprayed trees were wormy and only a few had more than one worm. Even after the banding and scattering, we notice an increase of nearly four times between the first and second brood in this orchard. It would of course be impossible to get an increase in the other orchards, as they were half wormy in the first brood.

It is interesting to note that over four-fifths of the first brood worms went in at the calyx. It is not possible to make similar comparison in the second brood, except in the Nokes orchard, because in the other orchards, there were more side worms than apples and many of the calyx wormy apples also had side worms.

High Efficiency of the 5 lb. L. A. Spray. The first three divisions of the table show combinations in which the first spray was applied. A glance down the calyx wormy column of the first brood shows that even under the extremely wormy conditions prevailing, the 80 per cent of worms that went into the calyx ends practically all perished, giving an efficiency of 99 or 100 per cent in every case. Even in the second brood with the number of worms increased many times, the lowest calyx efficiency is 95%[2] and the average almost 98% while the year total is 99%.

SUMMARY OF RESULTS OF DRIVING SPRAY TESTS, 1911

(Using Lead Arsenate 5 lbs. to 100 gallons)

Averages per tree				1st brood				2d brood				Yr. total				Early sprays
Orch-ard	Total apples	% wormy		Calyx		Total		Calyx		Total		Calyx		Total		
		1st B.	Yr.	Wmy.	Eff.	Wmy.	Eff.	Wmy.	Eff.	Wmy.	Eff.	Wmy.	Eff.	Wmy.	Eff.	1st–2d–3d
W....	257	3	28	0	*100*	8	*93*	2	*98*	66	*35*	2	*99*	74	*67*	1–0–1
N....	464	1–4	10	0	*100*	1	*99*	7	*97*	43	*87*	7	*98*	44	*90*	
Average efficiency..........					*100*		*96*		*98*				*99*			
S....	378	1	10	0	*100*	5	*98*	1	*100*	33	*87*	1	*100*	38	*93*	1–1–0
W....	446	5	35	1	*99*	23	*81*	1	*99*	133	*0*	2	*99*	156	*30*	
N....	446	1–2	6	1	*99*	2	*98*	3	*99*	27	*92*	4	*99*	29	*93*	
Average efficiency..........					*99*		*92*		*99*				*99*			
S....	533	7	27	0	*100*	36	*88*	5	*98*	109	*55*	6	*99*	145	*74*	1–0–0
W....	365	12	40	1	*99*	42	*65*	4	*95*	148	*0*	5	*97*	190	*14*	
N....	895	1–2	5	0	*100*	4	*96*	10	*96*	42	*87*	10	*97*	46	*89*	
Average efficiency..........					*100*		*83*		*96*				*98*			
W....	300	4	37	3	*96*	13	*89*	26	*67*	98	*4*	29	*82*	111	*50*	0–1–1
N....	862	4	32	30	*62*	38	*62*	138	*42*	237	*28*	168	*47*	275	*36*	
Average efficiency..........					*79*		*76*		*55*				*65*			
S....	215	11	40	9	*97*	23	*93*	25	*88*	64	*73*	34	*93*	87	*84*	0–1–0
W....	258	12	53	10	*87*	34	*72*	29	*64*	107	*0*	39	*75*	141	*36*	
N....	467	9	34	24	*69*	42	*58*	74	*69*	119	*64*	98	*69*	160	*62*	
Average efficiency..........					*84*		*74*		*74*				*79*			
W....	375	22	72	42	*47*	82	*32*	117	*0*	184	*0*	159	*0*	266	*0*	0–0–1
N....	674	9	40	48	*38*	63	*37*	142	*41*	208	*36*	190	*40*	271	*37*	
Average efficiency..........					*43*		*35*		*21*				*20*			
S....	650	48	85	263		311		202		241		465		552		0–0–0
W....	242	50	92	79		120		80		102		159		222		
N....	617	16	69	78		100		240		327		318		427		

[2] The 95% efficiency is obtained by subtracting the average of 4 wormy apples on the sprayed trees in the (W) orchard from the 80 on the unsprayed trees, leaving 76 killed out of 80, or 95% killed.

This is one of the highest records of efficiency ever published and under the wormiest conditions in which a brood separation has ever been made. To my brother, Mr. W. M. Ball, who had charge of this work, must be given the credit of this record.

The second three divisions show combinations in which the first spray was omitted. A glance is sufficient to show the striking difference in the number of worms and efficiency.

A comparison of the first spray only (1–0–0) with the second only (0–1–0) gives a fair estimate of the relative importance of these two sprays. The orchards are everywhere arranged in the order in which they were sprayed. The second spray was a little too late for the best effect on the later sprayed orchards, as some of the calyx cups had entirely closed. A comparison of the three orchards shows a steadily decreasing efficiency as the calyx cups closed.

The second spray is never used alone. Its place is supplementary to the first one where conditions are bad enough to warrant it. It will be observed that the 1–0–1 spray was slightly better in the first brood than the 1–1–0, but that in protecting the calyx in the second brood, the reverse was true, while the side wormy would be taken care of by late sprays.

These orchards, with the exception of experimental trees, received two early sprays and two late ones. The late sprays materially reduced the number of side worms in the second brood.

Efficiency of the 2½ lb. L. A. Spray. The table of the 2½ lb. L. A. Spray is almost a repetition of the 5 lb. one, with the number of worms everywhere slightly increased and the efficiency correspondingly lowered. The change is small in the first brood but becomes much larger in the second, where it equals 10 to 20 %. This confirms previous experiments showing that under wormy conditions 4 lbs. of lead arsenate is the least that should be used.

President F. L. Washburn: The next paper will be read by E. P. Felt, of Albany, N. Y., on "Recent Experiments with the Codling Moth," and at its close both papers on this insect will be discussed.

RECENT EXPERIMENTS WITH THE CODLING MOTH

By E. P. Felt, *Albany, N. Y.*

The experiments detailed below are a continuation of a series begun in 1909 in an effort to test the actual value of the various methods of spraying, so far as Hudson valley conditions are concerned. The usual practice of orchardists was followed, the aim being to cover the entire tree and especially to hit the tips of the young apples with the poison. The apparatus was a good type and in each instance belonged to the owner of the orchard, he also providing the men. Each plot consisted of approximately 42 trees, six trees in a row one way and seven in a row the other way, the central six being the actual experimental trees. The work the present season was limited to testing the value of one application made just after the blossoms fall, compared with another plot which received in addition, a second spraying three weeks later, a third plot receiving in addition to the two sprayings mentioned above, another the last of July. A fourth plot was given but one application about three weeks after the blossoms fell. There were, in addition, check trees. These latter, two in number, were placed between or near those of the four trees or thereabouts representing plot 4, this being the only exception from the arrangement of plots outlined above.

The experiments in series 1 were conducted in the young orchard of Mr. W. H. Hart near Poughkeepsie. It is located on a moderately high hill, the trees being thrifty, about seventeen years old, 18 to 20 feet high and 30 feet apart. All of the experimental and barrier trees were Baldwins, the former being carefully selected for uniformity in size, fruitage and infestation. The fact that there was a variation of only about 4,000 apples in the yield of the six experimental trees of three plots, shows a fair degree of uniformity. The spray applied consisted of 7½ lbs. of Grasselli's arsenate of lead (15% arsenic oxide) and 4½ gals. of a concentrated lime-sulphur wash (31° Baumé) to each 150 gallons. The pressure was maintained at from 150 to 160 pounds. The spraying was from the ground, the hose being tied to long bamboo rods and the nozzles were of the later Friend type with apertures which had been worn somewhat by earlier work with a lime-sulphur wash and the spray was therefore rather coarse. The first application, made May 18, required only 150 gallons for 59 trees. The second spraying was given June 8 and the third July 26.

The experiments outlined above in series 1 were duplicated under series 2 in the orchard of Mr. Edward Van Alstyne at Kinderhook, the trees being older, somewhat more crowded and therefore not so easily sprayed. Plot 1 consisted of greenings, the others were all Baldwins. There was a greater variation in the yield from the six experimental trees of the three plots, this being about 14,000 apples. The treatment was substantially the same as in the preceding series, except that lead arsenate (15½% arsenic oxide) manufactured by the Interstate Chemical Company was used at the rate of 15 lbs. to 250 gallons of water and a concentrated home-made lime-sulphur wash (27° Baumé) was used at the rate of 1 gallon to 25 of the spray. The first application began May 23d and, owing to unfavorable weather, was not completed till the 25th. The second application was given June 19 and the third July 29. A power spraying outfit was used as in the preceding series and a tower employed, one man being located on this and the other with an extension nozzle operating from the ground. There was probably considerably more spray material applied per tree than in the preceding series. The blossom ends were well sprinkled but there was practically no penetration of the poison to the inner calyx cavity. The leaves were well covered with the spray and rarely flooded.

The results obtained in these two series are at least fairly uniform and are well shown in the following summary of the plots.

SUMMARY OF PLOTS, 1911

Series	Plot	Total fruit	Clean Fruit		Wormy Fruit				
			Total	Per cent	Total	Per cent	End wormy	End and side wormy	Side wormy
1.......	1	16,638	16,515	99.26	123	.74	19	12	92
	2	19,994	19,903	99.54	91	.46	5	3	83
	3	20,926	20,830	99.54	96	.46	17	2	77
	4	8,969	8,393	93.57	576	6.43	186	95	295
	Check	5,337	4,540	85.06	797	14.94	379	166	252
2.......	1	20,802	20,401	98.07	401	1.93	28	14	359
	2	34,019	33,510	98.50	509	1.5	53	54	402
	3	31,119	30,852	99.14	267	.86	60	23	184
	4	16,815	13,113	77.98	3,702	22.02	1,422	578	1,702
	Check	14,670	9,860	67.21	4,810	32.79	2,048	949	1,813

A study of the summary of plots shows that conditions were fairly comparable in the two series, though the yield from the second was somewhat greater. The larger product of series 2 is, in some measure, offset by the trees being larger and more difficult to spray, an operation also hindered by interplanted plum and peach trees. The percentages of sound fruit from the plots in these two series show a fairly uniform increase with additional sprayings, though in the case of series 1 there is no difference between the percentage of sound fruit produced by plots 2 and 3, each yielding 99.54. There is, however, a nearly uniform gain in series 2, of $\frac{1}{2}$ of 1% from each spraying after the first. There is a marked contrast between the amount of sound fruit produced on plots receiving one treatment just after the blossoms dropped and similar plots sprayed three weeks later, the benefit resulting from this treatment ranging from $\frac{1}{3}$ to $\frac{2}{3}$ that of the early spray. An examination of the data relating to end wormy apples shows an interesting condition; in series 1, plot 1 there were 31; plot 2, 8; plot 3, 19; plot 4, 281 and on the check trees 545. It will be noted that the decrease in wormy apples resulting from the various sprayings is very largely in the end wormy, while the poor results following the one late spray must be attributed in considerable measure to failure in destroying the young caterpillars entering the blossom end of the apple. The large number of end wormy on the check trees gives an idea of the insect's preference for this point of attack. This is even better illustrated in the data for series 2. Plot 1 has 42 end wormy; plot 2, 107; plot 3, 83; plot 4, 2,000, while the check trees produced 2,997.

Incidentally, it may be well to call attention to a development in the spraying of plot 1, series 1. The day was showery and spraying of the actual experimental trees of this plot was finished by 1.46. A sprinkling of rain began a minute before and was rather lively before the work was completed at 1.46, the rain stopping at 2 p. m. The leaves at this time were partly flooded but there was no marked dripping. A subsequent examination of the experimental trees showed that in plot 2, sprayed some 10 minutes before the rain began to fall, there was very little or no washing, while in plot 1 those trees which had been completed just a few minutes before or at the beginning of the shower showed some washing, though this was limited largely to the carrying of the poison to the lower edge of the leaf where it settled in large drops. There was very little dripping and probably nothing was washed from the blossom ends of the young fruit. Despite the fact that the spraying of one experimental tree in plot 1 was completed in the beginning of a brisk shower, there was no marked variation in the percentage of sound fruit, the record of the various trees of this plot ranging from 99.11 to 99.41.

It is impossible, after scrutinizing the above figures, to escape the conviction that the first spraying within a week or ten days after the blossoms fall, is by all odds the most important so far as preventing wormy apples or controlling the codling moth is concerned. Manifestly, under the conditions obtained in series 1 and 2, the benefits resulting from the second and third applications are comparatively slight and of themselves would hardly justify additional treatment, unless it be advisable to spray for fungous diseases of one kind or another.

A study of the data obtained during the three years this investigation has been in progress, shows that a single spray gave averages for the various plots from 82.08 to 99.26% of sound fruit, or an average of 97.23% for the three years, if comparisons are made between an equal number of plots in each year. Reference to earlier published data shows that the low percentages occurred in 1910, a season remarkable for the unusual abundance of the second brood and one presenting infrequent conditions which were greatly accentuated by the small yield of the experimental trees. Excluding the data for this year, the lowest average percentage of sound fruit for one plot was 97.52. Incidentally, it may be well to note that less than ½ of 1% (.394%) of the wormy fruit from trees sprayed but once were end wormy.

SUMMARY OF THREE YEARS' WORK WITH THE CODLING MOTH, 1909-1911.

Treatment	Plot	Series	Year	Total Fruit	Clean Fruit		Wormy Fruit					
					Total	%	Total	%	End wormy	End and side wormy	Side wormy	% end wormy
Sprayed once	1	1	'09	30,177	29,818	98.81	359	1.19	33	18	308	
	1	2	'09	21,264	21,042	98.96	222	1.04	23	18	181	
	1	1	'10	1,839	1,664	90.48	175	9.52	16	21	138	
	1	2	'10	8,135	6,677	82.08	1,458	17.92	160	27	1,271	
	1	1	'11	16,638	16,515	99.26	123	.74	19	12	92	
	1	2	'11	20,802	20,401	98.07	401	1.93	28	14	359	
	Grand total and %			98,855	96,117	97.23	2,738	2.77	279	110	2,349	.394
Sprayed twice	2	1	'09	10,316	10,206	98.93	110	1.07	4	7	99	
	5	1	'09	19,275	19,084	99.01	191	.99	10	9	172	
	2	1	'10	2,846	2,756	96.84	90	3.16	6	1	83	
	2	2	'10	7,316	6,105	83.45	1,211	16.55	127	10	1,074	
	2	1	'11	19,994	19,903	99.54	91	.46	5	3	83	
	2	2	'11	34,019	33,510	98.50	509	1.5	53	54	402	
	Grand total and % ...			93,766	91,564	97.65	2,202	2.35	205	84	1,913	.308
Sprayed thrice	3	1	'09	9,680	9,582	98.99	98	1.01	8	10	80	
	6	1	'09	7,710	7,633	99.00	77	1.00	6	3	68	
	3	1	'11	20,926	20,830	99.54	96	.46	17	2	77	
	3	2	'11	31,119	30,852	99.14	267	.86	60	23	184	
	Grand total and %			69,435	68,897	99.22	538	.78	91	38	409	.185
Sprayed once, late	3	2	'10	7,594	4,355	57.35	3,239	42.65	1,485	326	1,428	
	4	1	'11	8,969	8,393	93.57	576	6.43	186	95	295	
	4	2	'11	16,815	13,113	77.98	3,702	22.02	1,422	578	1,702	
	Grand total and % ...			33,378	25,861	77.47	7,517	22.53	3,093	999	3,425	12.26
Unsprayed	Check	1	'09	3,251	2,366	72.73	885	27.27	312	302	271	
	Check	2	'09	7,015	5,127	73.08	1,888	26.92	674	630	584	
	Check	1	'10	711	202	28.41	509	71.59	186	240	82	
	Check	2	'10	2,000	593	29.65	1,407	70.35	700	324	383	
	Check	1	'11	5,337	4,540	85.06	797	14.94	379	166	252	
	Check	2	'11	14,670	9,860	67.21	4,810	32.79	2,048	949	1,813	
	Grand total and %			32,984	22,988	68.78	10,296	31.22	4,299	2,611	3,385	20.95

The six plots receiving two applications during this period produced from 83.45 to 99.54% of sound fruit or an average of 97.65%. The end wormy constitute about ⅓ of 1% (.308%). The average gain during this period resulting from a second application was less than ½ of 1% (.42%) which was accompanied by a slight reduction in the percentage of end wormy. It was unfortunate that in 1910 no plot received three applications and, as a consequence, the average percentage for this group is 99.22 of sound fruit, a yield undoubtedly relatively higher than would have been the case if two plots for 1910 could have been included. Even with this omission which, in a measure at least, is favorable to three applications, the average percentage gained between two and three treatments is only 1.57%. There is, however, a marked reduction in the percentage of end wormy, it amounting to only .185%.

The three plots receiving one late application during 1910 and 1911 gave an average percentage of sound fruit of only 77.47, there being a variation between individual plots from 57.35 to 95.57. The average percentage of sound fruit for these plots is approximately midway between that obtained from one spraying just after the blossoms fall and the yield on the check trees. The percentage of end wormy (12.26%), is a great increase over that in the preceding plots and shows in a convincing manner where this late spray lacks efficiency.

The check trees during this period gave an average percentage of sound fruit of 68.78, the yield varying in individual plots from 28.41 to 85.06. The small yield of good fruit, it should be noted, occurred on trees producing relatively few apples. The average percentage of end wormy fruit for these plots is 20.95, a great increase in the average for the plots receiving one late spraying and very different from the data from sprayed plots where the greater number of wormy apples have been injured by the second brood and are therefore side wormy.

A study of this data as a whole justifies the conclusion for the Hudson valley at least, that in normal years when the crop is abundant or fairly abundant, one thorough early spraying, namely, within a week or ten days after the blossoms fall, should result in the production of 95 to 98% of sound fruit. A slight gain will accrue from a second treatment about three weeks later, and an additional gain from a third spraying given the latter part of July. The benefit from the latter two is comparatively small, so far as the codling moth is concerned, though ample to meet the cost of the poison and, in many instances, probably the expense of treatment. Should there be sufficient fungous disease to warrant applications for this purpose, there should be no question as to the advisability of adding poison in the later sprayings.

A small crop almost invariably means a larger percentage of wormy fruit, and if the prospects are even fair for good prices, the third spraying (the latter part of July) would at least justify itself because of the additional protection from possibly severe injury and consequent loss by the second brood. The second spraying, namely, three weeks after the blossoms fall, might be advisable especially if the first application is not thorough for some reason or other.

President F. L. Washburn: Mr. Quaintance is down to discuss Doctor Felt's paper, and I will now call on him.

A. L. Quaintance: Doctor Felt is to be congratulated on the accomplishment of so large an amount of experimental work in testing spray applications against the codling moth. His experiments have extended over a period of three years, and during two seasons, tests have been made in duplicate. A large amount of data has thus been secured and it constitutes an important addition to our knowledge of the subject.

Anyone who has given attention to experimental work with sprays against the codling moth will appreciate how difficult it is to arrange for such work under even fairly satisfactory and uniform conditions, as in obtaining a sufficient number of trees of one variety and of the same size and fruiting capacity; in effecting the proper arrangement of the plats, and the selection and locating of suitable trees for making counts of the fruit. It is always difficult to obtain from the orchardists permission to leave untreated for purposes of comparison an adequate number of trees. Weather conditions also much modify the results as affecting the character of spraying which may be done, and efficiency of sprays subsequently. To obtain conditions during a second and third season, essentially the same as those of the first, is much more difficult. Doctor Felt in his three years' experiments seems to have been able to overcome these difficulties fairly well, though conditions have varied somewhat, especially as regards the varieties used, the age of trees, the strength of the arsenical, and also in the manner of making applications.

During the past six or eight years, a good deal of experimental work has been done in the use of sprays against the codling moth. This may be grouped approximately under two headings, namely:

(1) Work done by western entomologists, under arid conditions.

(2) Work done by eastern entomologists, under humid conditions.

Some of this activity on the part of eastern entomologists, has followed certain caustic but we are assured well-meant criticisms on the part of our western co-workers. More or less of controversy has arisen, and this has centered principally on two questions. Stated chronologically these are, first, the necessity or not of filling the inner calyx cup; and second, the sufficiency or not of the so-called one-spray method. Doctor Ball of Utah was the first to point out the importance under western conditions of spraying in such a way as to force the poison into the inner calyx cup; and the sufficiency of the one-spray method was advocated by Professor Melander a year or two later. Several eastern entomologists have now investigated these as well as other points in connection with the control of the codling moth under their conditions. It would now seem that sufficient information on the subject has been accumulated to warrant drawing general conclusions at least.

Filling the Inner Calyx Cup. Referring first to the matter of filling the inner calyx cup, it seems clear from the studies which have been made that a difference in behavior of the stamen bars, as respects their shriveling, must be admitted for the two regions under consideration. Several observers in the East agree that on certain standard commercial varieties, the stamen bars remain turgid and effectively protect the cavity below from sprays applied during the period that the calyx lobes are spread. The filaments begin to shrivel, it is true, as the calyx lobes are closing, but this does not occur for the most part until it is too late to do effective spraying. The turgid condition of the stamen bars was well shown by Slingerland (Journal of Economic Entomology, Vol. 1, p. 352), and Sanderson (19th to 20th Reports, New Hampshire Agricultural Experiment Station, pp. 443–448,) on this point states: "As mentioned above, the sepals usually close about one week or at most ten days after the blossoms drop. At this time the stamens are still entirely turgid, and no spray can be forced between them, no matter how high the power or coarse the spray." From Mr. Lloyd's experience in Illinois (Ill. Sta. Bull. 114, p. 384), we infer a rather different condition as regards the stamen bars, as he was able with comparatively low pressure and a heavy spray, to poison the inner calyx cavity of a majority of the apples treated. It is not stated what variety of apples were used and whether the spraying was begun promptly after the falling of the petals, or some days later.

The experiences of several workers in the Bureau of Entomology, substantiate on the whole the results of Professors Slingerland and Sanderson. Mr. Jenne in Arkansas however, during 1909, in the course of experiments on the one-spray method, was able in frequent instances to force a spray below the stamen bars. In the experience of Mr. E. W. Scott, during 1911, in Michigan, the employment of high pressure and a coarse spray did not result in poisoning the inner calyx cup, except in occasional instances. It would appear on the whole that under eastern conditions, the spray is not forced to an appreciable extent below the stamen bars, though the extent to which this is done will vary with the age of the apples when treated, and perhaps with the variety in question; more information is needed on this point.

Relating directly to this topic is the question of whether it is *necessary* to place the poison in the inner calyx cup; it would appear, in fact, that such is not the case. Observations by numerous experimenters, as shown above, on a single application of a coarse spray, under high pressure, show that in but comparatively few cases is the posion forced into the lower cavity. The results from the one-spray are on the whole excellent and fairly uniform, which indicates clearly that the young codling moth larva feeds mostly in the outer calyx cavity. Specific confirmatory observations are at hand on this point, notably those made by Professor Slingerland (l.c.), and Professor Sanderson (l.c.).

The One-Spray Method. The above considerations relate closely to the one-spray method. Data on the efficiency of a single application after the falling of the petals is tabulated below:

SUMMARY STATEMENT ON RESULTS OF ONE-SPRAY METHOD AGAINST CODLING MOTH AND PLUM CURCULIO

Experimenter	Codling Moth		Plum Curculio	
	Sprayed once. Per cent sound.	Unsprayed. Per cent sound.	Sprayed once. Per cent sound.	Unsprayed. Per cent sound.
Gossard	91.60	45.80		
Rumsey	97.40	65.90	87.50	67.90
Felt	97.23	68.78		
Bureau of Entomology:				
(1) Virginia 1909	84.07	53.02	73.96	54.02
(2) Virginia 1909	91.68	54.00	57.90	27.23
(3) Arkansas 1909	92.76	66.74	86.34	8.85
(4) Michigan 1909	93.61	77.79	97.54	87.42
(5) Delaware 1911	92.83	43.40	85.69	65.13
(6) Kansas 1911	84.16	30.20		
(7) Michigan 1911	87.05	52.73		
(8) Virginia 1910	99.01	84.49		
Averages of percentages	92.86	58.44	81.15	51.76

In 8 of the 11 experiments, the percentage of sound fruit is above 90. In one instance (Va. '09), the lessened efficiency of the treatment was due to the effect of a serious hail storm greatly favoring the side entrance of the fruit by the larvæ. Spraying results must, of course, be considered in connection with the severity of the insect. The percentage of sound fruit on the untreated trees of the respective experiments is shown for comparison. The average of the percentages of sound fruit for the one-spray method for all localities is 92.86 as compared with an average of 58.44 per cent of sound fruit on the untreated plats.

A few workers have also made observations on the effect of the one-spray method in controlling the plum curculio. A surprising degree of efficiency has been obtained by a single spraying as the petals fall, and can only be accounted for on the supposition that practically all the beetles are out and feeding at that time, and thus are practically exterminated. The average percentage of fruit free from curculio injury for the several experiments in which this point is reported, is 81.15 as compared with 51.76 per cent of sound fruit on untreated plats.

An interesting question comes up in this connection. Many records on unsprayed trees show that from two-thirds to three-fourths of the first brood larvæ of the codling moth enter the fruit at the calyx end. Assuming that all of the young larvæ entering the calyx are killed, there still remains some 25 to 30 per cent of larvæ which normally enter the fruit at the side. Based upon the percentage of sound fruit obtained, these also have been destroyed. Perhaps sufficient spray from a single application remains on the foliage and fruit to destroy the young larvæ as they are hatching some three or four weeks later.

Notwithstanding the excellent showing made by the one-spray method, it is another question under Eastern orchard conditions whether its use should be recommended. The necessity for several applications of fungicides adds but little to the expense of making additional treatments with arsenicals. If plant pathologists should be able to reduce fungicidal applications to one treatment, following the dropping of the petals, there is no question but that the one-spray method would come into large favor by orchardists, but it should be remembered that the results, above indicated, have been obtained in the course of experimental work where particular attention was given to thoroughness; while such results could, of course, be secured by orchardists, they will, for the most part, fail to obtain such a high percentage of sound fruit. I do not believe that entomologists would at present be justified in radically changing present spraying schedules for the codling moth, though orchardists should be made fully acquainted, for adoption or not, with the results following one thorough application.

Doctor Felt presents data on another question, concerning which there has been more or less uncertainty, namely, the value of the treatment given three or four weeks after the falling of the petals and when the codling moth larvæ are hatching in maximum numbers. Sanderson, who gave considerable attention to this point (l.c.), concluded as the result of his tests that as regards the value of the third spraying (2nd) the only conclusion possible is that if no rains occur after Spray I, that application of Spray III will be of doubtful value when unsprayed trees show not over 50% worminess for the season. This treatment, it will be noted, is considered in connection with the first treatment, and Doctor Felt's conclusions, and our own, agree fully with those of Professor Sanderson. When the first spraying has been omitted or imperfectly made, a second application shows to much better advantage, though it does not by any means overcome the worminess due to missing the first treatment. In Doctor Felt's tests to determine the value of this application alone, his final average of sound fruit for three seasons is 77.47 as compared with his final average of 68.78 of sound fruit from the untreated plats. There is here a difference in favor of a single application of about 10 per cent. According to Professor Gossard, this single treatment gave a percentage of sound fruit of 61.50, as compared with 45.80 per cent sound fruit on unsprayed trees, representing a saving of 15.70 per cent of the crop. The influence of still later treatments as against the second brood is comparable to that just cited, and their value varies in proportion to the thoroughness with which the first application was made. Its effect is largely against the young larvæ before they have entered the fruit, although as shown by Lloyd, a good many larvæ may succumb to the effect of poison sprayed on the fruit, after they have actually bored beneath the skin. Doctor Felt's conclusions seem amply justified from the data presented and his conservatism in still recommending the usual three treatments for the territory considered by him is commendable.

President F. L. Washburn: We would be very glad to hear from some one else. We ought not to limit discussion of this codling moth question.

T. J. Headlee: I have been tremendously interested in the paper and in the remarks that have followed it. We have completed two years of tests, comparing the mist with the dash spray. In the course of our work, we saw that the nozzle which Mr. Ball showed was too small, and used a larger one, but it didn't seem to give a satisfactory dash spray. That is, the drops broke and became too fine, and so we simply turned the hole free of the edge of the nozzle and shot a solid stream, which ran something like five or six feet before breaking up, using about sixteen gallons of fluid to the tree. We did that year before last. This last year we took the regular Bordeaux nozzle and shoved it over so as to make the edge of the hole catch the edge of the nozzle holder, and thus throw a fan-shaped spray, like that Mr. Ball has described. Both years we examined the calyx very carefully to see if we got any poison into it. These examinations, I am sorry to say, revealed a very small percentage of penetration, and when I worked up the summary of the two years' results, I found but little in favor of the dash, as opposed to the mist spray. Now, in order that you may understand the nature of the data upon which these statements are founded, I will say that our experimental plats were, in all cases, five rows wide; that the trees for count were taken from the middle row of each plat; that the check plat was, the first year, on one side of the orchard, and, the next year, on the other side of the orchard. We used the check-plat method. Of course, our check plat was the same size as the others, and we made our counts in the same way. We took into consideration all of the fruit that set on the trees selected, and we counted from six to ten trees per plat. I am certainly inclined, from our small experience, to agree with the statement of Professor Quaintance, that, in all probability, the staminal ring retains its rigidity until the calyx is practically closed.

E. D. Ball: Mr. President, everyone is, I think, agreed that the first spray is the most efficient single spray that could be applied and lest someone misinterprets the tables presented, let me say that the second spray, or spray nine days later, is never used alone in actual field work, but only as a supplementary spray to the first one where the conditions demand it.

When we have reduced the worms to 2 per cent or less, we use only the first spray to keep them down. The point is, if the worms are reduced to 2 per cent, the efficiency of the one spray is high enough in connection with the added force of the enemies of the codling moth to keep the worms down to this point. If conditions demand more than one spray—one spray and then banding would be used—then two sprays and banding, and for bad conditions, two early sprays, banding, and late sprays are often necessary.

So that you may better understand the conditions that we are sometimes called upon to meet in the West, I would like to call your attention to a public statement of Prof. E. P. Taylor with reference to the codling moth, and, as I was also in these orchards with Professor

Taylor, I can also vouch for their accuracy. In the Grand Junction district, as the result of following the one spray and the one pound of poison propaganda, the number of worms increased until we found in one orchard as an average of a long series of counts 42 eggs to an apple. Gentlemen, think of what such a condition as that means. One spray with one pound of poison or ten pounds of poison would not touch such a condition.

On the other hand, if Doctor Felt's experiments were under similar conditions to those shown by Sanderson's tables, and they probably were, there were less worms to kill in the second brood than there were in the first. Under such conditions, any spray that is fairly efficient in the first brood would be sufficient. If a worm was left in the first brood, it might make half a worm in the second brood—not more, while, in the western results, you will notice they increased from 10 to 16 times between broods, and Professor Quaintance shows increases up to 80 and more times between the first brood and the second.

Now, under the conditions found in Grand Junction, eight sprayings did not produce sound fruit and thousands of bushels of apples fell to the ground wormy, for which boxes had been ordered and all preparations made to ship. All this as the results of a false propaganda of one spray and one pound of poison without regard to conditions. We do not want any of that in the West. And, yet, there were whole valleys in Utah this year in which there was not a single orchard sprayed more than once. But, if those orchards should get more than 2 or 3 per cent wormy at the end of any given year, the next year they would get more than one spraying. We do not talk one spray or two sprays, we talk thorough spraying and holding the worms down. You must keep in mind the difference in conditions out there and the conditions that Doctor Felt has been talking about. There are high freight charges on our apples, and in order that they may bring a profit, they must be absolutely sound. You must also keep in mind that the value of the western apples is their color, and the colored apples are the ones on the outside of the tree, and those are the ones most affected by the worms. Our efficiency must be five times what yours is to have anything like the same results, so do not understand that I am talking this spray for your people, but we have a condition to meet in the western country which we cannot afford to fool with. It is a fight to the finish with us and we have finished the codling moth where we have gone at it right.

Just one more thing, I made two mistakes in my first bulletin. I want to correct them publicly. I stated that I used 85 pounds pressure, and that was because the manufacturer said the pump furnished that. I had no gauge on the pump at that time. Since putting a gauge on, I find that we have never used less than 120 pounds pressure. The second mistake was recommending a Seneca nozzle for the driving spray. I have never used one then and supposed that it was the same as the true Bordeaux. As soon as I tried one, however, I found out my mistake and have been careful ever since to specify the large Bordeaux type and warn people against the small one.

I am somewhat surprised to find that some of you have had poor success in driving the poison into the calyx cups. There seems to be no question about our doing it in the West, as I have frequently examined orchards with a hand lens and predicted in advance the success that would result from the spraying. These conclusions have been based on the amount of poison seen in the calyx, and have been markedly successful. I took a satchel full of apples to the Northwestern Fruit Growers' Association, cut them open before the growers and put them under a miscroscope and showed the poison in the calyx cup over nine months after the last spraying.

E. P. Felt: Our experience has been that we could get poison down into the calyx cup better in the Hudson Valley just after the blossoms dropped, before the stamens shriveled to any extent, than we could later, because later the stamens appeared to bar out the drops of water. We used arsenate of lead, and made examinations for penetration immediately after spraying, and if any drops were seen we concluded that there had been penetration into the lower calyx cup. If not, we knew there had not been. We looked for the liquid before it had an opportunity to dry.

T. J. Headlee: I have been wondering if Mr. Ball made a study of the closing of the calyx cup in relation to the maintenance of rigidity of the stamens,—whether in the West this staminate bar actually shrivels up and breaks down, before the closing of the calyx cup.

E D. Ball: It is unfortunate of course that we do not have Baldwin apples in our western country. I think I have in this publication here a copy of a sketch in which is shown the relation of the shriveling of the stamens to the time of the closing of the calyx. At the time in our western apples that the calyx cups begin to close but are still quite open, the stamen bars are thick and fleshy and close together like the fingers of one's hand. At this time it is very hard to force a liquid through. Some can be driven through, however, by driving straight in through the center where they curve out. Later, when the green calyx lobes have come to a nearly upright position is the time that we do our best work provided the nozzle is held close enough and the spray driven straight into each one of these narrow funnels. By this time, the stamen bars, as you look at them from the side, have become curved and twisted and somewhat shriveled, as shown in this second figure, and there are many spaces through which liquid can be driven. It is a fact that last sprays in the fall of the year often do considerable calyx good, as at that time the growing apple has again opened the calyx cup and more poison can be forced in.

I find that when I come to investigate the spraying of those that have not had good results previously, I usually find that they do not hold their nozzles close enough to the blossoms and do not turn the spray around sufficiently to get a straight drive on every apple. If you miss a calyx on a western apple, you have a calyx wormy apple almost every time, so we do actually spray in the western country until we are satisfied that there is not one apple in one hundred on our trees that has not been driven straight into. This is not conjecture on our part. You cannot get away from the facts presented in these records where we have had as many as four worms to an apple in some cases and yet as high as 99 per cent calyx efficiency. There is no question in my mind either but what the greater per cent of this killing is done in the lower calyx cavity. If you fill the top cavity above the stamen bars with poison, when they shrivel there is a considerable likelihood that some of the poison will be knocked off and dropped into the lower cavity, and increase the amount already driven there. It is also probable that we get a considerable efficiency due to the rearrangement of the poison on the trees during the summer. The poison that has been placed on the leaves and bark of the smaller branches and twigs will, as they rub together, tend to fall on the lower apples and give a higher efficiency there than we get on the upper ones.

P. J. Parrott: I am quite frequently confronted with some anomalous results in spraying for the codling moth in New York. I am at times surprised at the satisfactory returns obtained by some of our growers in spraying for this pest when considering how carelessly the work is performed. Then there are other orchardists who, in spite of careful spraying, experience considerable difficulty in obtaining a reasonable amount of protection. One of the great benefits that has been derived from the discussions in recent years upon methods of combating the codling moth is the emphasis that has been placed upon thoroughness of treatment. The discussion of this subject at Baltimore led me to make some tests to determine how far the spraying mixture penetrated into the center of the blossom part. We used a high-pressure spraying outfit and cochineal to stain the mixture but I was surprised how ineffective was our spraying as conducted in our usual fashion. It was apparent that we were not taking enough pains to treat all of the blossoms, nor were we using enough spray material. I have since encouraged our growers to use spraying mixtures more liberally and to spend more time with each tree. When the bordeaux mixture was commonly employed there was comparatively little danger in drenching the foliage; but the lime-sulphur solution is largely used now, and because of the danger of "burning" the leaves, we are confronted with the situation of advocating thorough spraying for the codling moth coupled with a warning to use the liquid in minimum quantities to avoid injuries to foliage.

President F. L. Washburn: Did you look for the cochineal in the lower calyx cup?

P. J. Parrott: Yes.

President F. L. Washburn: And find that you didn't get that?

P. J. Parrott: Well, I was surprised to find how little of the cochineal reached the lower calyx cavity. We failed to see it in the lower calyx cavities of most of the fruits. I should also like to say that we have an orchard of about thirty-five acres, said to contain upwards of 800 varieties of apples that I am supposed to keep free from insects. I take a great deal of pride in showing visitors the freedom of the trees from San Josè scale and various other insects, but I am constantly surprised at the number of wormy apples that appear. I am puzzled at my results and I have often wondered if some western entomologist could inform me how to reduce the number of wormy fruits. I attribute my failures to the mixture of varieties and the presence of neglected orchards in the neighborhood. There is no appreciable shrinking of the stamens, and it would be impracticable to attempt to reach the lower calyx cavity.

E. D. Sanderson: I agree heartily with Professor Quaintance in this matter. There is one thing, it seems to me, the entomologists might stand for in the East, and that is to get away from this idea of spraying a week or ten days after the first spraying for the codling moth. A lot of spray pump companies and newspapers keep on insisting on that recommendation for the codling moth, but I think it ought to be three weeks after the first spraying, as far as the codling moth is concerned. I find a good many horticulturists recommending a week or ten days after the first spraying, but I don't believe in it.

P. J. Parrott: The reason for that recommendation is that there is danger of a very late infection of apple scab, which sometimes makes that treatment advisable in New York.

Secretary A. F. Burgess: Mr. President, I would suggest that, inasmuch as there are many good men in the western states who are thoroughly familiar with Doctor Ball's spraying method, that it might be a good idea for some of our eastern institutions to obtain one of those men as an assistant and try the method here in all its details. They certainly develop entomologists in the West, and I think it would be a very fine thing to have that tried out in the East at some station where they need another assistant. Get a man, try it out, and see if it is possible to secure better results.

A. L. QUAINTANCE: Mr. President, I am reminded by Mr. Burgess' remark that I have in my office force Mr. E. L. Jenne, who was for some years connected with the Washington Experiment Station and spent two years I believe, in a careful study of the codling moth in the State of Washington in connection with Professor Melander. I think, therefore, that Mr. Jenne is thoroughly familiar with western methods of spraying. He was in charge of the spraying operations at Siloam Springs, Ark., upon which the Bureau has reported. We therefore think in this case, at least, that the spraying was done by a true westerner.

W. H. GOODWIN: During the last few years our results in the spraying experiments in the Ohio Station orchard were variable. The differences in the number of wormy apples where the same kind of sprays were used and the same number of applications were given, was surprising and was due, we decided, entirely to varietal differences. There are only three trees of each kind in the variety orchard and the results obtained were very striking because of the wide range of variation of the percentages of wormy fruit. Some trees having less than twelve per cent wormy while another tree in the same plot but of a different variety had almost forty per cent wormy fruit.

PRESIDENT F. L. WASHBURN: It might be a good thing for the men interested in this subject to get together while we are in Washington and discuss this subject.

Adjournment.

Friday, December 29th, 10.00 A. M.

PRESIDENT F. L. WASHBURN: The first paper of the morning is by Glenn W. Herrick, of New York. "Notes on the Control of Three Shade Tree Pests." Mr. Herrick.

NOTES ON THREE SHADE TREE PESTS

By G. W. HERRICK, *Ithaca, N. Y.*

The Elm-Tree Leaf-Beetle (*Galerucella luteola*)

The splendid elm trees on the campus of Cornell University have been so badly injured during the past half dozen years by the leaf-beetle that measures of control became imperative if the trees were to be saved. Fortunately, the University authorities realized the gravity of the situation in time and naturally turned to the Department of Entomology for help.

The problem seemed a rather large one and I was surprised to find how little definite data there really was to guide us in making an estimate of the cost of spraying shade-trees, or to give a really adequate idea of the kind of outfit to use, and the most economical and effective methods of accomplishing the work. We have nothing startling to offer in the way of new methods or apparatus, but we succeeded in spraying the trees with rather gratifying results in controlling the beetle and in a fairly economical manner. We hope, however, to improve the work during the coming season.

The first question that presented itself, of course, was the matter of apparatus. Our appropriation was not large and it, therefore, became necessary to limit ourselves to reasonably inexpensive and tried outfits. After much correspondence and several interviews with agents, we decided to purchase a Hardie Power Sprayer with a triplex pump, 3 H.P. engine, 200-gallon tank, 12-foot tower, two leads of hose, each 100 feet long, and two extension poles, one 20 feet long and the other 12 feet in length, and a Friend Hilly-Orchard outfit with a $3\frac{1}{2}$ H.P. engine, California model pump, 8-foot tower and other equipment like the former outfit. With these outfits, and both gave eminent satisfaction, we were able at all times to maintain 175 to 200 pounds (and over) pressure. One man remained on the tower and with his 20-foot extension pole and Bordeaux Nozzle was able to reach the tops of the very highest trees. The man on the ground ran the engine, drove the team, and sprayed the lower branches. The so-called foreman directed the work, mixed the solutions, attended to breakdowns, climbed trees if necessary, and kept things going in general.

The first spraying was made from May 16 to May 25 and the second from June 12 to June 22.

We used 3 lbs. of paste arsenate of lead the first time over the trees and $3\frac{1}{2}$ lbs. to 50 gallons of water the second time.

A careful and detailed record of the actual cost of spraying 435 trees was kept. Most of these trees were large and all of them stood near the street and near our water supply. It cost \$133.37 to spray these trees once or 30.7c per tree. On the average each machine sprayed $36\frac{1}{4}$ trees per day of eight hours, or $4\frac{1}{2}$ trees per hour or a tree about every $13\frac{1}{3}$ minutes. On an average we used approximately $18\frac{1}{6}$ gallons of liquid to each tree.

A detailed example of a day's work on the largest trees will give even a better idea of the cost of spraying such trees. On June 19th the two machines began on the largest elms on the Campus, namely, those from the Library south along each side of Central Avenue. The two machines sprayed 59 of these very large trees. The cost of the men and teams was \$17.00, the arsenate of lead \$6.61½, the gasoline 35c, total \$23.96½, which is an average of 40.6c per tree.

In all, there are about 530 trees on the University Grounds that were sprayed. About 100 of these were scattered over the steep hill-sides west of the buildings and along University and Stewart Avenues. Many of these trees were a mile from our water supply and the majority were scattered and not easy to reach. It cost, exclusive of permanent equipment, \$464.90 to spray these trees twice or an average of approximately 88c each. The scattered trees just mentioned raised the average cost of the whole, quite materially. If all of the trees had stood along streets and reasonably near a water supply the average cost would have fallen I think, below 70c. It took the two machines ten days to make the first spraying and eleven days to make the second. The second spraying was done more thoroughly and there was much more leaf surface to cover. On the other hand, experience had made the men more efficient.

In conclusion of these notes on the elm leaf-beetle, I should like to note the work of *Sporotrichum globuliferum* in killing scores of the pupæ and newly emerged beetles of the first generation in the latter part of July and first part of August, and a great majority of the pupæ of the second brood in September.

The Elm Sawfly Leaf-Miner (*Kaliosysphinga ulmi*)

This miner is present at Ithaca and injures the English and Scotch elms very severely. Its life history and habits were investigated by the late Professor Slingerland and described in Bulletin 233 of the Cornell Experiment Station. No adequate method of control, however, had been found up to 1911, so far as I am aware.

Recalling the penetrating power of certain contact insecticides, it occurred to me that possibly the larvæ might be killed in their mines in the leaves before they caused much injury. It was with a forlorn hope, however, that I sprayed a small Scotch elm which had been badly injured.

The mixture consisted of Black-leaf-40 at the rate of one gallon to 800 gallons of water with four and one-half pounds[1] of laundry soap to 50 gallons of water. The application was made in May just as the tiny mines had begun to show in the leaves. The effect was quite surprising. I examined a great many of the sprayed leaves and every larva had apparently been killed within a comparatively short

[1] We intended to use but two pounds of soap to 50 gallons but by a mistake in calculation four and one-half pounds were used.

time, at least before the mine had been perceptibly enlarged. The contrast, later in the season, between the topmost branches, which we could not reach and the lower branches was very marked. The leaves not sprayed were almost completely mined and became withered and most unsightly.

Apparently the elm leaf-miner can be controlled by spraying with the tobacco extract and soap. We shall have an opportunity to make a much more extended trial of this method of control during the coming season.

The Larch Case-Bearer (*Coleophora laricella*)

I have been giving considerable attention to the life history of this pest on larches during the past two years together with an attempt to find a practicable and efficient method of control.

This insect passes the winter in its fall case attached to the branches of the tree. On April 7th, before the buds had begun to swell and before the larvæ had left their winter positions, we sprayed a badly infested tree with lime-sulphur at scale strengths. The lime-sulphur was the home-made concentrated and tested 29° Baumé. It was diluted 1 to 7 and the tree thoroughly coated from top to bottom. The next day there was a heavy fall of snow. The subsequent three or four days were clear and sunny.

By April 27th an examination of the trees showed that the buds had started and that on the unsprayed trees the larvæ had moved to the leaves. On the sprayed tree, however, not a larva had left its winter position. On May 5th I examined many larvæ and found only two alive. The others were dried up and dead. In subsequent examinations I was unable to find that a single larva had moved from its hibernating position to the leaves. It would seem that the lime-sulphur at scale strengths is highly efficient for this particular pest, at least.

President F. L. Washburn: Discussion of this paper will come after Mr. Burgess' paper, "Some Shade Tree Pests in Eastern Massachusetts."

SOME SHADE TREE PESTS IN EASTERN MASSACHUSETTS

By A. F. Burgess, *Melrose Highlands, Mass.*

In few sections of the country have shade trees suffered more from the attacks of injurious insects than in Eastern Massachusetts. This region has not only had the usual number of native pests but from time to time several introduced, and very destructive foreign species have found lodgment and have caused more damage than they were accustomed to in their native homes. As a result of the threatened destruction of trees public interest has been stimulated in the matter and it is doubtless true that more work is now being done on shade trees in this section than in any other region of the same size in the United States.

Among the very serious European pests that have been introduced are the gypsy moth, the brown-tail moth, the elm leaf beetle, the leopard moth and the European bark beetle, (*Eccoptogaster multistriata* Marsh) which latter is causing enormous damage to elm trees, especially in Cambridge.

In the early nineties, when the gypsy moth was found in the suburbs of Boston, much interest was aroused in protecting shade trees and forests from this destructive pest, and as a result new methods were devised for carrying on warfare against this insect and excellent results were secured. During the summer of 1897, when this insect was under control and when its capacity for harm had been reduced to such an extent that it could be controlled by what would be now considered a moderate appropriation, it was discovered that another European pest, known as the brown-tail moth, had become established in the same region and was causing considerable injury. This discovery was most discouraging, owing to the fact that the annual expenditure for keeping the gypsy moth in check seemed to be as large as could be raised for such a purpose. Both insects, however, were fought by the best means that were then known and in 1900, when the State work was finally discontinued, they were under sufficient control so that no serious injury was being caused in the residential sections.

During the next four years these pests increased enormously and a large amount of damage resulted. In the meantime, however, their work, on the elm trees, was supplemented by the annual appearance of the elm leaf beetle, which caused permanent injury if no remedies were applied.

This condition stimulated the interest of the citizens throughout the affected section and much money was expended by private owners, as well as by some of the towns and cities surrounding Boston, for the purpose of protecting the shade trees within their borders.

After the State work was resumed in 1905 more attention than ever was paid to the protection of trees in the cities and public parks and although it has been confined strictly to fighting the gypsy moth and the brown-tail moth, it has aroused interest and caused many owners as well as many of the cities and towns, all of which are provided with official tree wardens, to protect the elms from the ravages of the elm leaf beetle.

The condition of the trees, at the present time, is a fairly good indication of the extent to which the citizens became aroused, but in some cases work was not begun until after it was too late, and as a result enormous damage and loss to the trees has been sustained.

The recent discovery about 1907, of the leopard moth, (*Zeuzera pyrina* L.) in Boston and vicinity and the finding of the European elm bark beetle in Cambridge are two of the most discouraging features of the campaign for the protection of shade trees in this region. Both of these insects work beneath the bark and the injury which they cause is inconspicuous until it has proceeded so far that it is difficult to repair the damage, or to destroy or check the pests. In addition to the insects already mentioned, it should be said that the San José scale is causing much injury to such shades trees and ornamental plants as it particularly favors for food and that this damage is increasing rather than decreasing from year to year.

The tussock moth (*Hemerocampa leucostigma* S. &. A.) occasionally becomes abundant enough to cause serious injury, but the damage sustained does not compare with that caused by the pests which have already been mentioned. Owing to the number of insects concerned and their different habits of life, it is impossible to lay down any one rule for treatment which will be effective for all. The cheapest and most satisfactory remedy for the gypsy moth and the elm leaf beetle consists in thoroughly spraying the trees with arsenate of lead, using ten pounds to one hundred gallons of water, as early in the spring as there is a sufficient foliage to hold the poison.

For this purpose high power spraying machines have been perfected during the past few years. The improvements made in these sprayers, nozzles and other equipment have resulted from the experiments conducted under the direction of Mr. L. H. Worthley, who has had charge of the work on the gypsy moth for the State Forester of Massachusetts. Several improvements have also been made by Mr. D. M. Rogers, Superintendent of Moth Work, for the U. S. Bureau of Entomology.

With the improved outfits now in use shade trees are sprayed from the ground, so that climbing is not necessary and it is possible to greatly increase the number of trees that can be treated in a single day, and the machinery is so reliable that very little time is lost by break downs. This has greatly decreased the cost of treatment per tree.

In treating for the brown-tail moth it is usually desirable to cut off the hibernating webs of the insects and at the same time it is customary to treat with creosote such gypsy moth egg clusters as can be found. Control work for the leopard moth is far more difficult and it appears evident that if the trees are kept in a vigorous condition, that injury from the European elm bark beetle must be reduced to a minimum.

The cities and town surrounding Boston expend large sums of money each year to care for their shade trees. It is not uncommon for a town to expend $1,000 or more annually for elm leaf beetle spraying in addition to the cost of controlling the gypsy moth and the brown-tail moth and for other shade tree work.

Two of the most striking examples that can be found in the region mentioned and which illustrate the interest that is manifested in work of this kind is in the treatment of the trees on historic Boston Common and those in the city of Cambridge, which lies just across the Charles river.

On the Common are many large elms and maples, some of which tower eighty to ninety feet into the air. Owing to the strong public sentiment in favor of the preservation of these historic trees, special care has been taken from time to time to protect them from insect injury, but in spite of this, considerable damage has resulted, especially in the last few years, from the attacks of the leopard moth.

In order to replenish the soil fertility so as to give the trees every possible opportunity to survive, the earth has been removed to a depth of from one to three feet, depending upon the quality which was found. The poor soil has been hauled away and rich loam, mixed with lime, bone meal, and manure substituted. Already thirteen acres have been treated in this way and the complete project contemplates similar treatment of thirty acres during the next few years at the expenditure of about $200,000.

In addition to this, an entomologist has been employed to look after the insect problem and Mr. J. W. Chapman has had charge of this work for a year or more. He has made a special study of the leopard moth and the European elm bark beetle and has recently published an excellent bulletin containing the results of his investigations.

The greatest problem in connection with the insect work has been to control the leopard moth and Mr. Chapman has succeeded in reducing the injury to some extent, but the task involves much difficult and tedious work and its ultimate success is impossible to forecast at the present time.

In Cambridge, which has been termed the city of elms, much injury has resulted from the work of the elm leaf beetle. For several years many trees have been defoliated by this insect, as a result of poor spraying, or failure to apply the poison early enough in the season. The leopard moth is exceedingly abundant in this city and is causing enormous injury. Over 1,000 large street trees, chiefly elms, have been removed or marked for removal during the past two years. Many of these were injured to some extent by bad pavement and other conditions. Nevertheless, it is a fact that in the adjoining city of Somerville, where pavement conditions are very similar and the tree growth is similar enough to that in Cambridge to permit a reasonable comparison, only a few trees have died each year. The leopard moth is fully as bad in Somerville as in Cambridge, and evidence of its work can be noticed without making a careful examination. The large historic elms in the college yard at Harvard University are for the most part in a dying condition, due entirely to these causes, and although an heroic effort was made to save them during the winter of 1909 and 1910 by pruning them severely and fertilizing the ground beneath them, it is now evident that most of them will succumb, in fact, some have already been removed.

In the town of Arlington, which immediately adjoins Cambridge, the street trees are in excellent condition. They have been sprayed systematically and have suffered practically no injury from leaf eating insects. To be sure, the leopard moth is present, and just how much damage it is destined to do is difficult to predict. The conditions, however, are in striking contrast to those in Cambridge. In a part of Arlington, street trees are less subjected to injury from pavements and this may account in a very slight degree for the differences noted. After all has been said, however, the insect problem is the most important, for if these pests are controlled the trees will have a fair chance to thrive but if the contrary is the case, their opportunity is exceedingly limited.

This subject brings up the question of the value which may properly be placed upon a well developed shade tree. It is impossible to state this at all definitely, although everyone appreciates the fact that shade trees add to the value of city or country property. If we base the value of a shade tree upon the cost of the small tree and the expense of planting and caring for it until it becomes large enough to give a reasonable amount of shade, we find that the total value is far greater than would be supposed. Undoubtedly this is a very conservative way of determining the value of such trees, as it shows what would be the cost of replacing them, although in addition to this it would be necessary to wait from ten to twenty years or more in order to obtain the result. In several cases tried in court the value of city shade trees has been rated as high as $500 each and this amount has been collected.

Dead and dying Elm trees, Massachusetts avenue, Cambridge, Mass., injured by Elm Leaf Beetle, Leopard Moth and European Bark Beetle. Photo. Sept., 1911.

Trees on Massachusetts avenue, Arlington, Mass., same street as that shown on the previous plate. There is no foliage injury on account of good care. Photo. Sept., 1911.

In Boston a contract was recently awarded for planting shade trees on each side of one of the fashionable thoroughfares. In doing this work it was necessary to take up a portion of the brick walk, dig out large holes, and when the trees were planted, to fill in these holes with rich soil hauled from the country. It was required that the trees should be pruned and protected for two years, and all that might die within that period were to be replaced. The contract price for this project averaged about $50.00 per tree and as this amount was contributed by the people who resided on the street, it indicates, in a way, the value which they place upon shade trees. Of course this is a far greater amount than would ordinarily be expended for tree planting in cities, but it should be remembered that the planting of a new shade tree is merely the beginning of an annual expenditure of money, if the tree is to grow and become worthy of the name.

In Cambridge, where so many trees have died, it has cost on the average about $20.00 per tree to remove them, and this figure was secured because the contract was such a large one. The amount which will have to be expended for removals should have been sufficient to protect the trees for at least ten years.

It seems evident that any city or town can well afford to expend a relatively small amount of money each year to care for large and valuable shade trees and protect them from insect damage, for if this is not done their death and removal is certain. Future shade must result from planting small trees under much less favorable conditions than those which surrounded the trees that have been removed. They must be cared for many years before any considerable amount of benefit or shade will be derived and it will be necessary to expend as much, if not more, money annually to protect them than would be the case if the large trees were put in good condition and given adequate attention.

The care of existing shade trees, and their protection from insect enemies is so necessary that it should appeal strongly to citizens in every community who are interested in their home town or city. If city shade trees are worth several hundred dollars apiece, their preservation should be a matter of prime importance and their care should be placed in the hands of competent and experienced men. These men should have the benefit of the advice of the State Entomologist or his assistants and in order that proper remedies may be used, that official should be given sufficient funds to investigate the habits of shade tree insects about which little is known, except that they cause serious injury to trees and are difficult to control.

It is probable that few cities have had as difficult an insect problem as those in eastern Massachusetts and it should be a source of congratulation to such that most of the pests which I have mentioned have not yet made their appearance. It should be a warning, however, and the facts should be taken advantage of before these pests appear, for, if the city or town trees are well cared for, they will be in condition to resist some of their enemies, particularly bark borers which usually attack the unhealthy trees. Furthermore, if the work is in proper hands, it will be comparatively easy to discover the presence of serious pests even when they occur in small numbers and by applying immediate treatment the trees can be preserved.

The whole problem is one which should be given careful thought and attention in each community. Local public sentiment, however, is absolutely necessary if progress along this line is to be made.

President F. L. Washburn: A discussion of these two papers by Mr. Herrick and Mr. Burgess is now in order.

P. J. Parrott: I wish to express my appreciation of this paper, and to say that it is gratifying to hear of these promising results in spraying because the elm leaf miner has been very prevalent in New York State. Recalling the experiments on the case bearers on larch, I would like to say that in the spraying of apple orchards we believe we have obtained similar results with lime-sulphur wash on the common case bearers on apples.

Glenn W. Herrick: Mr. President, just one further word. I want to say also that in an experiment to control a bud worm of the pecan, in the South, which lives over winter in hibernacula on the branches, close to the buds, I obtained similar results by spraying with lime-sulphur.

E. D. Sanderson: Mr. President, I would like to ask what is the cost of one of those outfits, and about what is the cost per tree for the regular spraying?

A. F. Burgess: The cost for an outfit, the original investment, for a high power machine, is about a thousand dollars. Professor Herrick can tell you the cost of the other machine.

Glenn W. Herrick: We paid $200 apiece.

E. D. Sanderson: What does it cost you per tree?

A. F. Burgess: These facts are very difficult to get at because the spraying is done by town gangs. Some are efficient,—some less so,—but in the city of Newton, where they have about fifty miles of shade trees, they sprayed and cared for last year nearly 3,000 large trees. They used arsenate of lead at the rate of ten pounds to the hundred gallons, and it cost about fifty cents per tree for one spraying, pruning, etc.[1] The experience has been, in eastern Massachusetts, in spraying for the elm leaf beetle, that if the work is done as soon as there is foliage enough to hold the poison in good shape, and if the poison is used at the rate of ten pounds to the hundred gallons, one spraying is sufficient. That is the way the trees have been treated in Arlington, and no serious injury by beetles has resulted.

Glenn W. Herrick: I should like to say that this was the first year the elm trees had been treated. They were in bad shape, and we tried to do a good job and went over them twice, with a little less than five pounds of arsenate of lead to fifty gallons of water.

H. T. Fernald: Mr. President, I would be very glad to give a confirmation of the condition in which the trees of eastern Massachusetts are found at this time, if such were necessary, but Mr. Burgess has not overdrawn it in any way. I think, however, that there may be one point to add. In western Massachusetts, speaking particularly of the town of which I am a resident, we have neither the gypsy moth, the brown tail moth nor the elm bark beetle, and yet, within the last three or four years, we have lost perhaps fifty elm trees which were from two to three feet in diameter at the bottom. This seems to call for an additional factor besides those enumerated by Mr. Burgess. The trees have been very carefully examined by plant pathologists and entomologists, several of whom have been available for this examination, and the conclusion has been arrived at that the death of at least a part of the large elms through Massachusetts was due not to insects or to disease, but to a series of rather remarkable climatic conditions. Apparently, the winter conditions were such for a year or two that large numbers of the smaller rootlets of these trees, which had not suffered for many years, were absolutely destroyed, and the trees finally went through what might be termed, perhaps, "a lingering death." The elm leaf beetle was not a factor in particular, for, though present, the trees were thoroughly sprayed and well taken care of, and I think that the weather may have been one of the factors in eastern Massachusetts, masked or concealed by the evident additional work of the insects present.

Z. P. Metcalf: Mr. Chairman, in Raleigh we had two magnificent

[1] Since returning from Washington, the writer has obtained considerable data on the cost of spraying shade trees with different kinds of outfits. This information shows that by using a high pressure machine and a solid stream city shade trees can be sprayed for about $.20 each. There are many factors which have to be considered in figuring the cost of spraying, and as space in this issue will not permit a statement of details, it is hoped that it will be possible to prepare a paper later on giving the information secured.

elms that died, and, to the best of my knowledge, in the last three years there has never been an elm leaf beetle on those trees.

President F. L. Washburn: This reminds me of a condition in Minnesota. We are losing many of our fine oak trees, which have died this last summer in enormous numbers. This death seemed to be due to a borer or borers and also to a fungus attack on the root. Normally, I think these trees would withstand these attacks, but a year ago we had a drought, and up to this last fall the ground from a foot below the surface downward was as dry as tinder, and I believe that while the trees would normally resist the attack of these beetles, which probably occur every year, this last year they were so weakened by unfavorable conditions that they succumbed in large numbers. We have reared the borers, I believe. Mr. Spooner, what did those Buprestids prove to be?

C. S. Spooner: There were two species, the flat headed apple tree-borer and the destructive borer, *Agrilus bilineatus*.

President F. L. Washburn: Any further discussion on these two papers? If not we will go to the next paper, "The Gooseberry Gall Midge or Bud Deformer (*Rhopalomyia grossulariæ* Felt)" by Mr. Houser, of Wooster, Ohio.

THE GOOSEBERRY GALL MIDGE OR BUD DEFORMER[1]

(*Rhopalomyia grossulariæ* Felt)

By J. S. Houser, *Ohio Agricultural Experiment Station, Wooster, Ohio*

The gooseberry gall maker is a new pest of gooseberries, having been described by Dr. E. P. Felt[2] from material sent him by the author. It is not known to occur anywhere except on one farm in the vicinity of Camp Chase, Ohio, and there its work is of a serious nature.

The plant is injured by the insect working during the larval stage in the terminal buds of spurs and branches, causing the bud to become abnormal both in size and structure. The bud scales increase greatly in numbers and size and, lying closely one upon another form a gall somewhat resembling in miniature the pine-cone willow galls so commonly encountered upon the tips of willow twigs.

The injured bud is incapable of producing normal leaves and the plant, striving to maintain itself, develops secondary buds within or

[1] Contribution from the Ohio Agric. Exp. Station, and the Department of Economic Entomology, Cornell University.

[2] Journal of Economic Entomology. Description, Vol. 4, No. 3, p. 347. Journal of Economic Entomology. Hosts and Galls of Amer. Gall Midges Vol. 4, No. 5, p. 468.

about the first and these in turn becoming infested, there is formed ultimately a large knot or cluster of galls. A typical cluster is illustrated in figure 1. Occasionally the injured cluster succeeds in putting out feeble growths which usually take the form of undersized twigs. Such a cluster, starting to develop, may be seen in figure 2. These growths appear at the end of the first or second season as illustrated by figure 3. As a rule, however, this secondary, "witch-broom" like growth does not develop, and one finds the infested plant with numerous, large, rounded gall-clusters located on any part of it as shown by figure 4.

History of the Insect. The work of the gooseberry gall maker was discovered for the first time during the summer of 1906 on the farm of Mr. C. D. Smith, Camp Chase, Ohio. Since that time the writer has examined gooseberry bushes in various parts of the state whenever the opportunity afforded, and while a student in Cornell University he sent a number of letters to some of the more important small fruit growers of New York State, by way of inquiry concerning the insect but it has never been found anywhere other than at the place of the original discovery.

Mr. Smith has been a rather extensive grower of gooseberries, having had at one time about an acre devoted to this crop. At the time the trouble was discovered, however, a good many of the bushes were dead and there was scarcely half an acre remaining.

During the last five years, so many of the plants died that the plot was destroyed, with the exception of a few plants and these are in a bad way. While it is true that the old age of the bushes undoubtedly was responsible in part for the present condition of affairs, it cannot be denied that the gooseberry gall midge has played an important role in the proceedings—so important, in fact, that the writer considers it a serious pest when it becomes established in a planting.

The Adult Insect. A detailed description of the adult will not be given here as it may be had in the publication already cited. Briefly, however, it may be said that it has the general appearance of the typical Cecidomyiid, with its long, ungainly legs and generally delicate structural characters. The gross appearance as to color is reddish brown.

The adult is very frail and doubtless lives but a very short time, as the eggs are laid within a few hours after the insect emerges. It is not at all likely to be seen by the casual observer unless it so happens that he be about at the time of emergence, as the adults which the author procured, were obtained only after practically every resource in the way of breeding devices had been exhausted. The main difficulties seemed to lie in maintaining proper moisture conditions, for a slight fluctuation towards humidity caused the development of mold upon the pupa or larva, as the case might be, and if the galls became too dry the insect within perished.

The body of the female, upon emergence, is very heavy and sluggish. Those specimens which the writer has observed were scarcely able to fly, and this fact is a very important feature in connection with the spread of the pest. The males were lighter, more active and fly at will.

The Egg. The egg, as stated previously, is deposited within a few hours after the adult leaves the gall. Females emerging during the night were ovipositing freely the next morning.

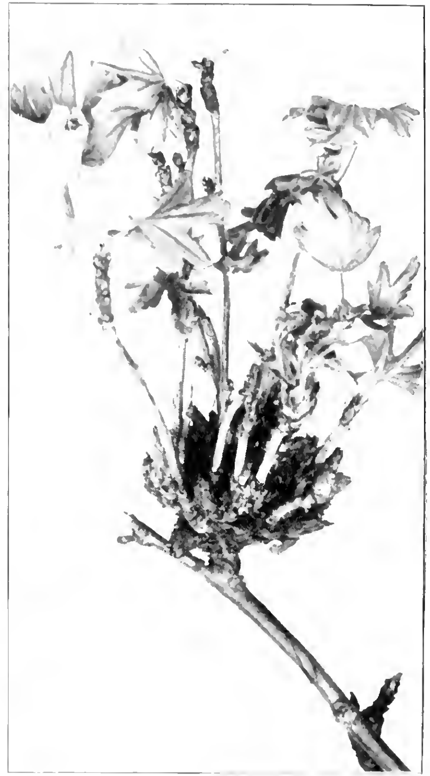
In appearance the egg is very narrowly elliptical, light red in color and is about .4 mm. in length. Those observed by the writer in the open were deposited singly or in clusters in the new growth coming from the old galls, this being the only place where he was successful in observing them. A very careful search was made for eggs at the bases of healthy leaves, with the hope of obtaining some light upon the manner in which the gall was formed.

The Larva. The newly hatched larva is shown in figure 4. The full grown larva measures about 2 mm. in length As one would expect of members of this family, the body is divided into fourteen segments, but differing from most Cecidomyiids the "breast bone" like organ cannot be detected. The median body segments are much longer than those at either end, the head is small, somewhat triangular and is capable of being retracted within the body segments when the larva is disturbed. There are nine pairs of spiracles. On the first thoracic segment, slightly caudad, and on each side of the head is a brown nodule or button which is about the size of the spiracles and has much the appearance of them. That these organs are not spiracles was proven beyond doubt by mounting a specimen directly in balsam, thus showing the details of the tracheal system. No trachæ extended from these structures.

The color of the larva is slightly faded salmon, with the head light brown. During the winter and early spring one finds them snugly encased within the protecting, enlarged bud. If the insect is dissected out at this time, it will be found in the curled up position assumed by the larvæ of Lachnosterna sp. when disturbed, with the head against the base of its cell, apparently in a feeding position. Immediately surrounding the body of the larva are green, living bud scales, usually of three scales thickness and surrounding these is a wall of dead bud scales six or seven scales in thickness. The bud

1

2



3

Fig. 1. A typical cluster of galls, natural size. Fig. 2. A gall cluster throwing out a new, abnormal growth in spring. Fig. 3. A witch-broom growth which sometimes develops from gall clusters.

4

5

Fig. 4. A gooseberry bush badly injured by the gall midge. The illustration in the corner of the cut is that of a newly hatched larva, enlarged. Fig. 5. The pupa within the bud gall, enlarged about twenty diameters.

scales are drawn closely together at the tip, particularly the green inner ones, thus making a secure home for the larva. So perfectly in fact do these scales fit one upon another that the cell within will remain moist for a few hours, even though the surrounding atmosphere is very dry.

The Pupa. Pupation occurs in the cell occupied by the larva. The larva reverses the position of its body before transforming so that the pupa rests with the tip of the abdomen next the base of the bud. A pupa within the pupal cell, one side of which is torn away, may be seen in figure 5. The male pupa is a little less than 2 mm. in length; head, thorax and appendages a dirty black, and the antennæ extend three-fifths of the distance to the tips of the wing pads. The encased legs reach to within two to five segments of the tip of the body. The abdomen is at first tinged with pink, later becoming a very dark pink. On the dorsal side of the thoracic segments is a lighter median line.

The female pupa is slightly longer, with comparatively shorter appendages and with a much enlarged abdomen.

Life History and Habits. The life cycle and habits of this insect are not perfectly understood, but enough is known to permit suggestions for remedial measures to be made with assurance.

The adults appear during the early part of May, the first ones observed this season having emerged the ninth or tenth. Within a few hours after emergence the eggs are deposited and these hatch, apparently, within a few days. How the gall is formed is not known, neither is it known whether the larval stage extends over more than one season. The only data which the writer has to present upon this point, is that at mid-summer there may be found galls which are apparently fully developed and which contain in the normal position a larva which seems about one-tenth grown. He has not succeeded in finding large larvæ during mid-summer, nor has he found anything except pupæ or adults at the season of the appearance of the full grown insect; so the natural assumption is that the larval stage does not extend over more than one season.

The larvæ transform to the pupal stage about April 1. At this time the live portion of the injured buds develop slightly and the green bud scales begin to push out beyond the dry ones. As growth continues, these green portions apparently carry the pupa along with them and by the time the adult is ready to emerge, the pupa has been pushed at least partially out of the gall proper. When the insect transforms, the dirty-gray, delicate, pupal skin is left hanging at the tip of the old gall.

The Insect's Future as a Pest. The insect has been a serious pest on Mr. Smith's farm, and it is the belief of the writer that prompt measures should be taken against it as soon as its work is observed. As stated previously, the female is very sluggish in her movements, apparently being scarcely, if at all, able to fly. This, taken in consideration with the fact that gooseberries are rarely grown on a very extensive scale and usually are found in isolated patches, indicates that there is little likelihood of the pest becoming generally distributed.

Natural Enemies. No parasites have been observed working upon the insect, but several dead larvæ have been observed, apparently killed by some bacterial disease.

Remedies. The remedy is so obvious, now that we know something of the life history, that it seems scarcely necessary to state it, namely: cutting out and burning the gall clusters during the fall or winter. The work in order to be effective must be done with care and thoroughness, for quite frequently isolated galls occur which are difficult to find, and these by escaping destruction would be sufficient to perpetuate the species.

President F. L. Washburn: Any discussion upon this paper? If not we will pass to the next paper on the programme, "Occurrence of Pear Thrips in New York," by Mr. Parrott.

THE OCCURRENCE OF THE PEAR THRIPS IN NEW YORK

By P. J. Parrott

This species, *Euthrips pyri* Daniel, has attracted much attention in recent years because of the course which it has run in California. Its importance to the deciduous fruits of that state, and the efforts[1] that have been made to establish more efficient methods of control are well known. Peculiar interest is now centered in the thrips because of its presence in a region very remote from its heretofore recognized area of distribution, where it is playing a like role as a destructive fruit pest. It is the purpose of this paper to present some observations upon its distribution and work in orchards in New York.

Distribution in the State. The pear thrips was discovered first at Germantown in the Hudson River valley where it was very destructive in many orchards in the immediate vicinity. The pest was

[1] Moulton Dudley, Circular, Cal. State Com. of Hort.; Bul. 68, pt. I and Bul. 80, Pt. IV, U. S. Bureau of Entomology.

Foster, S. W. and Jones, P. R., Circular 131, U. S. Bureau of Entomology.

similarly injurious in plantings about the neighboring communities of North Germantown and Cheviot. Scattering numbers of the insect were seen on pear trees grown south of this region, about Tivoli; to the north about Stuyvesant, and eastward to a line running between Chatham and Clermont. According to Mr. C. E. Hover, an extensive fruitgrower at Germantown, the thrips has caused most damage in a compass of about ten miles of this village, although it has not been equally destructive in all orchards. It is probable that the insect occurs over a larger area than is indicated by these bounds. Several growers, who reside across the Hudson River and have recently had their attention called to the destructiveness of the thrips, have expressed their opinions that the work of this insect was also observed during the past spring in their plantings about Milton and Marlboro. It is expected that the distribution of the pest in this State will be determined within closer limits during the coming year.

The area in which the pest occurs is located in the leading fruit-growing section of the Hudson River Valley. It is a hilly region, but the slopes are admirably adapted to the growing of the common bush and tree fruits, which are cultivated in an intensive manner. The individual holdings are as a rule small, but they are thickly planted; and as seems to be the prevailing practice each farm usually has a pear orchard as well as plantings of other fruits.

Nature of Injuries and Conditions in Orchards. The adult thrips were very abundant on all of the common tree fruits grown about Germantown, such as the apricot, apple, sour and sweet cherry, peach, pear, plum and quince. Pears generally sustained the greatest damage although the insect seemed to be equally numerous on other fruits, especially the sweet cherry and the apple. Of the leading sorts of pears grown in this community, Kieffer suffered the most and there was not an orchard of this variety among a large number examined by the writer that did not show evidences of the work of the thrips. Orchards on warm and protected slopes seemed to be especially attractive to the insects, which was attributed to the advanced condition of the buds. During the latter part of April and early May the thrips swarmed about the trees, injuring the buds and blossom clusters, which turned brownish or blackish and appeared as if blasted. The trees which were most severely attacked were wet with sap which ran down the fruit spurs, moistening the bark of the large branches, while bud scales, leaf stipules, blossom bracts, sepals of unopened blossoms and margins of leaves were blackish or discolored. In some orchards such a large percentage of blossoms were destroyed that very little fruit was harvested. While such damage according to the statements of fruitgrowers, has been more common in preceding years, it was the exception during this spring. Seckels suffered almost as severely as Kieffers, while Bartletts and Clapp Favorites, though showing considerable blighting of blossom clusters in different plantings, were not in the main seriously affected.

In view of the importance of the attacks of the thrips on sweet cherries, the conditions in plantings of this fruit were carefully noted. Such varieties as Black Tartarian, Napoleon Bigarreau, Schmidt Bigarreau and Windsor are the leading commercial sorts, and these were frequented by large numbers of the thrips from the time of the spreading of the winter bud scales to the dropping of the blossoms. As has been commented on by other writers, the most noticeable work of the pest was on the fruit stems which were much scarred as a result of oviposition. From the appearance and the numbers of the wounds it was at first thought that there would be considerable early falling of fruit. Premature dropping of cherries occurred to a slight degree, but in spite of the numbers of the thrips the trees produced satisfactory yields; and the fruit, because of favorable weather conditions, was of superior quality. There is much interest on the part of fruit growers as to the probable effects of oviposition upon the cherry crop because during some seasons there is considerable yellowing of the stems, which is sometimes attended with premature dropping of much of the fruit. The larvæ were observed in large numbers under the "husks" or loose calyces of the fruits; and, while an occasional cherry showed abrasions of the skin, the value of the crop was not appreciably affected. The leaves of sweet cherry trees were attacked by both adults and larvæ, and as a result of their injurious work the foliage was generally full of holes and sometimes quite ragged in appearance. Apples, apricots, sour cherries, peaches, plums, and quinces, in spite of the numbers of the insect, showed as a rule only slight evidences of injury.

History of Thrips about Germantown. The writer interviewed many growers upon the early history of the thrips in order to account for its presence in a region so distant from its well-known habitat. However, very little definite data was obtained as in the past the injuries to the trees have been attributed to spraying mixtures and late frosts, and the insect was not recognized as the originating cause of the unfavorable conditions of the trees until this year. From the statements of orchardists it seems that the thrips has been at work in some plantings for at least five years and recently its ravages have become increasingly conspicuous until 1910, when it was generally exceedingly destructive. During that year the yields of Kieffers were much reduced and the losses were large because of the extensive orchards of this variety. The opinion generally prevails that the introduction of the thrips in this region is of recent origin and that it is actually increasing in destructiveness. Future observations may lead to this conclusion. Prolonged droughts for successive years and an abnormally early development of fruit buds during 1910 afforded perhaps exceptional conditions for its destructive work that year, which eventually led to its detection. The question may well be asked as to whether the insect has been lately introduced or is a well-established species which has recently emerged from a state of obscurity and has risen at last to a position of first prominence.

Control of Thrips by Spraying. The Station conducted a number of experiments with various spraying mixtures, largely according to the directions of Foster and Jones, which have recently given such promising results in their work in California. The standard nicotine preparations with either soap or kerosene emulsion proved exceedingly satisfactory sprays, for they killed all the insects wetted by them. To destroy the thrips buried in the substance of the bud or in the compact blossom clusters the use of the oil emulsion with the tobacco extract is perhaps to be preferred; but when the thrips are in exposed positions a combination of the nicotine spray with soap was surprisingly effective. Both of the above combinations proved to be very safe to the foliage and, notwithstanding the fact that the trees were sprayed from three to four times on successive days, there was no material injury to the leaves. As recommended by the above writers, the Station will advise the growers of this State to make at least two applications for the adults to protect the expanding buds and blossom clusters, and one or two treatments to destroy the larvæ. In the spraying of pear orchards the young thrips were very susceptible to treatment. The accumulative effects from a systematic spraying of the trees each year must be considerable, and the applications to kill the larvæ appear to be a very important consideration in the spraying schedule.

Injuries to Pears by Other Species. Two other species of thrips which may be observed on fruit trees in New York are *Euthrips tritici* Fitch and *Thrips tabaci* Lind. During some seasons both species are very common, but the former appears to be usually more numerous than the latter. Ordinarily they do not seem to cause any appreciable damage to fruit trees, and only once in the writer's experience have they proven very destructive in orchards. This outbreak occurred during the spring of 1909 and marked damage was done in pear orchards in western New York, principally about Ransomville, Burt and Middleport. The varieties sustaining the greatest losses to the blossoms were Bartlett, Kieffer and Dutchess. The effects of the work of these thrips were not unlike those of *pyri*, except that the damage was not so extensive. The injured blossom clusters similarly turned brown as if blighted, while the leaves became discolored about the wounded areas and curled. Microscopic mounts indicated that *tritici* was more abundant on the trees than *tabaci*. For the identification of the species, I am indebted to Dr. W. E. Hinds of the Alabama Polytechnic Institute.

PRESIDENT F. L. WASHBURN: Any discussion on this paper?

GLENN W. HERRICK: I should like to ask Mr. Parrott whether he used the Black Leaf 40 or simple Black Leaf?

P. J. PARROTT: We used both preparations and we used them alone, with soap and with kerosene emuslion.

GLENN W. HERRICK: At the usual strengths?

P. J. PARROTT: The mixtures were somewhat stronger than recommended by Foster and Jones, because we had not received their publication at that time. Black Leaf extract was applied at the rate of a gallon to sixty-five gallons of water and with five pounds of soap while the Black Leaf 40 was used at the rate of ¾ of a pint to a hundred gallons of water with the same amount of soap. Nearly all the fruit growers have power spraying outfits, and there is no reason why most of them cannot spray their orchards in a day, so that there certainly will not be the difficulty in thoroughly spraying the trees as obtains in California because of their extensive plantings.

E. D. SANDERSON: I would like to inquire how the insects hibernate.

P. J. PARROTT: I think that some of the members of the staff of the Bureau of Entomology are much better prepared to answer that question, but in New York the adult thrips are now in the ground. We obtained the first specimen November 29th.

PRESIDENT F. L. WASHBURN: Any other remarks on this paper? The next paper on our programme is by Mr. Hunter of Texas. "Some Experiments to determine the Effects of Roentgen Rays on Insects."

RESULTS OF EXPERIMENTS TO DETERMINE THE EFFECT OF ROENTGEN RAYS UPON INSECTS

By W. D. HUNTER, *Bureau of Entomology*

The whole science of radiology is of such recent development that it is not surprising that but very few experiments have been performed upon insects. In fact, a somewhat careful search through the literature has revealed but two accounts of experiments that have been performed. One of these experiments was performed by Forel and Dufour. It was with the European ant, *Formica sanguinea*. The primary object of the experiment was to test the susceptibility of this ant to the ultra-violet rays. Apparently, as an afterthought, it was arranged to subject the insects to Roentgen rays. The apparatus used was a box about the size of a cigar box in which the ant colonies were placed. The apparatus was placed above the Roentgen ray apparatus. Sliding lead plates on the bottom of the box allowed the operators to direct the rays into different parts. When the ants were collected in one corner, for instance, the rays were admitted from directly beneath them. The results were absolutely negative. The ants showed no tendency towards being affected and continued their work in the normal manner. This was considered somewhat remarkable by Professor Forel since it followed experiments which had showed that the ants were quite sensitive to the ultra-violet rays. As far as the Roentgen rays were concerned it was concluded that they were not perceived by the ants. Neither was there any after-effect upon the ants; they appeared entirely normal for a period of eight days after the experiment, at which time the observations were discontinued.

The only other experiments of which we have been able to find any record are dealt with in a paper by Professor Axenfelt in the Centralblatt für Physiologie, 1897. In these experiments house flies were used. The insects were placed in an apparatus consisting of two chambers with a connecting passage. One of the chambers was constructed of lead and the other of wood. Both could be completely darkened at will. When the flies were in the leaden chamber, which, of course, was not penetrated by the rays, an exposure of four or five minutes caused them to pass over to the other chamber. When they were placed in the wooden chamber and exposed to the rays they remained there even when that chamber was darkened and the other light. The investigator concluded that the experiments showed that the house fly can perceive Roentgen rays and that they affect it in much the same way as ordinary light. The account of the experiments which was published is not detailed and it seems that the conclusions the author reached are hardly above criticism. There is a possibility that a difference in temperature in the two chambers due to the construction of different materials may have caused the movement of the insects from one to the other. This supposition appears to be more plausible in view of the experiments of Forel and Dufour which were performed under the most careful conditions of control.

One of the many remarkable features of Roentgen rays is their effect upon the sexual organs of certain animals including man. Until it was discovered, some ten years ago, that the rays had a very remarkable effect upon the organs of regeneration even when no external lesions whatever are caused, many operators were completely sterilized without any knowledge of the fact. This matter has been investigated carefully by a number of students in France and Germany. In fact, the histology of the organs subjected to the rays has been determined with great care. It has been found that certain bodies of cells are remarkably susceptible to the rays and that their functionality is entirely destroyed although morphologically they seem to be almost normal.

During the past year by accident the writer and several of his associates have had an opportunity to conduct a number of experiments with Roentgen rays. In these experiments special attention has been directed toward the determination of the question of whether the sexual organs of insects are affected in any manner analogous to that in the case of human beings, guinea pigs, rabbits and other animals with which the experiments noted were performed. At Dallas, Texas in April, 1911 the experiments were begun with *Calandra oryzae*, several species of ticks, and two Isopods, *Armadillidium vulgare* and *Porcellio laevis*. The manipulation in the experiments with the rice weevil are typical of the procedure that was followed in all cases. Grain containing large numbers of adults and immature stages was exposed to the rays at different distances and different periods. The exposure averages from ten to twenty seconds, the distance from the tube from fourteen to twenty inches and the current from five to seven milliamperes. After exposures according to this plan large numbers of the adult beetles were taken from the cages and placed in jars with grain which had been thoroughly sterilized by means of heat. It was considered that observations as to whether reproduction took place in this sterilized medium would show whether any effect had been produced upon the reproductive organs of the insect.

In brief the experiments are negative. In all but two of the ten experiments reproduction took place. It varied, of course, greatly in the different jars but this variation did not seem to be correlated with any differences in the treatment. In fact, the two series in which no reproduction was found to take place represented the longest exposure and the shortest.

The next experiments were performed with ticks of various species. The first series was designed to determine the effect of the rays upon eggs of *Margaropus annulatus* which were on the point of hatching. Such eggs were exposed from 1 to 15 seconds at a distance of from 11 to 18 inches, with a current of 5 to 7 milliamperes. In the exposed lots from 10 to 70 per cent of the eggs hatched, in one of the controls 30 per cent, and in the other 50. It was not evident, therefore, that the rays had any effect whatever upon the eggs. Another experiment dealt with eggs of *Margaropus annulatus* in which incubation had just begun. These eggs began hatching from 20 to 25 days after exposure. Eventually from 75 to 90 per cent hatched. There was a hatching of 80 per cent in the controls. This experiment therefore corroborates the conclusion from the prior experiment regarding the harmlessness of the rays to the eggs.

Later series of experiments were performed with the female ticks which were depositing eggs, with females which were engorged but which had not begun the deposition of eggs, and with unengorged larvae. The variation in the length of the exposure and other details were similar to those in the experiments that have been described. In all of these cases no effects from the rays were discernible.

In further experiments other species of ticks were utilized including *Argas miniatus* and *Dermacentor venustus*. In no case was any definite indication obtained of any effects whatever from the rays.

Somewhat later experiments were conducted at New Orleans with the sugar cane mealy bug, *Pseudococcus calceolariæ*. In this work a new factor was added. This was the determination of whether the effects of the rays tend to accumulate. It seems to be well established that in the case of human beings the effects accumulate in regular progression, that is that an exposure of one second on ten different days has exactly the same effect as an exposure of ten seconds in one day. In the case of the sugar cane mealy bug, gravid females were exposed for 1, 2, 4, and 8 minutes and also for 1 minute on 1, 2, 3, 4, 5, 6, 7 and 8 days. All exposures were at a penetration of 5, according to the Benoist radio-chronometer. In these experiments the time elapsing from exposure to hatching varied without any apparent connection with the number of days exposed. The control females yielded eggs which hatched in 3 days and this was the case with eggs from 1, 2, 5, 7 and 8 day exposures.

Similar experiments with the eggs of *Culex pipiens* were performed. The accumulated exposures did not yield any more definite results than in the case of the other species.

Up to this point our experiments (except those with the rice weevil) were concerned primarily with the determination of the possible destructive effect upon the insects in various stages and especially upon the viability of the eggs. A series of observations was made, however, more particularly to determine the effect upon the functionality of the sexual organs. In these experiments several species including the boll weevil, were tried but the most satisfactory results were obtained with the sugar cane borer, *Diatræa saccharalis*. In this case all of the specimens utilized were bred to maturity under isolation to obviate the possibility of accidental fertilization. Exposed males were later placed with unexposed females; in another series exposed females were placed with unexposed males; and in the third both sexes were exposed to the rays. The exposure varied from 4 to 16 minutes in the different experiments.

In a few of the cases no eggs were deposited but such occurrences were explainable by factors which had nothing whatever to do with the Roentgen rays.

In the case of the exposed males placed with unexposed females, even when the exposure ran as high as 16 minutes, eggs were deposited in normal numbers and were found to be viable. In fact, the larvae were bred to maturity. Exactly the same is true of all of the experiments in the series in which the exposed females were placed with unexposed males. In the third series, however, in which both sexes were subjected to the rays for the varying periods no fertile eggs were deposited. In this case the control failed to produce eggs so that no conclusions can be drawn.

The foregoing gives but a meager outline of the numerous experiments that were performed. The results are possibly open to criticism on account of the methods of manipulation that were followed. There is so much difference in the effects of the rays upon human beings depending upon the penetration, the length of the exposure, the amperage and voltage, that it is conceivable that under some conditions insects may be affected. Nevertheless, in all of the work we have done it is not apparent that the rays have had any effect whatever upon the fertility or the development of the various stages of the several species utilized in the experiments. At any rate the rather considerable amount of work done has not shown that there are any indications of any practical utilization of X-rays in the destruction of injurious species.

President F. L. Washburn: Any question to ask Mr. Hunter?

T. J. Headlee: Mr. President, have they gone far enough to determine whether the rays of light in any way affect the transmission of characters?

W. D. Hunter: In no way at all.

E. W. Berger: Mr. Chairman, I have recently conversed with a man in Florida who is interested in the big business affairs of that State, and he told me that they were planning to sterilize the eggs of the tobacco beetle in Cuba by means of the X-rays. He told me that he was interested in the subject and was working on it at that time. He seemed to have no doubt at all that the thing would be successful. It was altogether new to me, and, of course, Doctor Hunter's results here are all contradictory to this man's results.

W. D. Hunter: I think that the present plan of control of insects in tobacco does not concern itself with X-rays at all, but with a high frequency current. The man referred to carried on numerous experiments in Philadelphia, first with X-rays but later with high frequency currents. One of my associates provided numerous tests with the X-ray apparatus. It was found that the results were not satisfactory. At that time the experiments turned to high frequency currents.

President F. L. Washburn: The next paper on the programme is by Mr. Swenk, of Nebraska, on "The More Important Injurious Insects in 1911 in Nebraska."

THE MORE IMPORTANT INSECTS IN 1911 IN NEBRASKA

By Myron H. Swenk, *Lincoln, Nebr.*

(*Paper not received*)

The following papers were read by title and made a part of the proceedings:

THE SUSCEPTIBILITY OF ADULTS AND EGGS OF PEAR PSYLLA TO SPRAYING MIXTURES

By P. J. Parrott and H. E. Hodgkiss

(*Abstract*)

In summarizing briefly this paper the chief points presented are,—(1), that the emergence of adults from winter quarters, deposition of eggs and migration of larvæ occur with very little intermingling at distinct time periods and are, to a large degree, coincident respectively with certain life events of the pear tree, as the swelling of the buds, development of the blossom clusters, and opening of blossoms; (2), that the psylla in each of its life stages is sensitive to certain spraying mixtures. Experiments in 1910 indicated the possiblitity of protecting pear orchards by a single treatment to kill either the adults, or eggs, or nymphs.

The presence of the psylla in destructive numbers in 1911 in the leading pear growing sections of western New York afforded exceptional opportunities for a large series of tests to demonstrate, under ordinary orchard conditions, the susceptibility of hibernating "flies," eggs and nymphs to various mixtures. Quite a number of growers freed their orchards of the pest by spraying for the "flies" with miscible oils, home-made emulsions or commercial nicotine preparations. The

majority of orchardists, after spraying for the "flies," applied lime-sulphur solution at winter strength to destroy the eggs. In only a few plantings was it necessary to make a third treatment with a nicotine spray to kill the young nymphs.

In summing up the results of the spraying operations it was concluded that the chief factors which make for the successful control of the psylla are (1) a knowledge on the part of the grower of the different stages of the insect; viz., hibernating "flies," eggs and nymphs; (2), an understanding of the activities of the psylla during the dormant season until trees blossom; and (3), thorough work in spraying.

PROGRESS IN EXTERMINATING TWO ISOLATED GYPSY MOTH COLONIES IN CONNECTICUT

By W. E. Britton, *Agricultural Experiment Station, New Haven, Conn.*

In March, 1906, it was learned that the gypsy moth, *Porthetria dispar* Linn., was present in Connecticut at Stonington, the southeast corner town of the state. An immediate investigation showed the infestation to be a separate one of less than a square mile in area, and about fifty miles from Providence, R. I., the nearest point known to be infested. Measures were at once started with a view to complete extermination rather than mere suppression, as must be practiced in the large and badly infested sections of Massachusetts and New Hampshire.

In December, 1909, another isolated infestation was discovered in the village of Wallingford, twelve miles north of New Haven. Here the infested territory was probably no larger than that at Stonington, but was much more thickly infested and less scattered.

The exterminative work has not been done wholly by the state of Connecticut. The Bureau of Entomology has a special appropriation for gypsy moth work, and a portion of it under the supervision of Mr. D. M. Rogers, has been used to aid and supplement the work of the state.

We are now able to consider the progress made in six years at Stonington and in two years at Wallingford. The object of this paper is to show the results of this work in figures, so far as may be possible.

The methods employed were those in common practice in Massachusetts and other infested states. Scouting for egg-masses during the winter months when the trees are bare, destroying the eggs with creosote; pruning, scraping and filling the cavities of trees; banding trees in summer with burlap and in some cases with tree tanglefoot; spraying trees and shrubs with lead arsenate. In scouting for egg-masses there were a number of cases where stone walls had to be torn down and relaid and several cases where they had to be burned out with a torch to kill caterpillars. Many acres of brush land had to be cut and burned over at Stonington. Rubbish heaps and fences were overhauled. Young men were employed to turn the burlap bands each day or every other day from about the middle of May to perhaps the middle of July. Each man was given a certain territory and made responsible for the caterpillar conditions in it. He was given a pair of forceps and a four ounce bottle containing denatured alcohol, gasolene, or kerosene, and required to bring to headquarters each noon and night all caterpillars that he could find. The superintendent kept a record of each man's collections, and spent most of his own time watching the work of the men and scouting for caterpillars.

STONINGTON

Year	Egg-masses destroyed	Caterpillars destroyed	Pupæ destroyed
1906	73	10,000	47
1907	118	2,936	200
1908	76	2,560	44
1909	6	98	0
1910	1	146	0
1911	3	0	0

WALLINGFORD

Year	Egg-masses destroyed	Caterpillars destroyed	Pupæ destroyed
1910	8,234	8,936	95
1911	23	1,551	15

COST OF GYPSY MOTH WORK

Year	State funds	Federal funds	Total per year
1906	$1,500.00	....	$1,500.00
1907	4,550.00	$272.00	4,822.00
1908	2,550.00	77.00	2,627.00
1909	1,503.22	42.00	1,545.22
1910	4,560.22	1,411.36	5,971.58
1911	4,017.95	4,660.22	8,678.17
Total	$18,681.39	$6,462.58	$25,143.97

The accompanying figures were obtained in this way, and do not include the hundreds and probably thousands of caterpillars which we know were killed at Wallingford by the lead arsenate and the tanglefoot bands; neither do they include those killed by fire in the walls at Stonington, but are simply a record of the insects found and destroyed by the men working day after day.

It should also be stated that the money expended in this work by the state ($18,681.39) includes the cost of much scouting outside the infested regions, following up reports of infestations, and the traveling expenses for most of the work of inspecting imported nursery stock for the last three years. It also includes the cost of scouting and destroying brown-tail nests in five towns in the northeast corner of the state last winter, so that the actual amount expended in gypsy moth extermination would be considerably less. The Federal money has practically all been used for scouting, both in and outside of the infested territory.

(Proceedings to be continued.)

UNCONSIDERED FACTORS IN DISEASE TRANSMISSION BY BLOOD-SUCKING INSECTS

By Frederick Knab, *Bureau of Entomology, Washington, D. C.*

The study of the rôle of blood-sucking insects in the transmission of disease is a recent one, and it is still to a large extent vague and chaotic. Its teachings are not only built up largely on hastily collected and faulty data, but they are replete with errors. Many of the investigators not only have lacked the necessary knowledge of biology, but the mastery of detail, along with a broader view, which is eminently necessary in such work. Since the discovery that certain blood-sucking insects are the secondary hosts of pathogenic parasites, nearly every insect that sucks blood, whether habitually or occasionally, has been suspected or considered a possible transmitter of disease. No thought seems to have been given to the conditions, and the characteristics of the individual species of blood-sucking insects, which make disease transmission possible.

In order to be a potential transmitter of human blood-parasites, an insect must be closely associated with man and normally have opportunity to suck his blood repeatedly. It is not sufficient that occasional specimens bite man, as, for example, is the case with forest mosquitoes. Although a person may be bitten by a large number of such mosquitoes, the chances that any of these mosquitoes survive to develop the parasites in question (assuming such development to be possible) and then find opportunity to bite and infect another person are altogether too remote. Applying this criterion, not only the majority of mosquitoes, but many other blood-sucking insects, such as Tabanidæ and Simuliidæ, may be confidently eliminated. Moreover these insects are mostly in evidence only during a brief season, so that we have the additional difficulty of a very long interval during which there could be no propagation of the disease in question.

The truth is that all insects that have been found to be transmitters of human blood-disease are more or less closely associated with man and habitually suck his blood. This relation has long been recognized in the case of the two house-mosquitoes of the tropics, the one (*Aëdes calopus*) being the intermediary host of the yellow fever organism, the other (*Culex quinquefasciatus*) of those of filariasis and dengue fever, but its significance has not been grasped. It is only through a combination of circumstances that these insects are effective transmitters. These conditions are: The association with man and a predilection for his blood, abundance, comparative longevity—which means blood meals repeated at intervals, and practically continuous breeding, so that individuals are always present to act as intermediary hosts of the parasites. When these conditions are fulfilled the chain in the life-cycle of the parasite is continuous and we have an endemic disease. The relations just outlined might be expressed in terms of mathematical formulæ, but nothing would be gained thereby. It is the recognition of the principles involved that is important.

The writer is not at present in a position to review the entire field of disease transmission by biting insects from this viewpoint. However one more striking example in support of his views may be cited. This is the large hemipter *Triatoma* (*Conorhinus*) *megistus* which Carlos Chagas recently has shown to be the transmitter of a dangerous trypanosome disease of man in Brazil. As I have already pointed out in another place (Proc. Ent. Soc. Wash., xiii, 71, 1911) *Triatoma megistus* is remarkable among the American members of the genus in showing close adaptation to man. It lives in houses and does not occur naturally apart from man. The eggs are laid in the crevices of walls inside of houses and the young bugs feed on human blood from the start. In spite of its very large size, the bite of the adult occasions so little pain that it does not awaken a sound sleeper. This is clearly adaptational, as the wild species of the genus are known to have a very painful bite. Still another example are the biting flies of the genus *Flebotomus*, which, in the Mediterranean region transmit the so-called pappataci fever. Here too the species involved are closely associated with man.

It would seem at first thought that *Anopheles*, in the transmission of malaria, does not fulfill the conditions above formulated. The species of *Anopheles* have not been looked upon as particularly associated with man. However this is only due to the fact that the habits of the *Anopheles* have not been properly understood and particularly to the failure to differentiate the habits of the different species. There is every indication that those species which transmit malaria thrive in the vicinity of man, while, on the other hand, those species which live apart from man and do not habitually seek his blood are inoffensive. That the habits of the different species of *Anopheles* differ widely and are in direct relation to their effectiveness as transmitters of malaria is brought out in an interesting manner in the paper by Mr. Jennings on mosquito control in the Panama Canal Zone (printed on the preceding pages of this number). Conversation with him has added further data that support this view. Investigation of the role of the different species in the transmission of malaria, by inducing them to bite malaria carriers, has shown that *Anopheles albimanus*, the species which thrives particularly about settlements and is most persistent in entering houses and obtaining blood, is the principal factor in malaria transmission—no less than 70 per cent of this species developing the parasites.[1] An interesting point, brought out in conversation with Mr. Jennings, is that this species appears to be absent from those parts of the upper Chagres River which are uninhabited. It is highly probable that the reason for the absence of *Anopheles albimanus* from such localities is that this mosquito not only prefers, but probably needs, human blood. It has been suggested that the absence of *albimanus* from the upper Chagres was due wholly to the absence of suitable breeding-places. It appears, however, that this objection is not valid. Both Mr. Jennings and Mr. Busck have explored the Chagres for mosquitoes and they assure me that there are abundant opportunities for *A. albimanus* to breed. Neither of them found *albimanus* and they could hardly have failed to do so had it been present.[2]

The observations of James and Liston on the habits of the *Anopheles* of India show that the species of that country likewise differ in habits,

---

[1] Darling, Samuel T., Studies in relation to malaria, Washington, Govt. Printing Office, 1910.

[2] Since writing the above I have come upon a record of observations on *Anopheles tarsimaculata*, a geographic race of *albimanus*, by the Rev. James Aiken of Berbice, British Guiana, which support my contention. Under the name *Cellia albipes* he indicates the relation of this species to man as follows: "It is to be noted that on the Canje creek further up than Baracara I found no Anophelina, the same remark applies to the Berbice River above Mara, and in a collection made by Mr. Beckett at Sandhills none appeared. On a visit to the Supenaam creek I was also unsuccessful in finding this mosquito. All these districts are very sparsely populated, and so far as our observations go they are only to be found near human dwellings."—(British Guiana Medical Annual for 1906, Demerara, 1907, p. 66.)

and they speak of "domestic" and "wild" species.[3] However the significance of the phenomenon seems to have escaped them, as it has subsequent investigators. There is no doubt in the writer's mind that a critical review of the data will show that the *Anopheles* responsible for the transmission of malaria in India will be found among the "domestic" species, as the term is applied by the above mentioned authors.

There is a paper by Dr. Adolph Lutz of Brazil, on forest mosquitoes and forest malaria, which apparently contradicts the ideas just expressed with reference to *Anopheles* and malaria.[4] The probabilities are, however, that Doctor Lutz has misinterpreted the facts. His observations were made in the state of São Paulo, during the construction of a railroad from the coast to the capital. The first part of the route was through the moist and heavily forested slope from the table-land to the coast, and while at work here a large part of the construction gang were afflicted with malaria. Lutz searched for the transmitting *Anopheles* but could find no breeding-places upon the steep slopes. Finally he determined that only one species of *Anopheles* (*cruzi*) was present in the region, and that this bred abundantly in the water held by epiphytic bromeliads. To this species he attributed the outbreak of malaria. Most probably this *Anopheles* had nothing to do with the outbreak of malaria among the laborers. It is a well-known fact that in the tropics most persons, although apparently in good health, have latent malaria. When such an individual comes under some physical strain, such as overexertion, exposure, or some form of overindulgence, the disease manifests itself. It seems highly probable that this is the explanation of the outbreak observed by Doctor Lutz. The men already harbored latent malaria when they came into the region and the exertion and exposure incident to the work caused the eruption of the disease.

It must be noted in passing that the character of the disease itself, the duration of the parasites in the human blood, has an important bearing on the insect relation. Thus, in the case of yellow fever and dengue, where the parasites are present in the blood only during a very brief period, the association of the two hosts must be a very intimate one. In the case of malaria, where the parasites are present in the blood for a long time, the relation of the transmitting mosquito may easily be a less intimate one. But even here it must be remembered that the gametes, the sexual elements which are destined to

[3] James, S. P., and Liston, W. Glen. A Monograph of the Anopheles Mosquitoes of India. Calcutta, 1904 (first edit.).

[4] Lutz, Adolph, Waldmosquitos und Waldmalaria. Centralbl. f. Bakteriol., Parasitenk., u. Infektionskr., Abt. 1, Bd. 33, p. 282-292, 1903.

continue the cycle of the parasite within the mosquito host, are only present and available to the mosquito at definite intervals, and that after a certain time, if no reinfection occurs, these forms disappear altogether.

In conclusion the writer wishes to point out that he is fully aware of a certain class of blood-parasites and transmitters which apparently do not conform to the principles above laid down. One class are the diseases transmitted by ticks, where the parasites are directly transmitted from the tick host to its offspring, and where, for this reason, the insect remains a potential transmitter for a very long period. Another class are the trypanosomes which apparently thrive in a number of different vertebrate hosts and may be transmitted from cattle or wild animals to man. But the observations on this point are by no means conclusive and it is quite possible, as has been repeatedly suggested, that a number of organisms, different but indistinguishable, are involved. It may prove that a revision of the data, from the present viewpoint, may materially alter our conceptions on the subject.

UTILIZATION OF FUNGOUS PARASITES OF COCCIDÆ AND ALEURODIDÆ IN FLORIDA

By J. R. Watson, *Florida Agricultural Experiment Station*

As this station is receiving a number of inquiries concerning the success of the experiments which for several years have been in progress here looking towards the control of our worst citrus pests by means of fungi, it has seemed that perhaps a brief statement on the present status of the subject might not be without interest to readers of the Journal of Economic Entomology. The more so as there seems to be among entomologists a feeling (perhaps well founded as far as most of the states are concerned) of pessimism concerning the practicability of controlling any insect pest by means of its fungous enemies.

Although fungous enemies are here very efficient in checking the ravages of many other insects, as for instance the larvæ of many lepidoptera, the most attention has been given to the scales and to the whiteflies of citrus, and it is with these that the writer will chiefly deal in this brief notice.

History. The presence of parasitic fungi (the Red Aschersonia) was first noted as checking the work of whitefly in Florida by H. J. Webber in 1893 (Report of Fla. Hort. Soc., and Bull. 13 Div. of Veg. Path. U. S. D. A.). Prof. P. H. Rolfs (Fla. Bull. 41, 1897) first noted the Red-headed Scale Fungus (*Sphærostilbe coccophila*) as being a very efficient enemy of the San José Scale and worked out a method of artificially aiding its dissemination by tying on to the branches of infested trees where the fungus was absent, small twigs on which were scales infested with fungi, and also a method of spraying into the trees water containing the spores obtained from cultures of the fungus in artificial media.

Prof. H. A. Gossard (Bull. 67) took up the artificial spreading of the fungi parasitizing whitefly. Following Webber he recommended the method of transplanting nursery stock on which were parasitized larvæ.

The method which is now exclusively used on a commercial scale has been developed by Dr. E. W. Berger (Bulls. 88, 97, and 103, Fla. Exp. Sta. and Annual Reports 1907–11). It is to spray into the trees water in which are held suspended the spores and mycelia of the fungi. He found that the spores from about 40 fungus pustules to one pint of water was sufficient and that the leaves may be kept six months or more in cold storage, thus obviating one frequent difficulty, that of finding fungous material in the spring and early summer following the dry season. Or fungi may be used which have been grown on sweet-potato or other artificial media.

Prof. H. S. Fawcett, Plant Pathologist of the station, and Director P. H. Rolfs have worked on the life-histories of the fungi concerned and the methods of their propagation on artificial media (Bulls. 41 and 94 and Univ. Fla. Special Studies No. 1, 1908, Mycologia II–4, 1910).

Scales. The scale which is most widespread and has received the most attention lately is the citrus Purple Scale (*Lepidosaphes beckii*) and the following remarks apply chiefly to it, although many others seem to be affected to about the same degree. The chief fungi concerned are, the Red-Headed (*Sphærostilbe coccophila*), the Black Fungus (*Myriangium duriæi*), and the White-headed (*Ophionectria coccicola*).

It is not the object of this paper to go fully into the historical aspects of this subject as that has been done elsewhere (Berger Rep. of Fla. Hort. Soc. 1911), but it is well in passing to call attention to the fact that when this scale was first introduced and before the fungi had commenced to be effective, it was regarded as a much more serious pest than is now the case. So serious indeed that the very existence of the citrus industry seemed to be threatened. Even with no attention on the part of the grower and no efforts to aid in their dissemination, the fungi are very efficient aids in holding the scale in check. To what an extent this is true can be seen from the accompanying table (Table I) in the column showing the effect of spraying with Bordeaux mixture. It has long been recognized that spraying with this standard fungicide immensely increased the number of scales present. Heretofore there has been no careful quantitative data as to what extent this is true, but during the past summer such experiments were carried on by Professor Fawcett and the results are given in the accompanying table. Ten representative oranges and fifty representative leaves were taken from each plot and counts (or estimates in the case of those oranges from the Bordeaux plots) were made of the scales and whitefly on each. The figures in the table are the averages. These trees were sprayed in June, in July, and on August 31.

TABLE I

	Scales on fruit			On leaves		
	Sept. 1	Oct. 25	Nov. 28	Sept. 1	Oct. 25	Nov. 28
Check	25.7	52	70	33.4	10	8
Sprayed	370.0	2559	6835	175.6	155	194

The Bordeaux mixture by killing the parasitic fungi allows the unhindered multiplication of the scales and gives us some idea as to what they would do were they not naturally held in check by the fungi. The Bordeaux column, then, and not the unsprayed trees should be regarded as the "check" in considering the efficiency of the fungi. Even then, however, we do not get a true picture of the importance of the fungi as these trees were covered with the fungicide for only a few months, whereas it should have been extended over several years to give us a true check. Also they were surrounded on all sides by fungous-covered trees which reinfected them before the last count. Nevertheless this gives us some idea of the rôle that these parasitic fungi naturally play in the citrus groves of Florida and demonstrate the truth of the statement of Doctor Berger that "It is the fungi that keep the grower in business."

Whitefly. The chief fungi concerned in keeping in check *Aleurodes citri* R & H and *A. nubifera* Berger are, in the order of their importance, the Red Aschersonia (*A. aleyrodis*), the Brown Fungus (*Aegeritia webberii*), the Cinnamon (*Verticillium heterocladum*), the White Fringe (*Microcera* sp.), and the Yellow Aschersonia (*A. flavo-citrina*) on *Aleurodes nubifera* only. The first three and the last attract the larva and pupa, the fourth, all stages. This is also a complete saprophyte, developing in immense numbers on the bodies of insects killed by fumigation. They are all partial saprophytes since the major part of their development occurs after the insect is dead and they can all be raised on artificial media.

What was said about the efficiency of the fungi in keeping down the scales even when not aided by the grower applies equally well to the whitefly. It has long been recognized that even when no means were taken to combat it, the grower could reasonably hope to get about every third year a crop nearly free from the sooty-mold (Meliola) that develops in the honeydew given off by the whitefly and constitutes one of its chief injuries. Bordeaux mixture produces, here also, a rapid increase in numbers when sprayed on trees.

But the unaided spread of the fungi is often slow and very uneven. This is true not only of its spread from grove to grove as would be expected, but frequently from tree to tree in the same grove and sometimes from one part of a tree to another. As an illustration of this some counts taken by the writer in December, 1911, will be cited. Fifty leaves were taken at random from a grove with a conspicuous amount of fungus and counts were made of the number of whitefly alive, of the number surely killed by the Brown Fungus and Red Aschersonia as shown by well-developed pustules, the number dead from other causes including "natural mortality," and the number of empty pupa cases showing successful emergence. Most of those in column three were really killed by fungi which had not developed sufficiently to show pustules. Recent study by the author has shown pretty clearly that the so-called "natural mortality" is due to the White-fringe Fungus that does not develop the characteristic fringe as it does under favorable circumstances. The counts of some of the leaves and the average of them all is given in Table II.

TABLE II

Alive	Fungus pustules	Dead, no pustules	Emerged	
0	775	10	120	
0	100	2	8	
140	1	8	0	
0	8	0	0	
320	100	107	58	
450	5	150	225	
0	600	200	1	
420	1	84	240	
70 6	120.4	74.6	32.4	Average of the 50 leaves.
23.3	40.1	24.8	10.8	Per cent of the whole number.

This table does not show the real mortality as it does not take into consideration those that died and dropped off. It is not given as an example of the efficiency of the fungi as it was taken in the most unfavorable time of year, but it shows the unevenness of the distribution. It was shown, however, that even at this time of the year that the fungi had made a clean sweep of the larvæ on 19 of the 50 leaves.

Because of this occasionally slow spread and uneven distribution of the fungi, it is of advantage to thoroughly spray the grove with spores even when there is much fungus present. This has been abundantly proven in field experiments by Doctor Berger and the experience of commercial sprayers.

Spraying on a Commercial Scale. The method has been taken up very extensively by the growers of the state and several parties make it their business during the summer season. One alone of these commercial sprayers treated a hundred thousand trees last summer belonging to over a hundred growers and sold fungi to as many more who applied it themselves. Several others sprayed from fifteen to fifty thousand each, and a very large number of growers sprayed their own trees. Altogether during the last few years between one and two million trees have been thus treated.

Conclusion. Although some very good results have attended their use at other times, such as March and April, as is to be expected, the fungi do their most efficient work during the warm rainy summer (from about June to the middle of September).

We do not advise the grower always to depend upon the fungi alone, at least not in the case of a severe infestation during the dry season. Then it is frequently desirable, or even necessary, to use some heavy-oil insecticide to supplement the work of the fungi. Or fumigation with hydrocyanic acid gas can be used in isolated groves or communities.

It would seem that the practicability, in Florida, of combating insects by means of aiding in the distribution of their fungous enemies, at least in connection with other methods, has been sufficiently demonstrated to warrant a thorough trial in all other moist, sub-tropical or tropical countries. The method has already been successfully used against scales in Trinidad, Montserrat, and Barbados (Report of the Local Dep. of Agri., Barbados 1910–11; W. I. Bull. Vol. XI No. I).

American Association of Economic Entomologists

The following appointments are announced for the current year:

Committee on Membership, H. E. Summers, Chairman, Wilmon Newell and R. A. Cooley.

Committee on Entomological Investigations, T. J. Headlee, Chairman, Glenn W. Herrick, and W. C. O'Kane.

W. D. Hunter, *President.*

American Association of Economic Entomologists.

At the last annual meeting of the association it was voted that the President and Secretary arrange to organize an employment bureau for entomologists.

Prof. F. L. Washburn, St. Anthony Park, Minn., has been selected to take charge of this work and entomologists desiring positions or institutions desiring entomologists should communicate with him.

A. F. Burgess, *Secy.*

Proceedings of the Tenth Annual Meeting of the American Association of Official Horticultural Inspectors—(*Continued*)

Second Session December 29, 1.30 p. m., New National Museum

Meeting was called to order by President Sherman who introduced Dr. S. A. Forbes.

WHAT SHOULD THE STATE REQUIRE OF A NEGLIGENT OWNER OF A DANGEROUS ORCHARD?

By STEPHEN A. FORBES, *Illinois State Entomologist*

In suggesting this topic for this meeting—and I believe it was placed upon our programme at my request—I had no intention of preparing a paper upon it myself, but thought merely of obtaining a discussion of it in the hope that we might have a comparison of ideas and methods which would be helpful to us all. Perhaps the best way for me to open such a discussion is to describe to you the situation as it has developed in my own state, and the solution of our problem at which we have lately arrived.

I have been at work now for several years in Illinois, under our inspection law, upon what has come to appear as an impracticable programme. Under our law, dangerously infested orchards and other such property are a public nuisance, the maintenance of which, after due notice and requirement, is punishable as a misdemeanor; but the failure of the owner of such dangerous property to suppress the nuisance pointed out to him has been followed by an effort to suppress it on my part, the expenses of the operation to be collected from the negligent owner, who is further liable to prosecution and fine.

This system works out in the following manner: I can only determine whether premises are so infested as to be dangerous to adjacent property by an inspection made in the fall after the leaves have dropped and after the season of multiplication of the San José scale is virtually over. With the area now to be covered by such inspections in Illinois, the whole early part of the winter is required to take this first step. I must then notify the responsible owner of the existence of the nuisance on his premises, and must prescribe methods for its removal, giving him, of course, sufficient time to make his preparations and do this work; and his work must be done in time to permit me to make a second general inspection throughout the whole territory infested, to ascertain whether these nuisances have actually been suppressed—whether the necessary spraying has been done, and done effectively. And this second inspection must be completed in time to allow me to follow it up with an effective general spraying operation, wherever the dangerous conditions have not been wholly removed. But the first inspection being made during the early part of the winter, and active spraying being impracticable or useless with us in the midwinter months, orchard treatment must go over in the main until towards spring, and the season during which effective treatment is possible will be gone before all these various steps can be taken in succession. We have of late, consequently, been obliged to limit our operations to a part of the territory to be covered, in order that we might get over it all in time; and elsewhere we have had to trust to the owners of dangerous properties for such spraying as we could induce them to do. Enough orchards have thus been left untreated at the end of the season to cause vigorous complaint both on the part of those who have felt themselves compelled to spray and on the part of the commercial orchardists who take the best care they can of their property but who find their carefully treated trees still endangered by the neglect of their neighbors.

I have been asked this fall, in fact, by our State Horticultural Society, to prepare a description of the legislation necessary to compel the destruction of dangerous orchards and other such property which the owner is persistently neglecting to the disadvantage and loss of his neighbor. I thought it well, however, to learn first just what powers I had under our present law, and consequently put the question to the Attorney-General of the state, who replied to the effect that our Illinois law already clearly contemplates the enforced destruction of dangerous property where I deem this necessary to the safety of other property adjacent, and that I am warranted in proceeding upon that interpretation provided that I am careful to keep strictly within the letter of the law. I have consequently changed this fall the form of notice given to owners of dangerously infested properties in a manner to advise them that their infested trees and shrubs must be either effectively sprayed or dug up and destroyed by the first of April, and that, if found at that time to be still dangerously infested, they must be destroyed by the first of the following June. In other words, I have put myself in position to enforce effective treatment of infested property under a penalty of a destruction of the infested stock, provided this treatment is not administered in due time.

The attitude of our leading horticulturists upon that subject is shown by a resolution presented at the last meeting of the State Society by a special committee on this subject, and unanimously adopted by the Society in the following terms: "Resolved, that the welfare of horticulture and the best interests of the intelligent and responsible horticulturist require the prompt suppression of all dangerous horticultural nuisances as these are defined in our state inspection laws, and that we approve and will support the State Entomologist in all necessary lawful measures to that end. This statement is intended to include the destruction of infested or infected trees and shrubs neglected by the owner, and so situated as to be dangerous to the property of others." I shall hope to have the experience and the judgment of others upon the situations thus described.

One other point may be interesting to you, and that is the real extent and scope of some of our laws passed with primary reference to the San José scale. We have some of us sown a seed that will produce a crop quite different from what we had in mind when sowing. I am advised by the Attorney-General of Illinois that our so-called San José scale law, although designed and drawn especially for the control of the San José scale, is expressed in terms so general (in order to make it cover all possible cases) that it really applies to insect pests of every description as affecting any kind of property whatsoever. He tells me, in other words, that I have the same powers and obligations with respect to a wheat field infested by chinch-bugs likely to escape at harvest time to the injury of the corn of an adjacent neighbor that I have with reference to the San José scale in an infested orchard. We have thus obtained a general crop-pest law in Illinois without knowing it or, indeed, intending it at the time; and I am making some use of this fact this winter to arouse attention to the chinch-bug situation in the southern part of our state, by showing farmers concerned that by an attitude of indifference and inactivity with reference to their infested fields they are really violating a law of the state.

A RECENT DECISION OF THE SUPREME COURT OF KANSAS

By S. J. Hunter, *State Entomologist, University of Kansas, Lawrence*

[Professor Hunter outlined the history of the case and called attention to the far-reaching significance of the decision, which latter is reproduced below.—Ed.]

No. 17226.

S. W. Balch, Appellant,

v.

A. P. Glenn, *et al.*, Appellees.

Appeal from Sedgwick County.
Affirmed.

SYLLABUS BY THE COURT.
PORTER, J.

1. The statute creating the Entomological Commission and providing for the extermination of San José scale and other orchard pests (Gen. Stat. 1901, ch. 108, art. 43) is a valid exercise of the police power.

2. The statute is not invalid because it delegates to the commission the power to declare the existence of conditions which call into operation the provisions of the statute.

3. The legislature may declare that to be a nuisance which is detrimental to the health, morals, peace, or welfare of its citizens, and may confer power upon local boards or tribunals to exercise the police power of the state when in the judgment of such tribunals the conditions exist which the legislature has declared constitute such nuisance.

4. Nor is the statute in question unconstitutional on the ground that it provides for taking private property without due process of law. It rests wholly with the legislature whether, in the exercise of its power of police regulation, the individual whose property is destroyed shall receive compensation therefor.

5. The statute is designed to protect and promote the horticultural interests of the state and, in effect, makes all orchards, trees, shrubs, and plants, infested with the pests mentioned in the statute public nuisances, and being a proper exercise of the police power is not unconstitutional because it authorizes the expense of abating such nuisance to be charged against the property of the owner.

6. Nor is the statute unconstitutional because no separate tribunal is provided by which the owner may contest the amount of expense which shall be charged against his property. The act requires notice to be served upon the owner stating the amount of expense incurred by the Commission and notifying him that unless such expense be paid within twenty days the same will be taxed against his property. *Held*, that, ample notice being provided which gives property owner an opportunity to question the amount of such expense in an action in any court of competent jurisdiction before his property is affected, he is afforded due process of law.

7. The lien given by the statute upon premises for the expense of abating such nuisance thereon is not for a delinquent tax but for indebtedness due the county and the provision authorizing such expense to be collected as other taxes are collected is not obnoxious to any constitutional inhibition.

All the Justices concurring.

A true copy. Attest:

Clerk Supreme Court.

The opinion of the court was delivered by

PORTER, J.: In this suit the appellant challenges the validity of chapter 386 of the Session Laws of 1907, as amended by chapter 27 of the Session Laws of 1909, creating the Entomological Commission and providing for the extermination of San José scale. Appellant is the owner of a large orchard of apple and peach trees, grapes and other fruit and sued to enjoin the defendants from entering upon his premises for the purpose of inspecting, spraying and destroying the fruit trees and vines and from causing the expenses incurred in the performance of such services to be taxed against his property. In their answer appellees admitted that they were about to inspect, and, if necessary, destroy the trees, vines and other shrubbery on appellant's premises and that the costs and expenses incurred by them would be taxed against his property: they alleged that appellant's orchard is infected with San José scale and asked that he be enjoined from interfering in any manner with the work of the commission in exterminating the same. On the trial the court found the acts of the appellees justified and enjoined appellant from interfering with the proceedings. From this judgment he appeals.

Chapter 386 of the laws of 1907 creates the entomological commission, to consist of the secretary of the State Board of Agriculture, the secretary of the Kansas State Horticultural Society, the professor of entomology of the University of Kansas, the professor of entomology at the State Agricultural College, and a nurseryman actively engaged in the nursery business within the state, to be appointed by the governor. The purpose of the act is the suppression and extermination of San José scale and other injurious insect pests and plant diseases. In order to accomplish such purpose the entomologists, their assistants and employees, are authorized to enter upon the premises of any private individual and inspect, destroy, treat, or experiment upon such insects or plant diseases. In case the officers mentioned or their employees shall find such insects or diseases to exist they are required to mark in some conspicuous way all trees, vines, shrubs, or plants so infested, and to give notice in writing to the owner, tenant, or person in charge of the premises, of the condition thereof. The act then provides that if the owner or person in charge shall not within ten days thereafter destroy or treat the same in accordance with the regulations and rules of the commission, the commission shall cause the work to be done. The act of 1907 provided that the expenses of such extermination or treatment, properly certified by the commission, should be collected by the county attorney of the county where such premises are located, who was directed to account therefor to the commission. The legislature of 1909 amended the act so as to provide that the expense incurred in inspecting, treating, and exterminating such insect pests should be paid by the owner of the premises within a certain time after the services were performed, in default of which it should be taxed against the property and collected in the same manner as delinquent taxes. The amendment, so far as it relates to the present controversy, reads as follows:

"The necessary expense thereof shall be paid by the owner or owners of the real estate from which said infestation has been removed in pursuance of this act. The state entomologist or his deputy shall serve or cause to be served upon said owner or any one in possession and in charge, of said real estate, a notice, stating the amount of said charge, and further stating that if said charge be not paid to the county treasurer of the county wherein said real estate is located within twenty days from the service of said notice, that the same will become a lien upon said real estate. Copy of said notice, together with the proof of service, shall be at once filed with the county clerk, and if said amount is not paid within the time therein stated said county clerk shall spread the same upon the tax-roll prepared by him and said amount shall become a lien against said real estate and be collected as other taxes are collected, and said real estate shall be sold for non-payment of said taxes the same as now or hereafter may be provided by law for sale of real estate for delinquent taxes. Should the owner of said real estate not pay said charges within the stated time, the same shall be presented to the board of county commissioners by the county clerk and by them allowed and paid out of the general fund of said county by the county treasurer, and when said amount is collected as taxes it shall be paid into the general fund of said county. The cost of eradication or treatment of such infestation, as above stated, shall be paid to the county treasurer, to whom the county clerk shall certify all amounts due as reported to him by the entomologists in charge. The county treasurer shall forward to the state treasurer on the first of each month all amounts thus received. These amounts shall be paid into the general fund of the Entomological Commission." (Laws 1909, ch. 27, Sec. 1, Gen. Stat. 1909, Sec. 8732.)

There was ample evidence to warrant the finding that appellant's orchard is infected with San José scale. It is conceded that the appellees were attempting to follow the provisions of the statute. They and their employees had gone upon the premises of the appellant and had marked certain trees and shrubs for destruction and had marked others for treatment by spraying; they had given the appellant due notice in writing ordering him within ten days thereafter to treat and destroy the pest under the rules and regulations of the commission. Upon his failure to comply with the order the commission was about to cause the work to be done and the expense thereof charged against appellant's property.

The appellant asserts that the act of 1907 as amended by that of 1909 is unconstitutional. Generally stated his contentions are, that the law deprives him of his property without due process of law and therefore violates the 14th amendment to the federal constitution; that it deprives him of the right to a jury trial in violation of section 5 of the Bill of Rights; that it attempts to confer judicial power upon the commission and its employees and to give them authority to determine the amount of taxes which shall be assessed against the appellant's property without notice or opportunity to contest the amount thereof; that it violates section 1 of article 11 of the constitution of Kansas requiring a uniform and equal rate of assessment and taxation. Little if any attempt is made in the brief to argue these propositions separately; but counsel for appellant urge the following specific objections to the statute: (1) that there is no method of procedure or hearing provided by which appellant's right to protest against the destruction of his property is preserved; that the law delegates to the commission and its employees the power to mark trees for destruction without a hearing or trial as to the necessity thereof; (2) that it fails to prescribe any compensation for property destroyed, whether taken rightly or wrongfully; (3) that no notice or opportunity is provided by which the appellant may contest the amount of the expenses which shall be taxed against his property. Most of these objections rest upon what appears to be a failure to distinguish between the exercise of the power of eminent domain and the exercise of the power of police regulation. Many cases are cited where legislative enactments have been held invalid on the ground that they provide for the taking of private property for public use without compensation. These authorities have no application to the present case. The courts have universally recognized the distinction between the two powers. Under the exercise of the one private property cannot be taken either for public or private use without compensation; in the exercise of the other the use of property may be limited, or controlled, or the property itself destroyed without any compensation therefor being made to the owner. It is no objection to the validity of laws passed in the proper and lawful exercise of the police power that provision is not made for compensation to the individual whose property may be affected thereby. Property taken or destroyed for the purpose of abating a nuisance or to prevent the spreading of a pestilence is not taken for public use. All private property is held subject to such reasonable restraints and burdens as in the opinion of the legislature will secure and maintain the general welfare and prosperity of the state. It is held subject to the obligation that it shall not be used so as to affect injuriously the rights of the community. It belongs to the legislative branch of the government "to exert what are known as police powers of the state, and to determine primarily what measures are appropriate, or needful, for the protection of the public morals, the public health, or the public safety." (Mugler *v.* Kansas, 123 U. S. 623-661; 31 L. ed. 205. Mo. Pac. Rly. Co. *v.* Finley, 38 Kan. 550, 16 Pac. 951.)

In the exercise of this power the legislature may be justified in excluding property dangerous to the property of the citizens of the state, as, for example, animals having infectious or contagious diseases. The police power is said to be inherent in government, but can only be exercised by authority of legislative enactment. It is for the legislature to determine what laws are needed and appropriate to promote the public welfare and to prevent the infliction of public injury. So long as the legislature, in attempting to exercise this power, does not violate any of the provisions of the organic law or encroach upon some power vested in Congress by the federal constitution, the exercise of its discretion is not subject to review by the courts. (Matter of Application of Jacobs, 98 N. Y. 98, 50 Am. Rep. 636.) In the language of Justice Gray, in Blair & Hutchinson & Smith *v.* Forehand, 100 Mass. 136,

"All rights of property are held subject to such reasonable control and regulation of the mode of keeping and use as the legislature, under the police power vested in them by the constitution of the commonwealth, may think necessary for the preventing of injuries to the rights of others and the security of the public health and welfare. In the exercise of this power, the legislature may not only provide that certain kinds of property (either absolutely or when held in such a manner or under such circumstances as to be injurious, dangerous or noxious) may be seized and confiscated upon legal process after notice and hearing; but may also, when necessary to insure public safety, authorize them to be summarily destroyed by the municipal authorities without previous notice to the owner—as in the familiar cases of pulling down buildings to prevent the spreading of a conflagration or the impending fall of the buildings themselves, throwing overboard decaying or infected food, or abating other nuisances dangerous to health." (p. 139–140.)

It cannot be doubted that the legislature possessed the power to declare that the existence of the San José scale, which is well known to be injurious and dangerous to the fruit industry of the state, constitutes a nuisance. The evidence in the case at bar shows beyond question that this particular pest is so prevalent in Sedgwick county as to become a source of great danger to the fruit growers in the community, as well as to those in other sections of the state. The statute viewed in the light of the evidence and aided by facts which common experience and observation teach respecting the danger to an important industry of the state from the presence of insect pests must be regarded as appropriate and well calculated to accomplish the purpose of the legislature and therefore a proper exercise of the police power. Similar laws have been upheld in other states. Thus in County of Los Angeles *v.* Spencer, 126 Cal. 670, 59 Pac. 202, 77 Am. St. Rep. 217, it was said:

"It is known that the existence of the fruit industry in the state depends upon the suppression and destruction of the pest mentioned in the statute. The act in question is, therefore, a proper exercise of the police power which the legislature has, under section 1 of article 19 of the constitution, to subject private property to such reasonable restraints and burdens as will secure and maintain the general welfare and prosperity of the state: Abeel *v.* Clark, 84 Cal. 226; Train *v.* Boston Disinfecting Co., 144 Mass. 523, 59 Am. Rep. 113." (p. 673.)

The law in question here is of the same character as are the quarantine laws, pertaining to Texas cattle and splenic fever, which the legislature has enacted for the purpose of preventing the infection of cattle and other live stock. It falls within the miscellaneous cases referred to by Judge Cooley in his Constitutional Limitations, as follows:

"And there are other cases where it becomes necessary for the public authorities to interfere with the control by individuals of their property, and even to destroy it, where the owners themselves have fully observed all their duties to their fellows and to the State, but where, nevertheless, some controlling public necessity demands the interference or destruction. A strong instance of this description is where it becomes necessary to take, use, or destroy the private property of individuals to prevent the spreading of a fire, the ravages of a pestilence, the advance of a hostile army, or any other great public calamity. Here the individual is in no degree in fault, but his interest must yield to that 'necessity' which 'knows no law.'" (Cooley, Constitutional Limitations, 7th ed., p. 878.)

Cases sometimes arise where the exigencies of the situation require private property to be destroyed immediately in order to prevent the spread of pestilence or some other calamity, and where, under all circumstances, the loss which the individual suffers is so inconsiderable in comparison with the benefit to the public that in the opinion of the legislature he is regarded as fully compensated by his individual share in the benefit accruing to the public. Other cases will arise where it is apparent that if no action is taken by the State the property of the individual will be destroyed or rendered of little or no value. In Shafford *v.* Brown, 49 Was. 307, 95 Pac. 270, the supreme court of Washington had under consideration a statute giving power to a county fruit inspector to destroy fruit infected with insects and held that the owner of such fruit had no cause of action against the inspector for damages for its destruction for the reason that it had no value.

It is true that in some of the laws providing for the abatement of nuisances the legislature has made provision for compensation to the individual for the loss of his property where it has been destroyed. Thus the statute authorizing the live stock sanitary commissioner, when, in his opinion, it shall be necessary, to prevent the spread of any contagious or infectious disease among the live stock of this state, to destroy animals with, or which may have been exposed to certain diseases, provides that he shall first cause the animals to be appraised (Gen. Statutes 1909, Sec. 9138) and the owner is to be paid the value as fixed by the appraisement; but the statute expressly provides that this right of indemnity for such loss shall not extend to cases where such animals have been brought into the state in a diseased condition or from an infected district or state or brought into the state in violation of any law or quarantine regulation, or to cases where the owner has violated the quarantine law or disregarded any regulation of the sanitary live stock commissioner, nor to any case where the animal came into the possession of the claimant with knowledge that it was diseased or had been exposed to contagion. (Gen. Stat. 1909, Sec. 9143.) The same statute (Sec. 9139) provides that in fixing the value of any such animal the commissioner shall be governed by the value thereof at the date of the appraisement, so that the state does not undertake to compensate the owner for any loss occasioned by the disease or infection. And for some reason which the legislature deemed sufficient it is further provided in the same section as follows: "That no animal or animals shall be appraised except those affected with contagious pleuropneumonia of cattle or foot-and-mouth disease or such as have been exposed thereto." The legislature acted upon the theory that in the exercise of the police power for the purpose of affording protection to the live stock industry of the state it might authorize the destruction of private property, making provision in some cases for full compensation to the owner thereof, in other cases for partial compensation, and still in others for no compensation. The act for the protection of domestic animals is not before us and its constitutionality is therefore not in question. Its validity, however, has not, so far as we are aware, been attacked upon any of the grounds urged against the statute now under consideration.

In 1883 the legislature enacted a law providing for the appointment of sheep inspectors and prescribing their duties. (Laws 1883, Ch. 144, Gen. Stat. 1909, Secs. 9094–9100.) The act, which seems never to have been assailed as invalid, authorizes such inspectors to order the owner of sheep afflicted with certain diseases to cause the same to be dipped or otherwise treated and when the owner fails to comply with such order, he is subject to a fine which is made a lien upon the sheep. There is a further provision that the inspector shall then cause the sheep to be treated and the costs and expenses shall be charged against the sheep and made a lien thereon which shall be collected in any court of competent jurisdiction.

A similar act was passed by the legislature of 1909 for the suppression of tuberculosis in cattle which authorizes the owner of any animals found to be so infected to deliver them to the sanitary live stock commissioner and to receive from him an order on the board of county commissioners of the county in which the diseased animals are located for fifty per cent. of the appraised value of such animals as if they had not been diseased, provided that no county shall recognize such order unless such animals have been owned in the county at least 120 days prior to the time the tuberculin test was administered to them. (Laws 1909, ch. 169.)

It rests wholly with the legislature to determine whether in the exercise of its power of police regulation the individual whose property is destroyed shall receive compensation therefor. In the statute of which appellant complains no such provision appears. Doubtless the legislature considered, what is most obvious, that no serious hardship is likely to result to the owner of property through the enforcement of its provisions. No tree or shrub is to be destroyed until upon inspection it is found to be so seriously infested with insect pests as to be of no practical value. On the other hand, if its condition is found to be such that it can be preserved by spraying or other treatment, and the owner, after due notice thereof, refuses to give it proper treatment, the state steps in and for the purpose of preventing the spread of the infestation administers the necessary treatment and frequently preserves the property from ultimate destruction. The owner by being compelled to pay the necessary expense incurred in the treatment and preservation of his property is required to pay only what is justly due the state.

There is no force in the objection that the statute is repugnant to the 14th amendment. That clause of the federal constitution does not limit the subjects upon which the police power of the state may be exerted, nor was it designed to interfere with the power of the state to enact laws for the preservation of the health, morals, peace, or welfare of the people. (Mugler *v.* Kansas, 123 U. S. 623, 31 L. ed. 205 Minneapolis Railway Co. *v.* Beckwith, 129 U. S. 26, 32 L. ed. 585. Prohibitory Amendment Cases, 24 Kan. 700.)

In Mugler *v.* Kansas, supra, it was contended that the state, by prohibiting, in its constitution and laws, the manufacture or sale of intoxicating liquors for general use as a beverage, deprived the citizen of his property in violation of the 14th amendment. The court held that a prohibition simply upon the use of property for purposes declared by the legislature to be injurious to the health, morals, or safety of the community, "cannot in any just sense be deemed a taking or an appropriation of property for the public benefit" (p. 668–669) for the reason that the owner is not disturbed in the control or use of his property for lawful purposes nor restricted in his right to dispose of it, but its use is forbidden only for certain purposes prejudicial to the public interests. The court, however, went much further and held that "The destruction, in the exercise of the police power of the State of property used, in violation of law, in maintaining a public nuisance, is not taking of property for public use, and does not deprive the owner of it without due process of law" (Syl.) Upon this proposition the late Justice Harlan, in the opinion used this language:

"Nor can legislation of that character come within the Fourteenth Amendment in any case, unless it is apparent that its real object is not to protect the community, or to promote the general well-being, but, under the guise of police regulation, to deprive the owner of his liberty and property, without due process of law. The power which the States have of prohibiting such use by individuals of their property as will be prejudicial to the health, the morals, or the safety of the public, is not—and, consistently with the existence and safety of organized society, cannot be—burdened with the condition that the State must compensate such individual owners for pecuniary losses they may sustain, by reason of their not being permitted, by noxious use of their property, to inflict injury upon the community. The exercise of the police power by the destruction of property which is in itself a public nuisance, or the prohibition of its use in a particular way, whereby its value becomes depreciated, is very different from taking property for public use, or from depriving a person of his property without due process of law. In the one case, a nuisance only is abated; in the other, unoffending property is taken away from an innocent holder." (123 U. S., p. 669.)

The statute is not invalid because it delegates to the commission the power to declare the existence of conditions which call into operation the provisions of the statute. The legislature of the State may declare that to be a nuisance which is detrimental to the health, morals, peace, or welfare of its citizens, and may confer power upon local boards or tribunals to exercise the police power of the state when in the judgment of such tribunals the conditions exist which the legislature has declared constitute such nuisance. Similar power has been conferred upon cities of the first class to remove certain nuisances, and to tax the costs of the proceedings upon the property where the nuisances are located. (Gen. Stat. 1909, Sec. 918.) Like authority is conferred upon the sanitary live stock commissioner to determine that domestic cattle or live stock are infested with certain contagious diseases. (Gen. Stat. 1909, Sec. 9136.)

The legislature of the State may declare that a nuisance, which is such in fact, and may create a commission with a power to determine whether the conditions defined by the act exist." (Cooley, Constitutional Limitations, 7th ed., p. 882, n. 1.)

In determining whether the conditions exist which the legislature declares constitutes a nuisance, that is, whether a particular orchard or some portion thereof is so infested with insect pests as to require treatment or extermination, the commission exercises some discretion which is in a limited sense judicial, but no more so than the discretion generally exercised in the enforcement of police regulations. It is like the discretion exercised by inspectors of health, food, grain, milk, live stock, by the various state boards and commissions, and by city officers charged with the enforcement of police regulations, which in order to be effective, often require prompt and summary execution, and which from their nature call for the exercise of more or less discretion in the officers whose duty it is to make them effective.

The same objection was urged against the act creating the board of railroad commissioners and acts supplementary thereto. It was held that although the board is required to exercise judgment and discretion and to make orders for the regulation and control of railroads and other common carriers, the act does not confer upon the board either executive or judicial powers. (The State *v.* Railway Co., 76 Kan. 467.) 92 Pac. 606. To the same effect is Schaake *v.* Dolley, ante, p. 598, 118 Pac. 80, where it was held that the granting or refusing of an application for a bank charter by the charter board calls for the exercise of discretion and that the act creating the board is not invalid because it provides that the board shall refuse a bank charter if upon examination it shall determine against the public necessity of the business in the community in which it is sought to establish such a bank. The statutes construed in both of the foregoing cases were passed by the legislature under the police power of the state. The precise question was before the supreme court of California in County of Los Angeles *v.* Spencer, 126 Cal. 670, 59 Pac. 202 77 Am. St. 217, where a statute almost identical with this was construed, and it was held that

"A statute designed to protect and promote the horticultural interests of the state, which declares that all places, orchards, etc., infested with the pests mentioned in the statute are public nuisances, and which act is a proper exercise of the police power, is not unconstitutional on the ground that it confers judicial powers upon the horticultural commissioners, where a commissioner, in determining whether any particular place is a nuisance, must necessarily exercise some discretion which, in a strict sense, is judicial in its nature." 77 Am. St. Rep., Headnote. (Syl. par. 3.)

Nor is the act invalid because no procedure or method is provided by which the owner may contest the necessity for the destruction of his property. The exigencies of the situation and the conditions which the legislature had in mind require prompt and summary action. The fruit industry of a large portion of the state might be jeopardized by delays resulting from almost any method or procedure which could be devised by which the owner could have a hearing as to the necessity for the destruction of his property. If his orchard is infested with the dangerous pests which the statute was designed to exterminate the legislature declares the condition to constitute a nuisance which the interests of the state require shall be abated promptly and summarily. In order that private property might not be liable to destruction under the provisions of the statute, except where the conditions actually exist, the legislature provided that the commission shall be composed of persons possessing a scientific and practical knowledge of horticulture. And when those persons have determined that an orchard or some portion of it is infested with such insect pests it would seem that the question is one about which there could be little room for reasonable minds to differ. Under the police power the legislature may, when necessary, authorize the seizure and confiscation or destruction of private property without previous notice to the owner. (Blair & Hutchinson & Smith *v.* Forehand, 100 Mass. 136.)

It is urged that the act is unconstitutional because it authorizes the cost of the proceedings to be charged against the property of the owner without notice to him or opportunity to question the amount thereof. The act, however, requires notice in writing to be served upon the owner stating the amount of expense incurred by the commission and notifying him that unless the same be paid within twenty days the same will be taxed against his property. He therefore has notice before any lien is created upon his property, and before it can be taken or sold. Having this notice he is relegated to his common-law remedies. If he believes the amount charged is greater than it should be, he has ample time to determine what is the proper charge, tender the same to the county clerk and enjoin in any court of competent jurisdiction the collection of a greater amount. It has been held by the Supreme Court of the United States that the phrase "due process of law"does not necessarily mean a judicial proceeding. (McMillen *v.* Anderson, 95 U. S. 37-41.) On the other hand it does not necessarily mean a special tribunal created for the express purpose of hearing the merits of the particular controversy. Where ample notice is provided which gives the property owner an opportunity to have a hearing in any court of competent jurisdiction before his property is affected he is afforded due process of law.

But we do not regard the cost of the proceedings a tax, although the act refers to it as a tax to "be collected as other taxes are collected." It is merely the expense of abating a nuisance and there are various ways which the legislature might have adopted for its collection. They might have provided for its collection by an action against the owner, after his neglect or refusal, upon due notice, to abate the nuisance, following the method provided for collecting the cost and expenses of inspecting and treating diseased sheep (Gen. Stat. 1909, Sec. 9097); or, the method prescribed where infected cattle are taken by order of the sanitary live stock commissioner under section 9136 (Gen. Stat. 1909), which provides that all costs and expenses shall be paid by the owner and if not so paid, the animals shall be advertised and sold in the same manner as personal property on execution.

Instead of adopting either of these methods the legislature provided that the cost of abating the nuisance should be paid by the owner of the property, and in default of such payment the board of county commissioners should pay it so that the work of the commission should not be delayed; and then gave the county a lien upon the real estate for the indebtedness due it from the owner and authorized the county to enforce such lien by the method employed in levying and collection of taxes. The California statute gives to the county a lien upon the real estate for the expenses incurred and provides for its enforcement by an ordinary action. It was held that the lien is not for a delinquent tax but merely for an indebtedness due to the county. (County of Los Angeles *v.* Spencer, supra.)

Since the expense incurred by the commission is not a tax the act is not repugnant to the provision of the constitution which requires a uniform and equal rate of assessment and taxation.

The act being constitutional and valid the court properly denied the appellant the relief prayed for and the appellees were entitled to a permanent injunction against his interfering with the execution of the law.

The judgment is affirmed.

All the Justices concurring.

A true copy. Attest:— Clerk Supreme Court.

THE ADVISABILITY OF EXEMPTING FROM FUMIGATION NURSERY STOCK NOT SUSCEPTIBLE TO SAN JOSÉ ATTACK

By P. A. Glenn, *Chief Inspector, Office of State Entomologist, Urbana, Ill.*

The San José scale is present in so many of our states and has established itself in dangerous proximity to so many of our nurseries, that the problem of preventing its further dissemination on nursery stock and of giving to the buyer of nursery stock the advantage which is rightly his, of having trees to start with that are free from this troublesome pest, is one of the most important ones with which the inspection departments of most of our states in which nursery stock is grown extensively have to deal; and, moreover, nursery stock is so extensively shipped from state to state that it becomes a matter of great importance in each state how the problem is handled in others from which they receive shipments.

Some states endeavor to protect themselves by undertaking to inspect at the point of delivery all stock shipped into them; and, though this is an expensive program to carry out successfully, there is no doubt that it is worth many times more to the state in the way of protection against the introduction of insect pests than it costs. But, in the large majority of the states, the appropriations available for inspection purposes are too small to enable them to make such inspections in addition to the inspection of the stock grown within them. They must, consequently, depend to a very large extent for protection on inspections made in other states, and are of necessity almost compelled to accept at their face value the certificates which accompany shipments. Thirty-seven states thus accept the certificates from other states when signed by an authorized official of the state in which the shipments originate. Nine of these require, in addition to the certificate of inspection, a certificate of fumigation. Three will accept a certificate of fumigation in lieu of a certificate of inspection. Nine states accept no certificates, but subject all shipments to inspection. Two states have no regulations.

Since so many states have interests in common, and are, of necessity, dependent each upon the other for protection, it seems that some uniform regulations ought to be adopted that will be just to the growers of nursery stock on the one hand and adequately protect the buyers on the other, and will make it possible for one state to honor the certificates of other states with safety. We may not be able to secure uniform laws, but in nearly all the states the laws as they now stand require the inspection of growing stock yearly, and they also in nearly every case give to the entomologist in charge the authority to prescribe the treatment necessary when San José scale is present, so that the lack of uniformity of regulations in respect to San José scale is not so much a matter of law as it is of regulations by authorized officials, made by them in the exercise of their discretionary powers. A much greater degree of uniformity may, therefore, be had if it is desired.

In making regulations two extremes are to be avoided,—that of being too exacting on the one hand, and too lenient on the other. Nothing is gained by the former course except, perhaps, the ill will and opposition of the nurserymen, whose coöperation is absolutely essential to our success. On the other hand, if there is too great leniency, and the interests of the public are not adequately safeguarded, we betray an exceedingly important trust.

In this paper the discussion relates to nursery stock that has been exposed to San José scale attack. This condition is necessarily a very uncertain one, as it depends on so many points upon which we have no definite data, such as the distance which birds, insects, squirrels and other animals that frequent trees will travel from one tree to another, and the distance which the young insects may be blown by the wind, and on other conditions which vary so much, that they are never just the same in any two cases, such as the number and degree of infestation of the trees or shrubs which constitute the origin of infestation. It is the general supposition that nursery stock standing through the growing season within a half mile of infested trees is exposed to infestation. If the origin of infestation should be only a few trees or a single small tree, and the degree of infestation slight and not of long standing, the distance within which stock is considered as exposed to attack is correspondingly less. However, this does not concern us now. The inspector must determine in each case whether or not stock is exposed to infestation after taking into consideration all the circumstances. Our discussion relates to the kinds of stock, or rather species of trees and shrubs, that should be fumigated on account of exposure to San José scale attack, and species that may safely be exempt from fumigation.

In those states which have any regulations, all, with three possible exceptions, require that all stock known to be infested be destroyed. In a little more than half of them the practice is to require the fumigation with hydrocyanic acid gas of all the remaining deciduous stock which may be safely fumigated; in a smaller number the practice is to exempt stock not subject to attack, and in one state at least, the exemption extends to all stock except certain fruit trees.

The question as to what stock should be fumigated, and what may safely be exempt ought not to be difficult to determine. Our experience with the San José scale has been extensive enough to indicate to us what stock is subject to attack and what is not. Doctor Britton's lists, which represent the results of the experience of those whose observations have been the most extensive, with a slight revision, which can be made as the results of observations made since their first publication, will serve as our best guide in determining this point.

To require the fumigation of species of trees and shrubs that have never been known to be infested with the scale, though exposed to attack, is going to extremes. It places a burden upon the nurserymen that is, so far as we are able to demonstrate, useless. It is not a matter of so much importance to the nurserymen who grow mostly or entirely fruit stock, and little or no ornamental stock not susceptible to attack. The fumigation of their small amount of nonsusceptible stock adds little to their trouble and expense; but with the nurseries having from fifty to five hundred acres or more of ornamental stock, much of which is not susceptible, the case is quite different.

One of the best firms in our state recently wrote us as follows:

"Your sweeping regulations add needlessly to the cost. The result is either to cut down profits, or, by making one do his own interpreting, callous one's moral motives.

The removing of this handicap, with reasonable restrictions, would greatly help. . . . We sell large shrubs with balls of earth, and the several handlings shake much of the soil off and crush the roots."

The nurserymen have a just cause for complaint, and are entitled to just treatment. The honest nurserymen are in favor of proper restrictions, and when they are made, will coöperate in good faith; the dishonest ones will evade all restrictions possible, and the more exacting the restrictions are, the more they will evade them.

The practice of requiring the fumigation of all deciduous stock prevails in a majority of the states. They follow it, in most cases, not because it is regarded as necessary for adequate protection, but rather to avoid complicating matters by making exceptions, and to keep up the high standard maintained in other states in which they desire their certificates to be honored. If it were generally understood that making exemptions, with proper restrictions, would not tend to discredit their certificates, some states would be glad to abandon the practice. Judging from replies received from the entomologists of nearly all the states to a question bearing on this point, it appears that such exemptions would not interfere with the honoring of certificates except in about half a dozen states.

It is a fact well known to all that the scale is being disseminated more or less on nursery stock in spite of efforts to prevent it. But it is not the non-susceptible stock that is responsible for it. I doubt if any one has any positive evidence that it has ever been disseminated on any of the plants in Doctor Britton's third list, although some of them have been known to be quite heavily infested. The exemption of this list with a few exceptions would in no way increase the amount of scale dissemination. It is being disseminated on fruit and susceptible ornamental stock, and this comes about in several ways. It is not possible to detect it in every case; complete supervision is not always possible, and nurserymen are not all as careful and conscientious as they should be.

While we should be just in dealing with the nurserymen, and not place unnecessary burdens on them, we must not fail to protect as far as possible the buyers of their stock. Any plant which has been exposed to attack and is known to be capable of serving as a host for the scale should be fumigated, even though scale has very rarely been found on it. The fact that it is known to be able to harbor the scale, makes it a dangerous plant and justifies the demand that it be treated. It seems to be the case that some plants are more susceptible to attack in some localities than in others. But the fact that a plant is susceptible in any locality places it under suspicion.

In determining what plants should be fumigated and what ones may safely be exempt, Doctor Britton's list serves as a safe guide. All plants in the first and second lists, and a few included in his third list which have been reported as infested since its publication should be fumigated; those remaining in the third list may safely be exempt except when they stand in very close proximity to infested stock. Some of the shrubs of that list which should be excluded are as follows: Wistaria, and *Cercis canadensis* reported as infested by Prof. G. M. Bentley; *Staphylis* sp., reported as badly infested in one instance by Prof. A. E. Stene, and Rhamnus which has been found quite badly infested in Illinois; and there are perhaps others.

The evidence thus far as to the non-susceptibility of the remaining plants of this list seems to be chiefly of a negative character. There is need of experiments along this line to secure positive evidence. It is probable that experiments will prove that the scale is not able to come to maturity and produce a new generation on some of the plants which have been reported as rarely or slightly infested.

I feel sure that a full consideration of this subject at this time, or some future time, will prove profitable even though we may not be able to come to a mutual agreement as to a uniform method of procedure.

ENFORCING FUMIGATION AND THE ATTITUDE OF NURSERYMEN AND GROWERS TO THE TREATMENT

By T. B. Symons, *College Park, Md.*

The object of this paper is primarily to bring up a discussion of this subject among members of this Association, looking towards uniform requirements by the State Inspectors, and to point out how this work is being conducted in Maryland.

It is unnecessary to discuss before this Association the large amount of work that has been done in the past to assure us that fumigation with Hydrocyanic Acid Gas is the best, and at the same time a safe treatment, when properly conducted, of nursery stock liable to be infested with scale insects or other pests, that can be employed.

This is so generally recognized that it is believed to be required by all inspectors, and in fact is incorporated in all laws or rules and regulations that are now in force in the several States, having any legislation over the distribution of nursery stock.

While this is nominally or legally true, as you may call it, yet how many of us are assured that our instructions in this particular have always been systematically carried out.

In my experience the nurserymen have not looked upon the treatment as wholly necessary, and in fact many of them even to this day doubt the non-injurious effect of the treatment upon the stock, and feel that one requiring same is a professional whim or a dead letter.

Moreover, there are many growers who vigorously oppose the fumigation of their stock for fear that it lessens the vitality of their trees. In such cases, the nurserymen, in some instances, have allowed such growers to have their stock unfumigated, in order to make the sale.

The argument presented by the grower is that they already have scale in their orchards and do not now fear it, therefore, they do not mind buying trees that may be slightly infested, provided that they are otherwise healthy and of good vigor.

Under such conditions, it is readily seen that the nurseryman even if he is satisfied that no injury will result, readily desires to acquiesce to the demand of the grower as it saves him trouble and expense.

In order to be in position to know of the character of stock distributed, the Board of Trustees supervising this work in Maryland, has sought the coöperation of the nurserymen to the end that we now have a regular paid assistant under our immediate direction, placed at the large nurseries, during shipping season, to superintend fumigation and other treatment of stock for distribution. By this means the nurseryman has an expert at hand all the time for consultation on insect and disease control, and is assured as far as possible of having no irregularities by laborers in the fumigation or other treatment of the stock.

This arrangement has worked satisfactorily during the past season, and it is believed to be the only way by which the inspector can have first hand knowledge of the character of stock distributed. Treatment of stock at smaller nurseries is accomplished by sending assistants to the nurseries at digging time. If such arrangement could be effected in all the States, it is believed that we could largely improve the general character of nursery stock distributed.

Notwithstanding our desire to assure the grower of receiving healthy stock, and at the same time to aid the nurserymen in producing and distributing it, there are some apparent inconsistencies in the requirements that are hard to explain to the nurserymen or one who may be prejudiced. In cases where the San José Scale is in the nursery or a given block, it is our practice to have destroyed all trees found infested, by a hand-inspection of all the trees from the block, and require fumigation of the balance.

The question is often asked why hand-inspect—when fumigation is supposed to kill all insect life on the tree, or vice versa,—when trees are carefully hand-inspected and the infested or diseased ones rejected, why subject them to fumigation? Especially as the grower does not desire it and the stock is going to an infested neighborhood.

Moreover, recently, we had a case of a car-load of trees shipped to one of our nurseries from another State, under Certificate, that was found to contain many trees infested with scale. The consignee especially desired the trees to fill orders already taken. The local nurserymen desired to use the trees and agreed to fumigate them a second time, but did not desire to return those that showed infestation as they made up particular varieties needed.

In such cases, it is difficult to satisfy the nurserymen with our arguments, that, notwithstanding the double fumigation, it was not deemed best to allow such stock to be distributed.

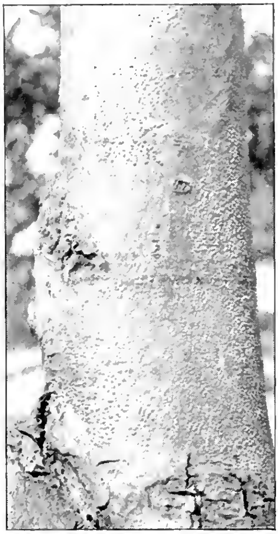
I believe there is room for a reasonable discussion of this subject and possibility for the inspectors in the several States to have greater uniformity in their requirements for the distribution of stock under such conditions. We must as a body of men study both sides of these questions, and as conditions develop be prepared to deal with them intelligently and reasonably. There is no doubt that both the nurserymen and growers require further education as to effect and usefulness of fumigation as well as other measures to prevent injury from insects and disease in the nursery.

THE CHESTNUT BARK DISEASE

By Dr. Haven Metcalf, *Office of Forest Pathology, Bureau Plant Industry, U. S. Department of Agriculture*

The chestnut bark disease was first recognized as a serious disease in the vicinity of New York City in 1904. Its origin is unknown, but there is some evidence that it was imported from the Orient. This view is not, however, held by all investigators, but whatever may have been its time or place of origin, it is certain that it has now spread into at least 10 States. In the vicinity of New York City and through adjacent counties it has killed practically all chestnut trees. Throughout a much larger neighboring area, practically all chestnut trees are infected. Outside of this area, throughout the country from the

2



3

Dead and dying chestnuts in mixed stand, killed by the bark disease, Richmond Hill, N. Y.
2. Pustules and summer spores of *Diaporthe parasitica*. 3. Pustules bearing winter spores.

northern border of Massachusetts and from Saratoga County, N. Y., to the western border of Pennsylvania and the southern border of Virginia, scattering areas of infection are known to occur and may be expected at any point. There is not yet the slightest indication of any cessation of spread or virulence of the disease, unless possibly locally in Virginia. The actual loss of property to date resulting from this disease cannot be estimated as less than twenty-five millions of dollars.

So far as is now known, the bark disease is limited to the members of the genus Castanea. The American chestnut, the chinquapin, and the cultivated varieties of the European chestnut are all readily subject to the disease. Only the Japanese and some other east Asian varieties appear to have any resistance.

The disease is caused by a fungus, *Diaporthe parasitica*. When any of the spores of this fungus gain entrance into any part of the trunk or limbs of a chestnut tree they give rise to a spreading canker, which soon girdles the tree. If the part attacked happens to be the trunk, the whole tree in consequence is killed, perhaps in a single season. If the smaller branches are attacked, only those branches are killed, or only those portions of branches beyond the point of attack, and the remainder of the tree may survive for several years.

Limbs with smooth bark attacked by the fungus soon show dead, somewhat discolored, sunken areas, which continue to enlarge and soon become covered more or less thickly with yellow, orange, or reddish-brown spots about the size of a pinhead. These spots are the pustules of the fruiting fungus. In damp weather or in damp situations, masses of summer spores are extruded in the form of long, irregularly twisted strings or "horns," which are at first bright yellow to greenish yellow or even buff, becoming darker with age (Fig. 2). If the canker is on the trunk or a large limb with very thick bark there is no obvious change in the appearance of the bark itself, but the pustules show in the cracks and the bark often sounds hollow when tapped. After smooth-barked limbs or trunks are girdled the fungus continues to grow extensively through the bark, sometimes covering the entire surface with reddish-brown pustules (Fig. 3).

After a branch or trunk is girdled, the leaves change color and sooner or later wither. Such branches have a very characteristic appearance and can hardly be mistaken for anything else, except in certain localities where the work of twig-girdling insects may produce a similar appearance in the spring. In case the girdling by the fungus is completed late in the season, the leaves of the following spring assume a yellowish or pale appearance and do not develop to their full size. If the girdling is completed between spring and midsummer the leaves may attain their full size and then turn a somewhat characteristic reddish-brown color, which can easily be detected at a long distance. Later this leaf coloration changes to a more brownish tinge and the leaves are commonly persistent for a considerable time. The burs commonly persist on the tree during the following winter, thus producing the only symptom which is at all conspicuous during the leafless season. The great damage which the disease has done in the late summer thus becomes most evident at the beginning of the next season, and that done in the spring becomes evident later in the same season, giving rise to the false but common idea that the fungus does its work at the time of year that the leaves change color, when in reality the harm was done much earlier.

Perhaps the most easily seen as well as the longest persistent symptom of the bark disease is the prompt development of sprouts on the trunk of the tree and at its base, or somewhat less frequently on the smaller branches (Fig. 1). Sprouts may appear below every girdling canker on a tree, and there are usually many such cankers. These sprouts are usually very luxuriant and quick growing, but rarely survive the third year, as they in turn are killed by the fungus. The age of the oldest living sprout, as determined by the number of its annual rings, is an indication of the minimum age of that portion of the infection immediately above it. Sprouts are sometimes produced as a result of other injuries; for instance, trees girdled by borers may develop sprouts, but these are generally less rapid in growth and are distributed with greater uniformity over the trunk.

The disease is spread by the spores of the fungus, of which there are two kinds. Both kinds of spores appear to be sticky, and there is little evidence that they are transmitted to any distance by wind except when washed down into the dust and so blown about with it. The spores are spread easily through short distances by rain; particularly they are washed down from twig infections to the lower parts of the tree. There is circumstantial evidence that the spores are spread extensively by birds, and there is excellent evidence that they are spread locally by insects and by various rodents, such as squirrels. The disease is carried bodily for considerable distances in tan bark and unbarked timber derived from diseased trees. One of the most prolific sources of general infection has been the transportation of diseased chestnut nursery stock from infected to uninfected localities.

When the spores have once been carried to a healthy tree, they may develop in any sort of hole in the bark which is reasonably moist. These may be wounds or mechanical injuries, but by far the most common place of infection is a tunnel made by a borer. Borers' tunnels are usually moist, even in dry weather, and in them the spore finds surroundings favorable to its development.

No definite evidence, experimental or otherwise, has been adduced to show that a tree with reduced vitality is more susceptible to infection, or that the disease spreads more rapidly in such a tree, than in a perfectly healthy and well-nourished tree of either seedling or coppice growth, provided that such reduced vitality does not result in or is not accompanied by bark injuries through which spores can gain entrance.

The control of the disease. From the standpoint of pure science, we are not equipped to cope with the situation as it presents itself. The disease attracted no attention until 1904, and it was not until 3 years later—1907—that an office was organized in the U. S. Department of Agriculture for the exclusive study of forest and ornamental tree diseases. Great conservatism has prevailed regarding the contagious nature and seriousness of the disease. Local investigators have paid little attention to its practical aspects. Obviously, treatment must be more or less empirical, and based upon analogies with general sanitary methods rather than upon accomplished experiments. For while experiments have been made on the method of control by elimination of advance infections, and have so far been successful, they are too few in number and too local in distribution to be absolutely conclusive. Yet they are indicative, pointing strongly to the ultimate success of the method of elimination of advance infections.

If extensive practical investigations of this disease could have begun in 1904 or earlier, we would now have a body of knowledge upon which we could base accurate and final conclusions. And such research could have been conducted at a very small expense—a mere fraction of the property loss already caused by the disease. But now it is too late to merely experiment. It is an old law in the practice of medicine, that when the patient is already moribund, the best remedy that presents itself must be applied, whether conclusively proved to be efficient or not: and this law applies equally well to plant pathology. The method of cutting out advance infections is open to many criticisms, but so far no other method of dealing with the situation has been even proposed.

For legal reasons, the actual elimination of the advance infection must be done under state, not national, authority; and for this reason responsibility for action or inaction lies with the several states in which the chestnut tree is a valuable asset. So far the only state to take up the problem vigorously is Pennsylvania. In this state the work is being carried on under a special law. In may other states, as in New York, the work can doubtless be carried on under the existing crop pest laws.

For more complete discussion of control methods, reference is made to Farmers' Bulletin 467, "The Control of the Chestnut Bark Disease," and to future publications of the Chestnut Tree Blight Commission of Pennsylvania. Perhaps the feature of control of most interest to Horticultural Inspectors is the inspection of diseased chestnut nursery stock.

As has been indicated, such stock has in the past been a most important factor in the spread of the bark disease. On account of a well-grounded fear of this disease much less chestnut nursery stock is being moved now than formerly, but there is still enough to constitute a serious source of danger. It is therefore obvious that every state in which the chestnut grows, either naturally or under cultivation, should as speedily as possible pass a law putting the chestnut bark disease on the same footing as other pernicious diseases and insect pests, such as peach yellows and the San José scale, against which quarantine measures are taken. Many inspectors already have legal power to quarantine against the bark disease on chestnut nursery stock, and they should now take special care that no shipment, however small, escapes their rigid inspection.

The most serious practical difficulty in inspecting nursery stock for this as for other fungous diseases lies in the fact that practically all state inspectors are necessarily entomologists, and are not trained in recognizing the more obscure symptoms of fungous diseases. Nursery trees affected by the bark disease rarely show it prominently at the time when shipped; the threads of summer spores or the yellow or orange pustules are rarely present, and usually all the inspector can find is a small, slightly depressed, dark-colored area of dead bark, usually near the ground, which is easily overlooked or mistaken for some insignificant injury. Upon cutting into such a spot, the inner bark shows a most characteristic disorganized "punky" appearance, quite different from that of any other bark injury; but it is impossible to adequately describe this appearance without recourse to colored illustrations. Occasionally a yellowish-brown band, either girdling or partly girdling the young tree, may be seen; this is very characteristic, but is so prominent a symptom that it may be noticed at the nursery, and presumably trees so affected will not be shipped.

If infected trees are set out they develop the disease with its characteristic symptoms the following spring. But on account of their small size such trees are girdled and die before the end of the summer, often in two or three weeks. Meanwhile they are spreading the disease to neighboring orchard and forest trees. Orchardists and nurserymen purchasing chestnut trees should therefore be warned to watch them closely during the first season, no matter how rigidly they may have been inspected.

Mr. Berger (*Florida*). Does this disease act to any extent on other trees?

Mr. Metcalf: The Chinquapin is absolutely subject to the disease and that species will take the same course as the chestnut tree. The Japanese Chestnut is highly resistant: so much so, that at one time it was thought to be immune to the disease. The Korean chestnut appears to be also highly resistant. The European varieties of chestnut are apparently quite as susceptible as American species and varieties.

A Member: Where does this disease come from?

Mr. Metcalf: That is exactly what we would like to know more about. The fact that the disease has obviously spread from a center, leads me to believe that it is an importation rather than a disease which has developed here. The fact that the locality from which it has spread is the same locality into which the Japanese chestnut was first extensively introduced; that the Japanese and Korean chestnuts are highly resistant and are the only varieties that are at all resistant—all suggests the hypothesis that the fungous parasite may have come from the Orient. However, the origin of the parasite is not a matter of practical importance unless it could be shown that the fungous parasite is developing spontaneously in many localities from some native saprophytic form, in which case the difficulties of control would be greatly increased. This suggestion is, however, so far-fetched that we do not need to consider it seriously until some facts are adduced to support it. The main fact is that the disease is here, and it is up to us to decide whether to fight it with the best means we have at hand or to let it go.

A Member: What are the fundamental principles of natural inoculation?

Mr. Metcalf: We are not sure that the disease can enter a tree in any way, but through wounds. Any of you who are familiar with the chestnut tree, know of the injuries made by various kinds of insects. I have not the slightest doubt that in ninety per cent of all cases of this disease, the fungus found entrance through lesions made by insects. The spores are sticky in character and may be transmitted by water, by birds, by insects, and to a large extent by human agency; doubtless also in other ways.

Mr. Fernald (*Mass.*): From what we have said, does it not follow that in case this disease is found present on nursery stock there is only one possible treatment,—the absolute destruction of the tree?

Mr. Metcalf:—This is unquestionably the case. I think the specimen here shows the characteristic form of the disease on nursery stock. Mr. A. B. Brooks of W. Va., found near the center of the State a tree in an advanced stage of this disease. He had the tree destroyed, made a very thorough search all through that locality, but could not find any other cases. He followed the matter up and found that the tree had been brought from a nursery near Philadelphia. That diseased tree, was, so far as we know, about 100 miles from any other diseased tree and was right in the heart of some of the best chestnut timber in West Virginia,—and that shows one of the most prolific ways in which the disease has unquestionably spread.

Mr. Norton: Is there any chance that this disease spreads more rapidly or causes more damage in the North than in the South?

Mr. Metcalf: It unquestionably has so far, but it started in the north: it is spreading as rapidly in Maryland as in Massachusetts. However, there is little basis at present for believing that it will slow down as it moves south or west.

Mr. Surface: I would like to ask how it is found on any trees and if it is sufficient to destroy those possibly infected?

Mr. Metcalf: The disease is clearly obvious on large trees. Of course, when you find the disease on nursery stock, there is nothing to do but destroy it.

Mr. Norton: Do you think it would be advisable to stop the propagation of stock from infected nurseries?

Mr. Metcalf: I think so decidedly. An absolute quarantine should be put on infected nursery stock. I have not the slightest doubt that this disease has been transmitted to orchards in the West and on the Pacific Coast, although we have no positive evidence of that.

Mr Hopkins: Doctor Metcalf's remarks about the relation of insects to the chestnut blight, I am sorry to say, brings the Division of Forest Insects of the Bureau of Entomology into the trouble. This chestnut disease problem has reached a point where it is absolutely necessary to know something about the relations of insects to the disease and to the dying of the chestnut. It is our plan to make a very thorough investigation to determine some of the fundamental facts about the insects to serve as a basis for conclusions and recommendations relating to methods of combating those which kill the trees on their own account and those which contribute to the spread and development of the disease.

Certain insects are known to be the cause of the death of chestnut trees and undoubtedly they have been killing some of the trees within the present areas affected by the disease.

I made some studies of the insects affecting chestnut trees in West Virginia between 1894 and 1901, and to some extent since my connection with the Bureau, and, owing to the extensive dying of chestnut in the southern Appalachians, nearly the whole season of 1904 was devoted to a study of chestnut insects by an agent of the Bureau from our field station located at Tryon, N. C.

Therefore, we have already a large amount of data on the subject. Our notes and bibliographical references indicate that more than 300 species of insects inhabit the chestnut, including those which are destructive, injurious, beneficial, and neutral in relation to the tree or its products.

We find references to extensive dying of chestnut timber in the middle and southern Appalachians more than forty years before the present disease was discovered in America. We also find that while insects have been the cause of the death of a considerable percentage of the chestnut within this same region within the past fifteen or twenty years, they are by no means the cause of the prevalent trouble which has practically exterminated the chestnut over large areas in Virginia, North Carolina, and South Carolina.

Therefore, it is evident that the chestnut throughout its range has has been for a long time in an unhealthy condition.

We have arranged to coöperate with the Pennsylvania Chestnut Tree Blight Commission in a thorough study of the relation of insects to the inoculation and spread of the disease in that State, but we are not going to confine our work on chestnut insects to one state. We are going to make it one of the special features of the Division of Forest Insects during the coming season and as many other seasons and in as many states as may be necessary to determine the essential facts.

The problem of interrelation between insects and diseases is a most complex one which will require the closest kind of co-operation between the Forest Pathologist and Forest Entomologist. We expect to refer everything we find that looks like a fungous or bacterial disease to Doctor Metcalf and, naturally, he will refer all insect matters to us but we will have to work together on the interrelated problems.

The whole problem is one which will require a great deal of scientific investigation before we can arrive at definite conclusions or adopt the best methods of protecting the chestnut from its fungous and insect enemies.

Mr. Metcalf: I am glad to know that legislation now pending makes it obligatory to take up this work. Regarding the situation in the South, I think there cannot be the slightest question that in the past fifty or eighty years, radical changes have taken place in the range of the chestnut. Many of the facts of the destruction and the death of the chestnut tree years ago, are matters of written record, and although inadequately described, these old accounts led us to investigate the situation in the South Appalachians. Two years ago Dr. Arthur H. Graves, of Yale, spent the summer in the South Appalachians looking over considerable areas, to see if the trouble there was the chestnut bark disease. Some little work on this has, I believe, been done by Mr. Barre, of South Carolina, and between 1902 and 1906, I made rather extensive observations myself in that state. The results are that no one has yet found the bark disease south of Bedford County, Virginia.

Mr. Symons: I would like to know briefly how the Commission in Pennsylvania is expending its money,—that is to say, the form it is providing to establish its quarantine or methods of preventing its spread?

Mr. Metcalf: Briefly, in the absence of any representative of the Commission, I can say that the mode followed is to first establish an instruction camp, to instruct all the persons of their employ in regard to all phases of the disease; second, they send these people out to scout the state, and locate all advance spots of infection. Beginning on the west, they will destroy the advanced points of infection as found, and working back to the east, in this way they will locate some point, where probably some sort of a quarantine line will be established.

President: If there are no further comments or questions in regard to this paper, we will call for the next.

THE PRESENT STATUS OF CROWN GALL

By J. B. S. Norton

At the present time there is, in spite of much study and investigation of the subject, considerable disagreement among nurserymen, inspectors, and even plant pathologists with regard to the danger to fruit culture from Crown Gall.

After the exhaustive work of Dr. Erwin Smith and others in the U. S. Department of Agriculture, there can be no doubt of the infectious nature of the disease or of the specific bacterium that causes it. This work has shown that the disease is very widely distributed and occurs upon a great variety of hosts, including many herbaceous plants, as well as trees and shrubs. Doctor Smith has recently pointed out also its remarkable similarity to cancer in animals.

The wide spread distribution of the germ will explain some of the cases of nursery stock acquiring the disease when grown on new ground never before cultivated, though the germ may also be introduced in apparently healthy parts of infected plants. With these facts in view, the danger of infecting new areas can be somewhat minimized, and the advice to grow on non-infected soil will have less value; though, of course, ground occupied by a thoroughly infected raspberry patch would be much more dangerous for a new plantation than a piece of ground with a little chance natural infection.

The opportunity of wounds affording entrance for the germ is very important, and any means of preventing or protecting exposed tissues is of value in controlling the disease.

I think most of us will agree that crown gall is very destructive to raspberries, less so to blackberries, and is quite serious on some stone fruits, particularly, if infected when young. There is much doubt of it being very serious on apple, except possibly on quite young trees. A number of responsible men have pointed out orchards several years in bearing and in apparently perfect condition, which were planted from infected stock, while others cite cases when especially under unfavorable conditions diseased nursery stock has failed to make good trees, or where gall trees show great tendency to secondary infections at the crown, or to break off at this point, or to have a much increased tendency to throw up sprouts from the root. Whether the length of bearing life would be much less in affected trees, time must tell.

Even in kinds of fruit where there is little danger from the gall disease, it must be remembered that the work of Hedgecock, Smith, and others, has shown that the germs from these slightly injured trees may infect other species that would be soon killed by them.

Hippodamia ambigua Lec. in Massachusetts. A package of celery was delivered in January to a customer in Amherst. In the warm room, beetles resembling the "lady bugs" of this vicinity, crawled out in large numbers. Considerably over twenty-five were gathered up and destroyed. The celery was then put away in a cool place, but later, upon being opened, a cluster of twenty-four beetles was found in the heart of the leaves. In all, there must have been upwards of fifty individuals in the original cluster.

The specimens were identified by Mr. Arthur I. Bourne of the Massachusetts Agricultural College Experiment Station, as the *Hippodamia ambigua* Lec. The identification was confirmed by Mr. Charles Schaeffer of Brooklyn Museum. Without either of these entomologists knowing it, the merchant who sold the celery, previously had pronounced it from California.

It is well recognized, I believe, that this species has the habit of clustering in large numbers. This behavior was exceptionally pronounced. The twenty-four specimens in the bottle remained in a compact ball when darkened. Upon receiving light, however, they scattered and climbed the sides of the bottle in the sun.

Another peculiar feature was the drinking of a drop of water. This observation was accidental, a beetle being confined under a tumbler in which there had been water. Drops of considerable size were readily taken. The first instance was observed immediately after a beetle had been warmed up sufficiently to crawl.

Burton N. Gates,
Massachusetts Agricultural College, Amherst.

THE POSITION ASSUMED BY FEMALE GRASSHOPPERS WHEN OVIPOSITING

By F. B. Milliken, *Assistant Entomologist of the Kansas State Agricultural Experiment Station*

In view of the fact that all available illustrations of oviposition by grasshoppers represent the female with her abdomen curved forward under the body, the writer was surprised while studying grasshoppers at Dodge City, Kansas, during the summer of 1911 to find that none of the species which were common there assumed this position as the normal one. Ten *Melanoplus bivittatus* Scud., six *Dissosteira carolina* Linn., and one *Schistocerca shoshone* Thos., were examined while ovipositing by excavating at the side of the abdomen before the latter was withdrawn from the tunnel or the insect had changed its position, and only one—a specimen of *Melanoplus bivittatus*—had the abdomen curved forward. This one had encountered an impenetrable mass of grass roots

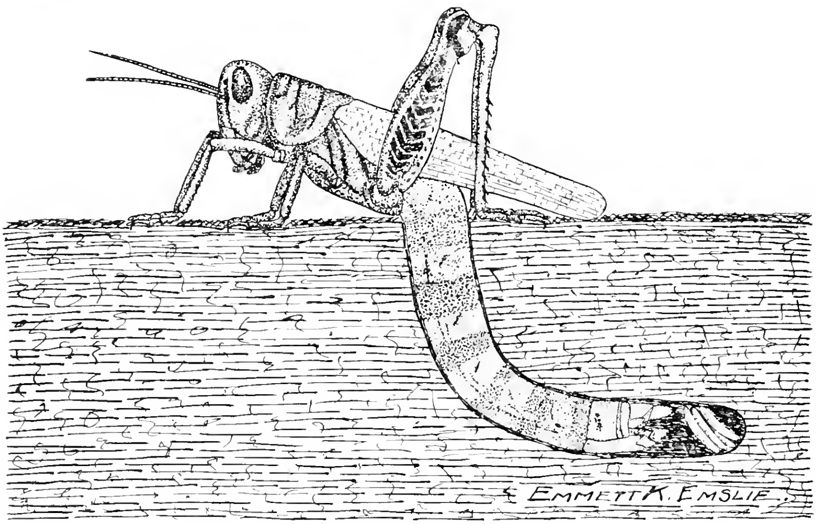


Fig. 3. Grasshopper ovipositing (original)

which altered the direction of the tunnel and inclined the abdomen forward. The remainder ran the abdomen down a short distance below the surface and curved it backward from the body. The curvature varied from a slight inclination to the rear at the tip to an angle that brought the posterior portion of the elongated abdomen parallel with the surface of the ground. No *Melanoplus spretus* were observed in the act of oviposition, as none were found in that vicinity this year.

The writer has recently found a correct account of the oviposition of *Melanoplus differentialis* by Hunter in California Bulletin 170, 1905, but no illustration is given.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

APRIL, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

This issue reflects the increased importance of shade tree insects, pests which, in connection with untoward climatic and other conditions, have brought about an acute situation in the northeastern United States, at least. It is the logical outcome of extensive plantings of one or two varieties through a long series of years. The first essential is to afford speedy relief by the general adoption of methods for checking insect depredations. This should also be accompanied by a recognition of the underlying causes, with a view of adjusting conditions in the future in such a way as to minimize the danger of extended injuries. The horticulturist and landscape gardener should advocate more diversified plantings and endeavor in the near future to correct, so far as practical, the illogical settings of earlier years. Maples and elms, while admirable shade trees in many respects, are by no means the only species which can be planted to advantage upon streets and in parks.

Most economic entomologists will concede that the *Bibliography of the More Important Contributions to American Economic Entomology* is an exceedingly useful compilation, since it includes in eight small parts the writings of all American economic entomologists up to January 1, 1905. We have been expecting for some time another issue bringing the bibliography down to 1910 and were surprised to receive, in response to an inquiry, the statement: "By decision of the Secretary of Agriculture" such work would in the future be limited to the *Experiment Station Record*. This latter publication is of great service to the economic entomologist and is frequently consulted. Nevertheless, we favor the publication of the bibliography of economic entomology and trust that the Federal Authorities will continue the issuance of this extremely serviceable and convenient work, a compilation of greatly increasing value with the advance of years. A readily available literature is an important factor in research work of all kinds.

Obituary

JOHN BERNHARDT SMITH

John Bernhardt Smith, Sc. D., who died March 12, 1912, at the age of 54 years, had for many years been a conspicuous figure in the entomological world and his contributions in Economic Entomology have been so numerous and important that his name must remain a familiar one to the workers in Economic Entomology for the future.

Doctor Smith was born in New York City November 21, 1858, and his early life was spent in the same vicinity but from the time that he entered upon his work at the National Museum in 1886, until his death at New Brunswick, New Jersey, his life has been so associated with work in entomology that he can hardly be thought of as belonging to any one locality in his influence. With his early life the writer is not familiar, but since our first meeting in 1884, scarcely a year has passed but what we have met at some of the various associations connected with entomological work, and while my acquaintance with him has been restricted to such occasional meetings and to a short association in Washington, I feel that the acquaintance has by no means restricted my opportunity for appreciation of his qualities and I may speak with confidence as to the worth of the man and the quality of his work. Professor Smith came into the work in entomology from a professional career in law, being attracted to it as are many devoted students of science, by his native talent and an association with enthusiastic students of this branch of science, largely at first, no doubt, from the standpoint of recreation, but it soon came to be with him a ruling passion and from the year 1884 when he commenced work for the United States Department of Agriculture, it was unquestionably the paramount interest of his life. In 1886 he moved to Washington to take up the position of Assistant Curator of Insects in the United States National Museum and while there did much to bring together and classify the somewhat chaotic mass of insects that had accumulated, the results of various surveys and of the collections from the Department of Agriculture, and the extensive collection brought together by Dr. C. V. Riley. In 1889 he resigned this office to enter upon his duties as Professor of Entomology at Rutgers College and Entomologist of the Experiment Station of New Jersey. Later, in 1894, he was made official State Entomologist for New Jersey and this position, with Entomologist of the station and the professorship in Rutgers College were retained until his death. The service he has rendered to New Jersey in these various capacities it would be hard to measure but we certainly can say that in no state in the Union has

John B. Smith

the work in entomology been pushed with greater vigor and with a more devoted effort to make the work of value to the people of the state.

Professor Smith, however, was a man of diversified talent and of a wide range of activity so that the results of his life work will be seen in many different phases of entomology. He was perhaps primarily a systematist and entered upon entomological work with this as his stimulus and throughout his life he continued to do much in the way of classification and arrangement of the groups of insects, most particularly in the *Lepidoptera*, in which he was a recognized authority and in which, especially in the *Noctuidæ*, his contributions have been of great extent and undoubted merit. In the field of insect anatomy he has made a number of contributions, particularly upon the structure of the Diptera and Hemiptera, and whether his views in these matters, which were somewhat revolutionary, be accepted or not, there can be no question as to the service given by his observations and interpretations in this field. In economic entomology which has perhaps engaged the greater share of his time during the past quarter-century, he has contributed extensive reports, embracing results of his studies in the State of New Jersey and covering practically all groups of insects and in greater or less degree nearly every species of economic importance in his state. His work upon the mosquito problems was prosecuted with special vigor and interest and the results have been marked and will undoubtedly show the greatest value in years to come. His lists of "Insects in New Jersey" which must have involved an enormous amount of labor, stand as among the best in this class of work and have afforded much help to students of geographical distribution.

Personally, Professor Smith was a man of very distinct convictions but of a genial, wholesome spirit, one whom it was a pleasure to know and his friendship extended practically to the whole number of working entomologists of the country and included many of the entomological workers of other countries. He was a member of many different scientific societies and an active worker in these, and was honored by prominent duties and offices in many of them, those showing particular confidence and esteem on the part of his fellow-workers, holding the Presidency of the Association of Economic Entomologists in 1895, and that of the Entomological Society of America in 1910. He was Secretary of the American Association for the Advancement of Science in 1894.

Aside from the numerous and voluminous bulletins published as a part of his experiment station work, and the extended papers on Systematic Entomology, many of which were published in the Proceedings of the National Museum, he was author of a book on "*Economic Entomology*" which has had a wide circulation and has been of great service in the education of entomological workers, and of a book entitled "*Insect Friends and Foes*," intended for popular reading and which must have had an extended influence in distributing information concerning insect life. His *Glossary of Entomology* is another important work. Doctor Smith was editor of *Entomologica Americana* from 1882 to 1890 and in 1891 was awarded the honorary degree of Doctor of Science by Rutgers College. He was always generous with both his time and his material, in assisting anyone interested in entomological work. No small part of his service to entomological science may be found in the numerous collections which he has identified for various students, and the specimens freely loaned for investigation in other hands.

HERBERT OSBORN.

Reviews

RECENT MEXICAN PUBLICATIONS ON ECONOMIC ENTOMOLOGY

During the existence of the Comision de Parasitologia Agricola, under the direction of Prof. A. L. Herrera, the Mexican Government published a number of bulletins and circulars on entomological subjects. The series came to an end in 1908 on account of the discontinuance of the Comision by administrative action. Recently, however, publications on economic entomology have been resumed in Mexico. They appear as bulletins or circulars of the Estacion Agricola Central and its various branches. The writers in several cases are entomologists who were formerly associated with Professor Herrera.

These commendable publications are intended largely to popularize entomology in Mexico but are of interest to entomologists in the United States for several reasons. They deal in some instances with pests which are more or less likely to be introduced in the United States in the future, and with methods of control of species which occur in the United States, the Mexican remedies for which must be different on account of the utterly different conditions prevailing in that country. The recent works are of several classes such as the treatment, in monographic form, of the pests of some particular crop, reports on special trips of investigationa and leaflets designed primarily to popularize the subject of entomology in Mexico.

Much of the work being done is of a pioneer nature and many of the publications consequently are similar to those issued by the experiment stations in this country soon after their establishment. It is to be hoped that the work now so well begun will be continued and will develop as it has in the United States.

R. Ramirez and J. R. Inda. **Las enfermedades del jitomate.** Bull. 56, Estacion Agricola Central, 1911.

This publication is a general treatment of the insects and diseases of the tomato in Mexico. It covers 46 pages and is accompanied by 16 plates, several of which are in colors. The insects are treated in several groups—those injuring the leaves and stems, those injuring the flowers and fruit and those affecting the roots or boring in the stems. The species of the last group are comparatively little known so that the bulk of the discussion deals with the forms affecting the leaves, blooms and fruit. In the list of species injuring the stems and leaves there are 18, while the forms injuring the flowers and fruit number five species. The majority of the pests with which the bulletin deals are species which occur in the United States. A number of additional species remain for further treatment.

W. D. Hunter.

[Notices of other bulletins in this series will appear in the next issue.—Ed.]

Insect Pests of Farm, Garden and Orchard, by E. Dwight Sanderson, pp. I–XII, 1–684; 513 figures. John Wiley & Sons, 1912.

The entomologist will welcome this much needed addition to his general reference library, while the farmer and fruit grower have a profusely illustrated and exceedingly useful compendium giving the life history and methods of control for practically all of their more injurious insects aside from those affecting citrus fruits. The scope of the work is indicated by the titles of the chapters, dealing with insects affecting grains, grasses, forage and miscellaneous crops, small grains, corn, stored grains, clover, tobacco, cotton, hop, potatoes and tomatoes, beans and peas, beets and spinach, cruciferous crops, melons, cucumbers, squash, etc., miscellaneous garden crops, sweet potatoes, strawberry, raspberry and blackberry, currant and gooseberry, orchard fruits, apple and pear, peach, plum, cherry and stone fruits. The author, in his groupings, has endeavored to avoid unnecessary duplication and has succeeded admirably in most instances. A few of the titles of the chapters are perhaps too inclusive, possibly unavoidably so, while some might take exception to the location of certain pests such, for example, as the plum Curculio in the chapter devoted to orchard fruits. Most parties familiar with this insect would probably look for it in the chapter discussing the stone fruit insects, though we must admit that it is an orchard pest. There are very few errors. We note on page 124 an evident slip of the pen to the effect that the larva of the Hessian fly has no true head, while on page 133, Elymus is probably given as Elynius and there is also a typographical error on page 628.

The work is well written and the illustrations, while somewhat miscellaneous in character are, for the most part, the best obtainable. They add greatly to the value of the publication. The letter press and paper are excellent. The author is to be congratulated on having produced a work which must take its place among the standard volumes on economic entomology.

E. P. Felt.

Current Notes

Conducted by the Associate Editor

G. H. Verrall, the eminent English dipterist, and a former president of the Entomological Society of London, died September 16, 1911, at sixty-four years of age.

Mr. E. S. Tucker of the Bureau of Entomology is studying the insects attacking stored rice, and is located at Baton Rouge, La.

Mr. E. W. Stafford, who resigned from the New Jersey Agricultural Experiment Station, has been appointed assistant entomologist of the Oklahoma Station.

Dr. C. W. Hooker of the Bureau of Entomology has been appointed entomologist of the Porto Rico Federal Experiment Station, and has entered upon his duties.

Messrs. Harper Dean and F. B. Paddock of the Texas Agricultural College have also been appointed assistant entomologists of the experiment Station, and Mr. Dean will give his entire time to the Station work.

Professor G. M. Bentley, State Entomologist of Tennessee, was recently re-elected secretary-treasurer of the Tennessee State Nurserymen's Association, at its annual meeting held at Nashville.

Mr. John D. Tothill, B.S.A., formerly in charge of the Tachinid parasite work at the Gypsy Moth Parasite Laboratory at Melrose Highlands, Mass., has been appointed to the Canadian Division of Entomology, and is at present in charge of the brown-tail moth campaign in New Brunswick.

Mr. Germain Beaulieu, B. A., LL. B., who has devoted particular attention to the insects of the province of Quebec, has been appointed to the staff of the Canadian Division of Entomology, and, in addition to carrying on investigations in Quebec, will study particularly the heteropterous Hemiptera.

During a recent visit to England, Doctor Hewitt, Dominion Entomologist of Canada, searched for the parasites of the larch sawfly, and discovered a locality in which they were fairly abundant. An attempt will be made to introduce them into Manitoba, where the sawfly is spreading westward.

Mr. Wm. A. Ross, B. S. A., of the Agricultural College, Guelph, Canada, who was carrying out investigations on the apple maggot under the direction of Mr. L. Caesar of that college last year, has been appointed as field officer, and will be located in a field station in the Niagara Peninsula of Ontario.

It may be of interest to note that during the present season's inspection of European nursery stock by the Canadian Division of Entomology under the "Destructive Insect and Pest Act," of which work Mr. Arthur Gibson, Chief Assistant Entomologist, has charge, pupæ (fortunately dead) of the gypsy moth were found on azaleas imported into Ontario from Belgium, indicating the possibility of the importation of this insect on such plants.

According to *Science*, the late Dr. A. S. Packard of Brown University was at work on a third volume of the series on the Bombycid Moths of North America, two volumes of which have been published by the National Academy; the third treats of the large silk-producing moths, and the material had been placed in the hands of Prof. T. D. A. Cockerell of the University of Colorado, who will edit it for publication.

Mr. J. H. Merrill, a graduate of Dartmouth College and a graduate student of the Massachusetts Agricultural College, has been appointed assistant entomologist of the Kansas Station and instructor in the college, succeeding L. M. Peairs, who resigned to accept a position at Morgantown, West Virginia.

The following delegates were appointed by President S. A. Forbes to represent the Entomological Society of America at the celebration of the one hundredth anniversary of the founding of the Academy of Natural Sciences at Philadelphia, March 19, 20 and 21. Prof. John B. Smith, Rutgers College, New Brunswick, N. J.; Dr. L. O. Howard, Bureau of Entomology, Washington, D. C.; Dr. E. P. Felt, State Entomologist, Albany, N. Y.; Prof. W. M. Wheeler, Bussey Institution, Forest Hills, Mass.; Dr. W. E. Britton, State Entomologist, New Haven, Conn.

At the Washington meeting of the Entomological Society of America, the following officers were elected for 1912: President, S. A. Forbes; First Vice-President, A. D. Hopkins; Second Vice-President, C. P. Gillette; Secretary-Treasurer, A. D. MacGillivray; additional members of executive committee, J. H. Comstock, J. B. Smith, Henry Skinner, Herbert Osborn, E. D. Ball, and P. P. Calvert; member of Committee on Nomenclature for three years, H. T. Fernald.

The growth of the entomological work of the Canadian Department of Agriculture is indicated by the additions to the staff of the Division of Entomology during the past year. The most notable is the appointment of Mr. J. M. Swaine, M. Sc., B.S.A., formerly on the staff of Macdonald College, Que., as assistant entomologist to take charge of the forest insect investigations. Mr. Swaine's published work on the timber-infesting species of Coleoptera, particularly the Ipidæ, is sufficient to indicate his ability to take full advantage of the unexcelled opportunities for work in the Canadian forests.

At a meeting of the Entomological Society of Washington December 7th, the following officers were elected for 1912: A. L. Quaintance, President; August Busck, First Vice-President; A. N. Caudell, Second Vice-President; E. R. Sasscer, Recording Secretary; S. A. Rohwer, Secretary-Treasurer; H. G. Dyar, Nathan Banks and E. A. Schwarz, additional members of the Executive Committee. Prof. A. L. Quaintance was elected to represent the society at the Washington Academy of Sciences.

Mr. C. S. Spooner and Mr. H. B. Scammell, assistants in entomology at the University of Minnesota, have resigned, the former to accept a position with the State Entomologist of Georgia, and the latter has been appointed county inspector of nurseries and orchards in Colorado.

Mr. C. W. Howard of Cornell, known in connection with grasshopper work in South Africa, and at present with the Rockefeller Institute, New York City, has been appointed to an instructorship in the Division of Entomology, University of Minnesota. While connected with the University Mr. Howard will pursue work leading to a doctor's degree, his major being in Economic Entomology.

Dr. Creighton Wellman, Director of the Laboratories of Hygiene and Tropical Medicine, New Orleans, La., who is making a study of the Coleopterous family Meloidæ, has just returned from a voyage to Central America, where he was sent to recuperate after an illness of several months in the hospital. Doctor Wellman now expects to continue his work.

The name of Prof. Robert Newstead has been selected by the council for recommendation to membership in the Royal Society.

Mr. O. G. Babcock, of College Park, Maryland, has been elected as assistant to the Entomological Division University of Minnesota in charge of the insectary. These two appointees take the places of Mr. C. S. Spooner and Mr. H. B. Scammell respectively, the first of whom goes to Georgia, accepting a flattering offer from the State Entomologist there, the latter having been elected County Inspector of Nurseries and Orchards in Colorado.

According to *Science*, Dr. L. O. Howard, received the honorary degree of Doctor of Laws on the occasion of the celebration of the one hundred and twenty-fifth anniversary of the University of Pittsburgh.

Prof. J. H. Comstock of Cornell University, Ithaca, N. Y., and Dr. W. J. Holland of Pittsburgh, Pa., have been appointed by the London Entomological Society as its representatives at the celebration of the centenary of the foundation of the Academy of Natural Sciences of Philadelphia.

Professor Herbert Osborn has been designated to represent the American Association of Economic Entomologists at the Second International Entomological Congress to be held at Oxford, England, August 5 to 10, 1912.

Samuel Henshaw has recently been appointed director of the Museum of Comparative Zoölogy of Harvard University.

The transmission of insects and nursery stock through the mails. At the suggestion of Dr. L. O. Howard, Chief of the Federal Bureau of Entomology, we reproduce below, sections 7 and 8, order number 6158 issued by Postmaster-General Hitchcock under date of March 23, 1912.

"7. Queen bees and their attendant bees, when accompanied by a certificate from a State or Government inspector that they have been inspected and found free of disease; beneficial insects, when shipped by departments of entomology in agricultural colleges and persons holding official entomological positions; other live insects, when addressed to the Bureau of Entomology of the United States Department of Agriculture, to departments of entomology in State agricultural colleges, and to persons holding official entomological positions, and dried insects and dried reptiles may be sent in the mails when so put up as to render it practically impossible that the package shall be broken in transit, or the persons handling the same be injured, or the mail bags or their contents soiled.

"8. Nursery stock, including field-grown florists' stock, trees, shrubs, plants, vines, cuttings, grafts, scions and buds (which may carry injurious insects) may be admitted to the mails only when accompanied by a certificate from a State or Government inspector to the effect that said nursery stock has been inspected and found free from injurious insects."

Dr. Howard adds that he is trying to get a modification of this order in regard to the inspection certificate for queen bees.

The above restrictions upon transmission of nursery stock through the mails are essential if we are to prevent the dissemination of injurious insects and fungous diseases. There has been complaint for some years respecting this phase of the traffic, and all interested in conserving our agricultural interests can not but welcome this much needed restriction.

E. P. Felt.

Mailed April 25, 1912.

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

WANTED—Riley's 7, 8, 9. Have for exchange or cash: Ins. Life, Vol. I, Nos. 3, 10, Vol. II, Nos. 1, 2, 3, 4, Div. Ent. O. S., Nos. 6, 17, 25, 31, 15 cents each, postpaid, Science '04–'10 incl., Pop. Sci. Mo. '07–'09 incl., 50 cents per vol.

A. W. Morrill, Phœnix, Ariz.

WILL SELL FOR CASH a complete set of Illinois Geological Reports, or will exchange for technical entomological writings, those dealing with parasitic insects preferred.

J. E. Hallinen, Interlaken School,
Laporte, Ind.

WANTED—To correspond with those desiring to exchange life-history series of important insects for economic collections.

W. E. Hinds, Auburn, Ala.

WILL PAY CASH or exchange for parts 9 and 10, Vol. IV, Insect Life.

H. F. Wilson, Bureau of Entomology,
Washington, D. C.

WANTED—Bulletins Bureau of Entomology, new series, Nos. 2, 15, 21, and Technical series, Nos. 1, 4, 5, 6, 7. Will pay cash.

James F. Zimmer, Bureau of Entomology,
Washington, D. C.

WANTED—Exp. Sta. Record, Vol. 3 No. 4 and Vol. 4 No. 5; Trans. of the Am. Ent. Soc. Vols. 2 and 3; Proc. of Ent. Soc. of Philadelphia, Vol. 2; Ann. Repts. Ent. Soc. of Ontario Nos. 2, 3, 7, 8; Papilo, Vol. 2 Nos. 2, 3 and 7, Vol. 3 No. 1. Will pay cash or exchange.

R. W. HARNED,
Agricultural College, Miss.

I offer in exchange for rare lepidoptera or coleoptera from the U. S. of N. A. specimens of the introduced species of Mantis—Tenodera sinensis; also, specimens of the rare beetle—Polyphylla variolosa.

Philip Laurent, 31 East Mt. Airy Ave., Philadelphia, Penn.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4, 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS,
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

BACK NUMBERS WANTED.

Will pay 60 cents for No. 2, Volume I, and 30 cents each for No. 1 and No. 6, Volume II, No. 6, Volume III, and No. 2, Volume IV, to complete sets. Address:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS,
MELROSE HIGHLANDS, MASS.

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

A bi-monthly journal, published February to December, on the 15th of the month, devoted to the interests of Economic Entomology and publishing the official notices and proceedings of the American Association of Economic Entomologists. Address business communications to the Journal of Economic Entomology, Railroad Square, Concord, N. H.

TERMS OF SUBSCRIPTION. In the United States, Cuba, Mexico and Canada, two dollars annually in advance. To foreign countries, two dollars and fifty cents ($2.50) annually in advance. Single copies, fifty cents. To members of the American Association of Economic Entomologists, one dollar annually in advance. 50 cents extra postage to foreign countries.

MANUSCRIPT for publication should be sent to the Editor, E. Porter Felt, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. Burgess, Melrose Highlands, Mass.

VOL. 5 JUNE, 1912 No. 3

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Published by
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
CONCORD, N. H.

Entered as second-class matter Mar. 3, 1908, at the post-office at Concord, N. H., under Act of Congress of Mar. 3, 1879.

CONTENTS

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 5 | JUNE, 1912 | NO. 3

Proceedings of the Twenty-fourth Annual Meeting of the American Association of Economic Entomologists—(*Continued*)

SPREAD OF THE LEOPARD MOTH IN CONNECTICUT AND ITS INJURY TO SHADE TREES

By W. E. BRITTON, *Agricultural Experiment Station, New Haven, Conn.*

The most destructive insect pest of shade trees in New Haven at present is the leopard moth, *Zeuzera pyrina* Linn. This insect is now at work in nearly every city and town along the Connecticut coast from New York State to the Rhode Island line. It is chiefly a town and city insect, and apparently does little harm in the open country.

First appearing in this country at Hoboken, N. J., more than thirty years ago, the leopard moth has spread slowly southward and inland, but has spread much more rapidly to the north and east, and especially along the coast. At present it is known to be distributed from Asbury, N. J., to Lawrence, Mass., and in no case has it been recorded as occurring inland more than twenty-five miles.

Though according to Professor J. B. Smith,[1] Colonel Pike as early as 1894 reported that the leopard moth had reached Connecticut, the first definite record was made by Mr. H. M. Russell, who collected adult moths at Bridgeport in 1901.[2] The first Connecticut specimen in the collection of the Agricultural Experiment Station was a male captured at New Haven, July 1st, 1907, by Professor H. W. Foote of Yale University. But the insect must have been present in New Haven for some years, as photographs taken about that time and

[1] Insect Life, Vol. vii., p. 138.

[2] Bureau of Entomology, Circular 109, p. 3.

recently examined show that the trees were then badly injured from its attacks.

Many of the magnificent elms on the central green, planted one hundred and twenty years ago, have recently died and have been removed. Though seriously injured by the repeated attacks of the elm leaf beetle, lack of nourishment and several other troubles, the immediate cause of death appears to be the leopard moth. Similar conditions exist in Wooster Square and the Broadway green, and also along the streets in the older parts of the city where trees still exist. Elms and silver maples seem to be preferred to other trees, though nearly all kinds are subject to attack. The insect is not confined to the center of the city, but is working in silver maples around the outskirts adjacent to the open country.

In Bridgeport the conditions are nearly as bad as in New Haven, but in the smaller coast cities like Stamford, South Norwalk and New London, the injury, though present, is not as serious or as widespread. We have not examined all of the inland cities, but the pest does not appear to be present in Hartford. A little injury at Danbury is reported by Mr. F. A. Bartlett. Danbury is about twenty-five miles inland, or as far from the coast as the pest has yet been recorded in America. At Wallingford, twelve miles from New Haven, the damage is rather severe.

Infested trees in late summer and fall drop many twigs which break off during storms and high winds because tunneled by the small larvæ, which usually fall with the twigs. Some twigs wilt and hang upon the tree, but this is more apt to take place the second summer, when the borers are larger, and larger branches are attacked. After several years of injury a tree exhibits dead branches above the foliage mass, giving it the well-known staghorn appearance. The branches die because they are quite or nearly girdled, and though the tree may sprout below, the new growth is at once attacked, and the tree soon dies.

On old trees having rough bark, like the elm, it is difficult to detect the burrows, and this can be done only by a close examination of the under sides of the branches. The frass and the white covering of the outlet are the chief guides, and the latter may be between plates of bark so as to escape notice altogether. On young trees having smooth bark, like the maples, it is a much simpler matter, and the borers may be killed by the use of a hooked wire or by injecting carbon disulphide into the tunnel and closing the outlet.

In the vicinity of New Haven the adults fly from about June 20th to the first week in August, but they are most abundant the first half of July. Males are numerous around the arc lights in the evening, and females, though much less common, may be found resting on telephone poles and on the trees. The females are poor flyers, and do not as a rule go far from the point where they emerge. For this reason trees set closely, with branches interlacing, are usually more severely injured than those well separated from each other.

In cities, many larvæ in the fallen branches are killed by being carted away and burned. Bats unquestionably devour many adults, mostly males, around electric lights. It is thought that birds, particularly woodpeckers, have prevented the leopard moth from spreading into the open country. In Europe four parasites are known, one of them having long been recognized in this country, but not as attacking the leopard moth. In fact, no American parasites have been observed. Doctor Howard has promised to import the European species in the hope of bringing relief to the infested cities of the northeastern states.

It is outside the scope of this brief paper to give a description or life history of the leopard moth, but full accounts, with references to literature, may be found in Bulletin 169 of the Agricultural Experiment Station, New Haven, Conn., which has just been sent to the members of this association, and also in a recent paper by James W. Chapman, entitled "The Leopard Moth and Other Insects Injurious to Shade Trees in the Vicinity of Boston," published by the Bussey Institution of Harvard University.

A THIRD BROOD OF CODLING MOTH IN KANSAS IN 1911

By L. M. Peairs, *Manhattan, Kan.*

During the summer of 1911 the Kansas experiment station carried on several tests in orchards in northeast Kansas and also conducted spraying demonstrations in other orchards in this section. The writer was in charge of the work in these orchards and had, in the course of the work, opportunity to make quite extensive observations on the behaviour of the codling moth throughout the greater part of the season.

While nothing greatly out of the ordinary occurred early in the season, the conduct of the insect was so different in September from the recorded habits that it was evident that an abnormal condition obtained. This could be explained only by the assumption that a third brood had been produced.

The season was in many ways, abnormal. A spring with not more than the normal amount of rainfall was followed by severe and practically unbroken drouth throughout May, June, July, and a part of August. Some rain fell late in August and in September the rainfall was rather heavy. The drouth was accompanied by excessive heat continuing until about September. September conditions were really more like June than autumn.

The apples were not noticeably undersized in spite of the dry weather perhaps because it was an "off year" for the apple crop and so no trees were heavily loaded.

In the course of the experimental work counts were made of all the apples set on over one hundred trees but bands were placed on only fifteen unsprayed trees in Doniphan county orchards and it was from these trees that all data used here was obtained, although it was evident that similar conditions obtained in the other orchards. Band records were not quite complete as some collections were missed during August when the writer was forced to be absent from the orchards, but the records from the fallen fruit show that the band records, though incomplete, are not misleading. It was at first the intention to keep emergence records of all larvæ collected but other work interfered so only pupation records were kept. In the following table the number recorded as having pupated does not indicate the true percentage, as most of those larvæ which did not pupate, especially in the early part of the season, died.

THE BAND AND PUPATION RECORDS

Date	Number larvæ collected[1]	Number pupated	Number emerged	Number died
(Fifteen trees)				
May 30	42	31	26	11
June 5	66	57	....	14
11	71	51	37	30
23	199	118	....	....
July 1	247	201	....	67
9	239	141	....	....
12	167	122	....	....
19	111	98	....	....
Aug. 1	69	52	....	17
18	87	60	....	30
31	119	98	....	....
Sept. 12	201	185	97	....
21	164	96	48	....
[2]Sept. 30	108	73	....	....
Oct. 7	89	47	19	....

The writer's experience with the codling moth and all published records from this latitude indicate that by far the greater percentage of those larvæ coming down from the trees after August 1st do not

[1] Pupæ collected under bands counted as larvæ. [2] Last two collections from 11 trees only.

pupate but pass the winter as larvæ. One notable exception to this rule occurred in Kansas in 1910. Here records taken for the Kansas Station by Mr. Hillis at Parker show considerable moth emergence up to the tenth of September. In this case these were thought to be only belated individuals of the second brood but some of them may have been third brood moths.

The band records above show a normal first brood with the second brood larvæ appearing about August first and continuing until picking time. The remarkable feature of these records is the pupation. In place of stopping with the first brood larvæ it continued until the very last collection of larvæ.

In the orchards during picking time moths were abundant and eggs on foliage and fruit were more plentiful than at any previous time. It was not unusual at this time to find five or six eggs on a single apple, and almost no apples were free of eggs. From September 10th to picking time 50 per cent more damage was done than in the entire season previously. Young larvæ began to be numerous about September 15th, and were increasingly so up to the time all the apples had been picked. On October 18th, of four hundred apples showing moth injury, 320 had young larvæ present in the fruits, and many of the apples had more than one. Over ninety per cent of these larvæ were less than three eights of an inch in length and certainly were not more than fifteen days old.

The first frost of the season occurred on October 19th and as most of the apples were harvested at this time, it is probable that many of the late larvæ failed to survive. It will be interesting to watch developments in the same orchards next season.

While the foregoing notes do not prove absolutely the presence of a third brood, it does show a very unusual state of affairs which can best be explained by the assumption that there was a third brood and that it was, perhaps, induced by the very unusual weather conditions. It is unfortunate that arrangements were not made to observe certain individuals and their progeny throughout the season so that we would have irrefutable evidence, but since this was not done the observations recorded may prove of interest to some.

INSECTS OF THE YEAR 1911 IN MASSACHUSETTS

By H. T. Fernald, *Amherst, Mass.*

No unusual destruction by insects has been observed in Massachusetts during the year which has just closed. On the other hand, many different kinds have contributed toward the loss which has been experienced and several not usually met with have been in evidence.

The unusually hot, dry summer was of course, favorable to the rapid increase of plant lice and the San José scale. Cutworms were also very abundant and did much damage, and the elm-leaf beetle was unusually destructive, though in most towns this pest is now quite well kept in check by spraying. It was first found in Nantucket this summer in small numbers, on five or six elms near the center of the town, not as perhaps might have been expected, on the trees nearest the wharves.

The leopard moth, *Zeuzera pyrina* L., is now present almost everywhere in eastern Massachusetts near the coast, and has even reached Nantucket. It does not seem to have worked its way far inland, however, and as in other states, its injuries are most pronounced in the cities and larger towns.

The twelve-spotted asparagus beetle, *Crioceris 12-punctata* L., which has been working its way northward, was taken at Concord and Roslindale near Boston in 1909. It was not observed at Amherst until last summer, which might indicate a more rapid dispersal along the coast than inward.

The cottony maple scale, *Pulvinaria innumerabilis* Rathv., has been unusually abundant in the Connecticut Valley this year, many of the soft maples being so thoroughly covered with it as to have made little or no growth. This is the first time for several years that this insect has attracted any attention in the state.

In 1910 the white birches throughout New England were attacked by the birch-leaf skeletonizer, *Bucculatrix canadensisella* Chamb., and almost without exception, the leaf tissues were entirely consumed. As scrub birch is so abundant everywhere in this part of the country, much attention was directed to this insect and many inquiries as to the likelihood of the destruction of the trees were received. During the past fall the insect was again in evidence, but to a less degree, only a small portion of the foliage being destroyed, and as a whole, the greatest injury appears to have been in localities where the pest was least abundant last year.

The cutleaved birches so much favored as ornamental trees have had a different experience. They have suffered equally with the native varieties, but in addition, for the last three years in the Connecticut Valley at least, they have also been attacked by the bronze birch borer, *Agrilus anxius* Gory, and in nearly every case where this insect has entered a tree, its death has followed, while the native birches have thus far appeared to be exempt.

The latter part of May some large chestnut trees in Amherst were reported as dying. An examination showed that they had been nearly girdled, close to the ground, and full grown larvæ, pupæ and adults of *Leptura zebra* Oliv. were found in the burrows.

For several years the elm-leaf miner, *Kaliosysphinga ulmi* Sund., has been present in considerable abundance. Last year this insect was less noticeable than in 1909, but during the past summer its work on Camperdown and European elms has been very noticeable. In many cases the parenchyma of all the leaves of the trees has been almost entirely consumed and the trees have made little or no growth.

Some facts which have been noted would seem to indicate that there are two generations a year of this sawfly in Massachusetts.

The work of the maple-leaf stem sawfly, *Priophorus acericaulis* MacGill., was quite noticeable in some parts of the state last spring. It had previously been noticed but has evidently become much more abundant during the last year or two.

A specimen of the roach, *Panchlora hyalina* Sauss., was taken near Amherst in a field at least half a mile from the nearest store. It is of course, to be presumed that it came in on some tropical fruit, but it is evidently liable to fly some distance, and may therefore be met with almost anywhere.

During June the members of an elementary class in Entomology at the college, interested in collecting insects, obtained a trolley car headlight with the requisite apparatus, and took it to a point where the local car line passes through a densely wooded area. There they established connections with the feed wire of the line and used the headlight to attract insects. The resulting catch included about twenty *Actias luna*, several *Telea polyphemus* and *Automeris io* moths, besides a large number of smaller Lepidoptera, in a little over an hour. Several trials of this method gave extremely good results, and suggests the possibility of using electricity at places where moths are most abundant, when trolley lines are properly located for this purpose.

On the 5th, 10th and 23d of June, blister beetles were received from correspondents in Stockbridge and Williamstown which were evidently of the genus *Pomphopœa* and which were kindly identified by Mr. Charles Schaeffer of the Brooklyn Museum as *Pomphopœa sayi* Lec. This insect has never before been received by the Experiment Station, and the data sent with the insects were of such interest as to be worthy of record. The Williamstown correspondent, under date of June 5, writes: "On the mountain ash tree where they were found, there were about a quart." One of the Stockbridge correspondents wrote, June 10: "Yesterday morning on entering my garden I found that these beetles had taken possession of the place. Every flower stock had been eaten down and the iris and roses were fast being devoured. Lupins seemed to be the favorite and not one was left. The beetles seemed to be drunk with the nectar for they stuck to the flowers and we could easily cut the stock and drop it in a pail of kerosene. We caught hundreds in this way. Later, in the afternoon, they seemed to have taken flight. There was a flight of about 300 on June 12, eating lupin, roses, syringas, iris, etc., eating the flowers and not the foliage. They appeared suddenly, over night. There was no special wind or other climatic conditions noticed. They were exterminated by hand and after a heavy rain at night none appeared next day."

The other Stockbridge correspondent, on June 23, wrote: "Three days ago I found these beetles eating the roses in the garden. They lighted, half a dozen or so, on one rose and devoured it rapidly. They were either so sluggish or so hungry that they were easily caught and the gardener drowned several hundred in an hour. Since then I have seen only a few scattered individuals. They seem tenacious of life, as specimens have lived three days in a box.

During the last ten years it has been of interest to note that the insects named by the New York State Entomologist in any year as attracting attention, were also as a rule, those receiving similar attention in the Connecticut report of that year, and it was usually safe to expect their presence in Massachusetts the following year. It would almost seem as though most of these cases of increase in abundance originated to the west, and reached Massachusetts from that direction. This has sometimes been so marked that the western end of the state would show an unusual abundance of some pest which the following year extended its injuries into the eastern end of the state.

The above is of course, only a generalization, but it has nevertheless occurred so often as to attract some attention.

INJURIOUS INSECTS OF 1911 AT TREESBANK, MANITOBA

By Norman Criddle

The season of 1911 had few surprises for the economic Entomologist and the injury done to crops and other vegetation was chiefly due to the continuous, or increased abundance of insects commonly met with the previous year. The most important of these are depicted in the following notes.

Insects Injurious to Grain and Grasses

Hessian Fly, *Mayetiola destructor*.—Infested spring wheat plants were gathered on May 17, being injured chiefly below the ground. The larvæ at this time were small and difficult to detect. On June

16 adults began to emerge from the above mentioned plant and continued to do so for about a week afterwards but owing to lack of time and unsuitable breeding cages, I was unable to carry them farther.

In the past it has always been supposed that the Hessian fly was single brooded in Manitoba, but from the above observation there is strong reason for suspecting otherwise. I believe that eventually the life history will prove to be somewhat as follows: Adults appear from over wintering pupæ in early spring as soon as the first spring wheat shows above the ground upon which they deposit their eggs, this attack being confined to young plants. The insect reaches maturity about the second week in June, varying of course, with the seasons, and soon after lays its eggs upon stemmed plants from which we have the commonly noticeable breaking down of the stems in late July. Larvæ of this generation reach the pupal stage in August to appear as flies the following spring. Much of this surmise has already been partly worked out.

Injury to grain from Hessian fly was difficult to estimate owing to the similarity of attack to the lesser wheat-stem maggot. It does not, however, appear to have been extensive and very little damage was done by the, presumably, second brood.

The Lesser Wheat-stem Maggot, *Oscinis soror* (?).—There are probably few insects that are so persistently injurious to spring wheat in Manitoba as this. Damage is done by it every year and occasionally to such a large extent as to cause extensive depredations amounting in some instances to twenty per cent. Whole fields will have a patchy appearance as if the grain had failed to germinate properly. An observant person, however, will at once detect the withered plants showing, perhaps a single green leaf remaining, while others will be entirely killed. When dug up plants look as if they had been pinched or chewed near the roots.

The flies appear in the early spring when plants have made but one or two leaves. Eggs seem to be laid singly or occasionally in pairs close to the ground and the larvæ after hatching, at once work their way downwards below the ground where they remain. There is another generation in June and perhaps yet another in late autumn attacking volunteer wheat and some of the grasses, though I was unable to secure flies by sweeping after June. Adults were reared from wheat gathered on May 17, appearing June 12 and for several days after. They were also collected from native grasses, particularly from genus *Agropyron* and from the now extensively cultivated grass, *Agropyron tenerum*.

Injury to grain in some cases amounted to five per cent but usually was much less. Late sown wheat seems to be freer from attack.

Western Wheat-stem Sawfly, *Cephus occidentalis*.—This species was again troublesome but not quite so much as in 1910. The first adults were observed on June 16. Fields next to last season's crop occasionally suffered on the edges to some 40% but the damage did not extend into them for more than a couple of hundred feet and became less severe towards the centre. These sawflies still appear remarkably free from parasites.

Grasshoppers or Locusts.—As was anticipated a rather severe outbreak occurred during the year, resulting in a few instances in considerable injury but as a rule the poisoned horse droppings were sufficient to keep them in check. They commenced to appear, as usual, early in May, but were retarded somewhat by cool weather. On July 10 the well-known fungus disease, *Empusa grylli*, broke out among them and continued to spread so that by the first of August as many as a dozen dead locusts could be counted in a square yard and often two or three upon a single weed. The disease, however, was by no means evenly distributed. It continued intermittently until October, by which time most of the locusts had died off. Several parasites were also at work, particularly a tachina fly, while the common prairie blister beetle, *Epicauta sericeus*, was exceptionally numerous. There were also vast numbers of red mites—*Trombidium*—present which in August became so plentiful as to leave very few locusts free of them.

An examination for eggs shows a considerable decrease in their numbers in comparison with last season, with an unusually large proportion of them destroyed. They are, however, still in sufficient numbers to cause trouble provided no farther damage is done to them.

During the season some experiments were tried with sawdust as a substitute for horse droppings which proved, on the whole, successful. It was not supposed that this substance would replace horse droppings, but when the latter are not easily procurable it will, I believe, prove equally satisfactory to bran with the advantage of being cheaper. It requires, however, a larger quantity of salt to make it attractive but has the advantage of being easily spread finely so that there should be no risk of poisoning stock when it is placed correctly.

Insects Injurious to Roots and Vegetables

Imported Cabbage Worm, *Pontia rapæ*.—This butterfly is again on the increase. It was observed to be particularly numerous in the neighborhood of Stinkweed, *Thlaspi arvense*, upon which it feeds extensively.

Colorado Potato Beetle, *Leptinotarsa 10-lineata*.—Surpassed even last year's high record for numbers and took advantage of early lack of attention. Considerable injury was done by it to potatoes, and several garden plants were attacked, including *Nicandra physaloides* and *Nicotiana affinis*.

Turnip Beetle, *Entomoscelis adonidis*.—Very prevalent in June upon small wallflower, *Erysimum parviflorum*, which is its native food plant. Later it became quite rare and was only present in small numbers upon turnips in the fall.

Peppergrass Beetle, *Galeruca externa*.—This insect was enormously abundant wherever its chief food plant occurred. During May larvæ were found covering the ground in patches of several feet in circumference and plants of *Lepidium* were so badly infested that in places where they prevailed to the exclusion of other plants, large patches of half an acre or more were completely stripped bare and killed. Besides these all other species of *Cruciferæ* were attacked especially the genus *Arabis*, but farm crops escaped with slight injury due no doubt, to their scarcity in the family of plants usually eaten.

Miscellaneous

Among insects not so directly affecting agriculture, that were common during the year, the following are worthy of being recorded:

Willow-leaf Beetle. *Galerucella decora*.—This beetle appeared suddenly on the 31st of May from unknown breeding grounds and at once proceeded to attack Aspen poplars which by the evening in certain spots, were actually bent down with the weight of beetles upon them and from a short distance whole bushes had a spotty grey appearance. The insects seemed to have congregated in certain places so that every tree covering an area of several acres would be infested, while the surrounding country remained comparatively free, edges of bushes were more attacked than centers and the sunny sides more so than shady ones.

Within twenty-four hours most of the leaves within the infested areas had been skeletonized, causing them to shrivel up and turn a dirty brown color. Willows also suffered severely, eventually more so than the poplars because it is upon them that the insects breed. This became abundantly manifest later in the season when the willows becoming completely stripped many of the larvæ died from starvation and but a moderate proportion reached maturity.

June Beetles *Lachnosterna* sp. including *rugosa*, *dubia* and *grandis* as determined by Doctor Glasgow, did considerable injury by eating the leaves of several trees and shrubs, but the larvæ were less numerous than usual and so caused little trouble.

Another leaf eater observed here for the first time was the Larch Sawfly. Though from the fact that even isolated trees, far removed from others, were stripped, there is reason for suspecting that they must have been present the previous summer.

Plant lice of many species were also unusually prevalent during the early part of the season but later became greatly reduced through their usual predaceous and parasitical enemies.

From a stockman's point of view an interesting event was an extensive outbreak of the well-known fungous disease, *Empusa muscæ*, during June and early July. Strangely enough only the smaller flies were attacked, but these included the Hornfly which was so severely infected that it was of little annoyance to cattle, though promising a severe outbreak early in the season.

I may mention here that careful observations with both this and the locust fungus have led me to believe that cold—with possibly lack of sunlight, is the chief factor in the encouragement of these diseases, and that wet "muggy" weather has little to do with their spread. A moment's thought will bring to mind the fact that there is but one period of the year when *Empusa muscæ* is nearly always present, namely late autumn when the temperature is becoming low. In 1911 low temperatures were invariably followed by an increased number of deaths from *E. grylli* and so it was with *E. muscæ* and flies.[1]

Among other troublesome insects may be mentioned an unusually severe outbreak of mosquitoes covering most of the province, also an abnormal number of stable flies, *Stomoxys calcitrans*, and Horse bot flies, *Gastrophilus equi*.

THE COTTON SQUARE-WEEVIL OF PERU AND ITS PARASITES

By Charles H. T. Townsend, *Piura, Peru*

At the 1910 meeting of the Association of Economic Entomologists, a paper by the writer was presented announcing the discovery of this new cotton pest of the boll-weevil class and giving such notes upon it as had been possible of accumulation within two months after first making its acquaintance. The article appeared in the April, 1911, issue of the Journal of Economic Entomology. The present article gives fuller information concerning it and its parasites, being such additional facts as have come to light during the past year.

Mr. W. Dwight Pierce has examined specimens of the weevil and states that it may be called *Anthonomus vestitus*, the description by

---

[1] I am indebted to Mr. H. T. Güssow, Dominion Botanist, for the determination of both these fungi.

Boheman agreeing quite perfectly with weathered female specimens. He is about to publish full descriptions of both the adult and pupa under this name. He states that it belongs to a group not represented in North America.

It has developed as practically certain that the square-weevil reached the cotton districts of the Peruvian coast from the humid coast region of Ecuador. This clinches the comparative certainty of its being the same species that Boheman named *vestitus* from the Island of Puná in the Bay of Guayaquil. Wild cotton from the vicinity of Guayaquil has been examined and found to show evidence of the weevil in the presence of the peculiar cells which it makes within the buds. Cotton squares from the coast region of central Peru, in the Chancay valley, have revealed the grub of the weevil. Thus the species appears to be spread all along the coast of Ecuador and Peru where cotton occurs.

On the other hand it does not appear to occur in the mountains nor on the other side of the Andes in the montaña. During a trip into the montaña of the Province of Jaen, immediately east of Piura, in September, 1911, I was unable to find either the weevil in any stage or any sign of it in the cotton of that region, wild or cultivated. The scattered cotton plants seen were extremely clean of all pests, revealing no sign of either weevil or scale. Thus the square-weevil does not seem to inhabit other than the lowlands of the Pacific coast strip, in this part of South America at least. It is certainly a humid tropical species, as evidenced by its almost complete cessation of activity during the hot dry season. Nevertheless it maintains itself well here, resuming activity promptly on the advent of the humid months, though these mean nothing more than an atmospheric humidity during night and morning with cloudy weather usually for the greater part of the forenoon during which the humidity continues. The afternoons are almost invariably sunny, and the sun quickly disperses the humidity of the air.

During the present year the weevil has been found to a limited extent in the newly-set bolls, just after the dropping of the flower. Out of 1971 such bolls collected in July and August, 1911, from various points over the whole cotton area of Piura Department, there issued or were extracted 178 weevils and 18 parasites. Subsequent examination showed 220 of the bolls to have been infested, indicating issuance of weevils from some of them prior to collection. These were all newly-set bolls that had either dropped or were yellowed and about to drop, or were dried and still hanging, and formed some 15 separate lots. In one case three adult weevils were taken from one of these small newly-set bolls. A half dozen or so infested fresh bolls of this kind, from which were taken larvæ in the field, are not included in this count. Not a single case of infestation of any larger bolls has been found. It is probable that these newly-set bolls were infested just before the opening of the flower. After the flower is shed and the boll begins to grow, it is not affected by the weevil.

In July and August of the present year 4408 squares were collected from various points in the whole area at various dates, making 20 separate lots. These were fallen squares, and hanging squares that were either dead or more or less yellowed or opened indicating work of the weevil. From these were secured exactly 2800 weevils and 573 parasites. Most of these issued naturally, but all the squares were later opened and unissued weevils and parasites extracted. There was found to be a total of 2131 squares that had contained weevil stages. The other squares had doubtless been largely killed by the feeding punctures of the weevil.

The parasitism of weevil stages in the squares indicated by the above figures is practically 17%, being slightly short of it. That indicated in the newly-set bolls is over 9%.

The total of 591 parasites from the July and August, 1911, lots appears to represent at least 11 species, all of which I believe to be true parasites of the weevil. They are as follows, in the order of their comparative abundance:

(1) Sigalphus n. sp. (det. Viereck)—439 specimens. Ten of these averaged very much smaller than the rest and further differed in having much darker legs, but they are probably only a variation. This, as will be seen, is by far the most abundant parasite. The rearing records indicate a period of not less than 23–26 days, and 18–21 days for the small form.

(2) Bracon n. sp. (det. Viereck)—71 specimens. Two of these were extremely small, being only one and one-half millimeters in length, but I could see no structural nor even colorational differences in them. The rearing record is evidently valueless here, indicating not less than 11–13 days.

(3) Cerambycobius n. sp. (det. Crawford)—42 specimens, 33 being female and 9 male. Stated by Mr. Crawford to resemble closely *C. cushmani*, but differing in the sculpture of the mesonotum. Rearing records indicate not less than 17–29 days for the females, and 18–23 days for the males.

(4) Catolaccus n. sp. (det. Crawford)—13 specimens. Rearing records indicate not less than 10–14 days, which is evidently too short.

(5) Eurytoma n. sp. (det. Crawford)—9 specimens.

(6) Braconid—5 specimens. This is a large and elongate species,

wholly brownish-yellow in color, including all parts. It was reared from four different lots, and though very large for the weevil is, I believe, an occasional parasite of it. (795° 3g)

(7) Braconid—4 specimens. This was reared from two lots secured from widely separated points on the same estate. It resembles the Sigalphus sp. at first sight, but has swollen hind tibiæ, a wide and heavy-set head, and the antennal scape is swollen and elongate. The legs are mostly light reddish, but barred with light brown. It is very active, and unlike the Sigalphus can jump completely out from the bottom of a 25 x 100 mm. glass tube in one jump. It is remarkable for not appearing until long after all the other parasites as well as the weevils have ceased issuing. Rearing records indicate not less than 31–35 days. (795° 3q)

(8) Braconid—3 specimens. This is an elongate and rather large blackish species, with brownish-yellow legs and antennæ, and very black conspicuous stigmal area in the forewing. The hind femora are brown. (795° 3h)

(9) Encyrtinæ Gen. Nov.? (det. Crawford)—2 specimens. Mr. Crawford thinks this a doubtful weevil parasite. One came from a lot of newly-set bolls from the Rio Chira, and the other from squares from the Rio Piura.

(10) Braconid—2 specimens. This is a small slender pale-colored form. The abdomen is pale yellow with a brown dot on each side of each segment, and the thorax has a pale brownish tinge. Stigma pale. The specimens are from two lots. (795° 3o)

(11) Braconid—1 specimen from newly-set bolls. This looks much at first sight like the Bracon sp., but is extremely active and distinguished at once by this peculiarity. Head and thorax brown or blackish. Abdomen pale green with terminal one-half of tergum brown, rest of tergum shaded with brown. Legs and antennæ reddish-yellow. Ovipositor reddish, the sheaths dark. (795° 3u)

It should be stated that the rearing-record periods could be taken only from the last-issuing individuals of the lots. In some cases the parasites may not have found their way into the tubes promptly upon issuing. Moreover the conditions were not strictly normal.

The similar rearing-record periods for the weevil were 24–31 days, and these seem about right for that time of the year—July and August, the coolest months.

Finally it may be noted that the talented Italian, Raimondi, who spent 19 years of the last century in traveling over and investigating the natural resources of nearly every corner of Peru, cites in his great work "El Peru," vol. 2, page 278, the visit of D. Jorge Juan and D.

Antonio de Ulloa to Piura in the year 1740, mentioning the cultivation of cotton in the small fields here at that time. This shows that cotton has been cultivated more or less in the Department of Piura for centuries, but only on a small scale until 1864. Thus there is no telling how long ago the weevil found its way from the humid Ecuadorian coast region into the semi-arid districts of Piura and the coast strip of Peru farther south.

THE WORK IN PERU AGAINST THE WHITE SCALE OF COTTON

By Charles H. T. Townsend, *Piura, Peru*

Hemichionaspis minor, commonly known in Peru as the piojo blanco, has within a few years past developed into a serious pest of cotton in the Department of Piura in northwestern Peru. This insect, if we include its close allies, is nearly tropicopolitan and its country of origin is a matter of much doubt. Whatever country may have been its original home, it is now quite certain that, like the square-weevil, it reached Peru from the humid coast region of Ecuador, where it occurs on wild cotton at the present time.

It was first noted in Peru in May, 1905, on cotton in the valley of the Rio Piura for a couple of miles along the river in the immediate neighborhood of the town of Piura, notably at Coscomba and Miraflores. It was not noted in the Rio Chira valley to the north of Piura until the second year following, in 1907, and did not reach Somate in the upper limits of the large cotton districts of the Chira until 1908.

At the time of my arrival in Peru, in November, 1909, it was well distributed throughout the large cotton haciendas of the Rio Chira, and those of the upper half of the Rio Piura, but had not spread farther south in the latter than the vicinity of Casa Grande. In February, 1910, it was first noted at Santa Clara just to the south of the last-named point, and during that year it appeared scatteringly throughout the lower Piura valley, reaching the vicinity of Sechura which is near the sea. The present year it has appeared quite uniformly throughout this newly invaded district, and thus now holds the entire cotton region of Piura Department in force. It is yet unknown in the cotton districts farther south in Peru.

In this part of Peru, namely the northern coast region, the wind blows always from the south and is usually strong and long-continued. The scale has been spread through the Chira and Piura districts by two agencies acting in contrary directions. The winds have carried it northward up the rivers. The waters of the two rivers, flowing south and west and used in irrigation, have carried it in general southward especially in the Piura valley, this in direct opposition to the prevailing strong winds. Its late invasion of the lower Piura valley is thus explained.

The species is recorded in the Fernald catalogue from New Zealand, Japan, Ceylon, Brazil, Grenada, Antigua, Jamaica, Panama, Florida, and a variety from West Africa. Mr. W. W. Froggatt writes me that the locality New Zealand is probably in error, and that Maskell's material probably came from some of the Pacific islands. To the above localities can be added Hawaii (Ehrhorn), Barbados (Ballou), Trinidad (Urich), Ecuador and Peru. The insect affects a great variety of plants. To those already recorded I can add probably twenty observed in Peru, but these are immaterial since the species is practically a general feeder as regards host-plants.

Some authors believe that *H. aspidistra* is the same as the present species, but I believe with Mr. E. Ernest Green that the two are distinct and can be easily separated in practically all cases. I have *aspidistra* from Cape Colony (Lounsbury), and Ceylon (Green). I also have *H. minor* from Ceylon (Green) and find the two forms easily separable on external puparial characters which are supported by the pygidial structure.

Both Japan and Africa have been suggested by authorities as the native home of *H. minor*. Professor Cockerell states that Hemichionaspis is a genus of the Old World tropics, with a lot of closely related species. *H. minor* is thus most probably not of American origin. As supporting this view I can state that I have uniformly found it absent from the montaña region on the east slopes of the Andes, on four trips that I have made in southern, central and northern Peru, and southern Ecuador.

The species evidently entered the Piura region at the port of Payta, where I found it abundant on various plants in November, 1909, and heavily parasitized. There are frequent steamer connection and exchange of commodities between Guayaquil and Payta, and the small intermediate ports of Tumbes, Zorritos, Talara and Negritos. The scale occurs at practically all of them. The distance from Payta to Guayaquil is 221 miles. From Payta the scale was probably carried direct, in shipments by rail, to Sullana in the middle Chira valley and Piura in the Piura valley, at both of which points it entered the small cotton fields and cotton patches near by, thus gaining a foothold. We may therefore consider the pest of Old World origin, long ago spread to America, and recently brought into northern Peru from the humid coast region of Ecuador.

Like most diaspine coccids this insect, if left to itself, is able to breed quite continuously under practically all kinds of climatic conditions from cool humid to hot arid. The only requisite is that its host-plant shall continue in a condition of normal physiological activity. From this fact much interest, both from a bionomic and from an economic standpoint, attaches to the recent spread of the insect into the coast region of northern Peru.

The climatic conditions of Piura Department are practically unique. Situated about 5° south of the equator and practically at sea level, it partakes of few conditions that may be considered even tropical not to say equatorial. Probably no other region on earth is similarly influenced as to climate. So far as rainfall is concerned it is highly arid, being practically rainless, but during at least six months of the year—June to November—its atmosphere is largely charged with humidity. From the latter part of December to the first part of May it is a truly arid and extremely hot region, comparable during these months with the summer season of Sonora, Sinaloa and the Gulf Coast of Lower California. These conditions are due to the trade-winds which sweep tropical South America in a general westerly direction, to the peculiar configuration of the Andes south of the equator which deflects these winds upward, and to the northward-flowing cold Humboldt ocean-current from the Antarctic region which hugs the west coast of South America until near the equator and sends over the Peruvian coast region an unvarying south wind cold by comparison in the humid months but tempered by the fierce heat of summer.

H. minor, having gained access to this region with its peculiar climatic conditions, either brought with it or was met here by certain microhymenopterous parasites common to diaspine scales in tropical and subtropical countries and by some especially American. These parasites are practically confined to the now nearly cosmopolitan *Aspidiotiphagus citrinus*, *Prospaltella aurantii* and apparently *P. berlesei*, *Aphelinus fuscipennis*, and two or three if not more species of the tropical American genus Signiphora. These parasites are very active during the humid months, but unlike the host are unable to continue high activity during the hot dry months of summer. The dry and excessive heat of December and January sends most of them into a state of what I shall term aridation, in contradistinction to æstivation which takes place during the dry season in humid climates but under conditions of considerable atmospheric humidity. The host, being furnished with a never-failing food-supply in the ever-active cotton plant of this region, which affords it moisture internally and externally, protected as it is from outside conditions by an impervious scale, is not similarly affected by the change to hot and dry conditions but continues as active as before.

The parasites just mentioned are able to dominate the scale by the end of the humid season, aided by other agencies to be described shortly. They resume activity in May and June and increase steadily during the ensuing humid months. As a rule in October and November very little living scale is to be found on the cotton plants, a very great part being parasitized, even up to 95 and 98 per cent in spots. But not all the scales succumb to the parasites and allied agencies, and here lies the flaw in ordinary parasite and natural enemy work against coccids in this region. The very few scales that escape, being relieved from the activity of their enemies, multiply in ever-increasing ratio from December to May, until the plague has assumed practically the same proportions as before. Thus the parasites and other enemies have lost all they gained, have all their work to repeat, and the scale has been present in damaging force for half the year.

It may be stated here that spraying and all kinds of insecticidal operations are practically out of the question in the cotton fields of Peru, not only on account of the large extent of the plantations making the total cost of treatment exorbitant and the present impossibility of securing concerted action, but also particularly because of the methods of cultivation and irrigation in vogue, which are peculiarly well suited to the prevailing conditions and could only with the greatest difficulty be changed and which do not allow the use of work-animals and machinery in the fields. Moreover work-animals are not to be had, at least for the present, and all cultural and insecticide work would have to be performed by hand-labor, which is scarce. Thus the only feasible mode of procedure against the scale for the present lies in parasite, coccinellid or other natural-enemy work.

Cutting back once a year would greatly reduce the seriousness of the pest, but the favorite native Peruvian and perennial variety of cotton is not amenable to this practice. Annual planting would similarly reduce the injury, but greatly increase the cost of production. Moreover both conflict with the season of irrigation in the Piura valley, which is without flowing surface water for half the year, and with the established cropping seasons in the whole region. Neither would greatly reduce the pest, which flourishes in especial abundance on willows, castor-bean plants, pigeon-pea, beans, and many others, all of which would need similar treatment. All of these and still other conditions emphasize the natural-enemy plan of work as the sole tenable mode of procedure.

It must now be noted that no doubt a considerable part of the nearly complete mortality of the scale at the close of the humid season is due to natural physiological causes inherent in the host and not all to the parasites and enemies. In other words practically all of the adult scales that have not succumbed to the enemies die naturally after having performed their function of reproduction. But the fact remains that but a very small percentage of young escape at this time, and this result is evidently due to the activity of the parasites and other natural enemies.

The enemies of the scale so far at work here, other than hymenopterous parasites, are chiefly coccinellids, mites and fungi. A small black scymnid belonging either to Microweisia or to a closely allied genus is abundant in both the larval and the adult stages feeding upon the scale over the whole region. The mites are so far problematical in their influence, since it is likely that they feed chiefly on the dead scales. A species of the fungoid genus Sporotrichum quite extensively attacks the scale, but probably mostly the older and already spent individuals. The larvae of the cecidomyid genus Lestodiplosis and the lepidopterous genus Blastobasis have been reared in extremely small numbers from the scale, and have no present effect upon it. Practically all of these enemies, whether of value or not, conform to the same custom as the parasites and become largely if not wholly inactive during the hot dry season.

The establishment here of the oriental *Chilocorus similis* has been attempted, three sendings having so far been kindly shipped from Japan by the Imperial entomologist, Mr. S. I. Kuwana. The few individuals that survived the voyage uniformly failed to withstand the hot season here. While this and other foreign coccinellids would probably not continue active here during the hot months, they would certainly be able to flourish during the humid months and would aid in the decrease of the scale.

As to the habits of the parasites and enemies now at work here, it may be said that we evidently have in them, for the period of their activity during the humid season, as nearly a complete chain of attack or sequence of enemies as is possible of attainment with a host of this nature. The scymnid Microweisia (or nearly allied genus) attacks the eggs as well as the young and adults. Aspidiotiphagus parasitizes the newly-hatched young while they are still active and up to the time that they become fixed. Aphelinus evidently parasitizes the adults and the early stages after they have become fixed and excreted the scale-covering. Prospaltella probably has the same habit as the last, at least *P. aurantii* from its large size, while it is probable from their small size that the species of Signiphora may have a similar habit to that of Aspidiotiphagus. It further seems likely that the last-named genus at least is parthenogenetic. All these points will be fully investigated as soon as the proper facilities can be had for carrying out the work.

The oviposition of Aspidiotiphagus may be described here, as I think it has not before been observed. Tilting a pill-box cover bearing on the inside surface both the Apidiotiphagus and the active Hemichionaspis larvæ so that I could see the underside of the body of the former, I was able to witness every stage in the act clearly and repeatedly with the 65x magnification of the binocular. The parasite approaches an active larva and strokes it with her antennæ to quiet it and to determine the position of its head apparently. If on approaching it she happens to be facing its head, I noted in several cases that she turned so as to face the same way as the larva before advancing to place the latter immediately under her abdomen with her feet on each side of it. By this means she can tell whether the larva moves during the act. The larva usually remain motionless, apparently soothed by the preliminary antennal stroking into receiving the insertion of the parasite's ovipositor. I noted in one instance that the parasite attempted to insert the ovipositor into a larva that happened to face in the opposite direction from herself, not having taken the precaution to turn around before advancing to cover it, whereupon the larva ran out between her hind legs and the ovipositor slipped to the surface of the box cover, into which the parasite, unconscious apparently of the escape of the larva, endeavored to force it. The Aspidiotiphagus, being in position for the act, brings the tip of the ovipositor with the tips of the two lateral ovipositor-guides to the dorsal surface of the larva, usually about the center of the dorsum, the guides being held in that position for a moment or two until the point of the ovipositor has effected an entrance when they are allowed to return to place approximated to the ventral surface of the abdomen and the ovipositor is seen to remain as a minute long bristle stuck into the body of the larva. It remains inserted in the larva's dorsum but a few moments, evidently long enough only for the passage of a single egg. The parasite then proceeds to find another larva, when the operation is repeated.

The habit which Aspidiotiphagus and probably certain other of these smaller parasites have of ovipositing in the active coccid larvæ has an important bearing on the spread of the parasite species concerned. As the active larval period is the only one during which these coccids become dispersed from plant to plant, the advance of the host assures the transportation of the parasite provided the latter is sufficiently numerous at the origin of spread.

Concerning other parasites available for the work here, the following records of rearings from *H. minor* may be made:

Barbados—From material sent by Mr. Ballou through the courtesy of the Honourable Commissioner of Agriculture for the West Indies, I have reared *Arrhenophagus* sp., *Azotus* sp., and *Signiphora* sp., besides *Aspidiotiphagus citrinus* and *Aphelinus fuscipennis.* The Signiphora seems the same as the Peruvian species that I reared at Lima, and which has recently been found at work on the scale here, probably as the result of our introductions.

Ceylon—Material sent by Mr. E. Ernest Green furnished an abundance of *Prospaltella berlesci*, and some *Aphelinus diaspidis.*

Hawaii—Material from Mr. Edward M. Ehrhorn furnished *Aspidiotiphagus citrinus*, and what is probably *Aphelinus mytilaspidis.*

Trinidad—Material from Mr. F. W. Urich showed only *Aspidiotiphagus citrinus.*

Practically all of the determinations of parasites mentioned in this paper were made by Dr. L. O. Howard, whose kind assistance I here acknowledge.

Several other parasites have been reared from lots of the scale in Piura, but they are of rare occurrence and have not yet been positively connected with the host. Some are mymarids and probably egg-parasites, and others may have come from weevil larvae within the cotton stalks bearing the scale. They need further investigation. A host of species of micro-hymenopterous parasites occurs throughout Peru, many of which may be made use of to fight the scale. Many lots of various scales containing such parasites have been used as vehicles and brought from Lima for the liberation of the parasites here. Others have been brought from the United States, Barbados and Japan,through the courtesy of the respective official entomologists of those countries, and the parasites liberated here. Only the Barbados shipment consisted of *H. minor* as a vehicle, the Japanese and United States shipments using *Diaspis pentagona.* The Lima shipments used various species of Diaspis and close allies. These have to some extent borne fruit. In addition systematic shipments of parasite material using *H. minor* as a vehicle have been made for two seasons between different points in the whole region of the Piura and Chira valleys, for the purpose of distributing the various species of parasites as evenly as possible over the whole area. With all these facts borne in mind, it needs to be emphasized that all our varied resources in this line appear as yet to be quite confined to the possibilities of the humid season alone.

It remains now to make the final statement of the outlook. Evidently we need here an enemy of the scale that will persist in a state of high activity during the hot and dry season. Such enemy is not yet in sight. But it would seem probable that the sunburned extents of Sonora, Sinaloa and the Gulf Coast of Lower California should hold such an insect, if not several of them. Large extents of that region are almost rainless and possess a very low average of atmospheric humidity. Coccids abound there and there certainly should their enemies abound as well. Parasites and coccinellids adapted to the driest and hottest parts of that region should be able to continue active through the hot dry season of the Peruvian coast region. Lower California, known as a land of drought and desert, offers the most promise of all in this respect in its Gulf coast region near the middle of the peninsula. This part receives the least rainfall of the whole region above outlined, has the least atmospheric humidity, and is evidently the hottest throughout the year. It is probable that an effort will be made to investigate this region in the hope of securing the requisite agency for use against *Hemichionaspis minor* in Peru.

TOBACCO EXTRACTS, THEIR COMPARATIVE VALUES AS INSECTICIDES

By W. O. Hollister, *Research Laboratory, Parke, Davis & Co., Detroit, Mich.*

The use of tobacco as an insecticide is recommended in the earliest available literature on the subject. It, therefore, bears the unique distinction of being not only one of the oldest of insecticides, but one most frequently used at the present time for a certain class of insects. Just when it was first used is not known, although several of the early writers refer to it in their papers on remedies for insects.

The first available report of its use was in 1763 when it was recommended in France as a remedy for plant lice. Both tobacco water and tobacco powder were used at that time. The first mention of its use in America was in 1814 by Yates of Albany, who applied tobacco water for sucking insects. William Corbett in the English Gardener, 1829, recommended tobacco juice for woolly aphis and Thomas Fessenden in the New American Gardener, 1832, included tobacco in a list of materials which he stated "may annoy or completely destroy insects."

Doctor Riley in 1884, said that the three most valuable insecticides of general application in use during the early days of economic entomology, and up to within a few years, were tobacco, white hellebore and soap.

It is very evident that tobacco is an old time remedy and its use at the present day for the eradication of a certain class of insects is indispensable. During the early use of tobacco it was employed for all sorts of insects, one writer only a short time ago reported that a decoction made by steeping 5 grms. of smoking tobacco in 15 cc. of water was fairly successful against scale insects. Tobacco water and tobacco smoke have long been employed against aphids and other delicate insects wherever the vapors can be confined, as in a greenhouse. Boiling of tobacco in such enclosures is as effective and often less injurious to the plants than the older methods of syringing a decoction or of fumigation by burning.

Tobacco, as an insecticide, may be used in several ways and forms: as (1) a liquid spray of a decoction made by soaking the stems, (2) a powder for dusting on plants, and (3) a fumigant, the fumes being produced by the burning of the stems or powder. To these might also be added the various commercial tobacco extracts and nicotine preparations now on the market, which may be used both as sprays and as vapors.

While there is no set rule or formula for making tobacco water or decoction, one pound of stems is generally used to one gallon of water. Warm water may be used, but never boiling, as the heat will volatilize some of the nicotine and the essential ingredient of the decoction would be lost. Tobacco water is sometimes mixed with soap or other materials, but it is generally used alone, being diluted according to the hardiness of the plants on which it is to be applied.

Chemically, tobacco is made up of many constituents, the most poisonous being nicotine. The word nicotine or Nicotiana, the genus to which tobacco belongs, was given to it in honor of John Nicot, who, in 1560, sent seeds to the king of France, describing them as the germs of a medicinal plant of great value. Different varieties of tobacco and the locality where it is grown affect the quantity of nicotine, plants grown on heavy moist soil possessing the highest percentage of the principle. The decoction varies in the amount of nicotine present, having a range of from .53 to 5.21 per cent (Shaw), depending not only upon the variety of the plant and locality in which it is grown, but also upon the method used in obtaining the extract. It is said that an addition of 10 per cent of lime to the water will more efficiently draw the nicotine from the stems.

Nicotine itself when pure is a colorless, volatile liquid which rapidly changes to a brown color when exposed to the air. There are several methods for extracting nicotine from tobacco. A relatively high temperature cannot be used in extraction or the nicotine will be lost. Some of the products now advertised are made from the pure nicotine while others contain more or less of the other ingredients of the extract. It is claimed by some that the nicotine is the principal active constituent of a tobacco extract, while others hold that other ingredients add to its effectiveness as an insecticide.

To determine this, experiments have been carefully carried out by the writer with different nicotine preparations now on the market. These preparations contained percentages of nicotine which varied from 7 to 40 per cent. They also varied in weight, color and odor. As a check upon these, dilutions of pure nicotine were used, a solution containing 10 per cent nicotine.

The preparations were guaranteed to contain the following percentages of nicotine:

No. I	8 per cent.
No. II	25 per cent.
No. III	30 per cent.
No. IV	40 per cent.
No. V (Check)	10 per cent.
No. VI	7 per cent.

No. VI was nicotine sulphate made from pure nicotine combined with sulphuric acid.

As a test insect the common bedbug, *Cimex lectularius*, was used. The bedbug was used not to find a remedy for its extermination, but because it was easy to obtain and because of its resistance and tenacious hold upon life. A total of over sixteen hundred insects were used in the experiments.

The method of making the tests conform with that described in a paper on "A Contribution to Our Knowledge of Insecticides" which was read before the International Congress of Zoölogists at Boston in 1907. The insects were placed in glass tubes covered at the ends with cheese cloth, a thin cloth being used to allow the free passage of the liquid. With a hook fastened into the cloth the tube was quickly plunged into the solution. By rapid agitation the protective air globules, which surround the spiracles can be removed and the whole of the insect comes in contact with the insecticide. At the end of one minute the tube was withdrawn and the insects quickly removed to a dry paper and covered with a clock glass to prevent any lively ones from escaping. The first results were noted at the end of twenty-four hours. Bugs dipped in clear water for one minute recovered and became as lively as ever in a very short time. This proved that the insects dipped in the nicotine solution did not die from drowning.

Four different dilutions were made of the products tested, the dilutions containing respectively .50, .75, 1 and 2 per cent of pure nicotine. Five fresh dilutions were made of each, using ten insects to a test and no insect or dilution was used twice.

The following results were noted at the end of the first twenty-four hours.

NICOTINE

Nicotine	.50 Per cent		.75 Per cent		1 Per cent		2 Per cent	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
No. I.	40	10	34	16	39	11	20	30
No. II.	44	6	40	10	39	11	32	18
No. III.	47	3	47	3	44	6	44	6
No. IV.	33	17	24	26	16	34	12	38
No. V.	46	4	40	10	39	11	27	23
No. VI.	43	7			38	12	32	18

Insects untreated were as lively as ever.

The final results noted five days later are as follows:

Nicotine	.50 Per cent		.75 Per cent		1 Per cent		2 Per cent	
	Alive	Dead	Alive	Dead	Alive	Dead	Alive	Dead
No. I.	18	32	12	38	8	42	0	50
No. II.	22	28	29	30	6	44	2	48
No. III.	26	24	20	30	4	46	1	49
No. IV.	18	32	8	42	1	49	0	50
No. V.	25	25	18	32	8	42	0	50
No. VI.	30	20			17	33	3	47

RESULTS EXPRESSED IN PERCENTAGE

Nicotine	.50 Per cent	.75 Per cent	1 Per cent	2 Per cent
No. I. Per cent dead.........................	64	76	84	100
No. II. Per cent dead.........................	56	60	88	96
No. III. Per cent dead.........................	48	60	92	98
No. IV. Per cent dead.........................	64	84	98	100
No. V. Per cent dead.........................	50	84	84	100
No. VI. Per cent dead.........................	40		66	94

As seen from the above the different products vary but little in their final results, although No. IV, a thick heavy preparation containing a large percentage of the tobacco extract, shows more dead at the first observation and a slightly higher percentage of killed insects at the termination of the experiment. This difference, however, is not great enough to recommend such a product over others having the same percentage of nicotine. Pure nicotine (No. V) appears to be as efficient as the first four preparations and possesses a slight advantage over the sulphate, No. VI. Thus it would appear that any advantage gained by making a sulphate would be lost by its becoming less efficient as an insecticide.

Experiments with a pure nicotine product and one containing more or less of the tobacco extract show that the pure nicotine solution has several advantages over the latter preparation. The pure solution is much cleaner to handle, less distasteful to use and will not stain clothing or anything with which it may come in contact. Delicate flowers may be sprayed with such a preparation with no discoloration of the petals.

The manner in which nicotine kills an insect is not known. G. Del Guercio of the Experiment Station at Florence, Italy, believes that the solution of nicotine acts poisonously upon insects by means of vapors and that these vapors, even in minute quantities, cause irritation, convulsive movements and, if sufficiently increased, death to the insect. It is evident from spraying experiments that nicotine very quickly causes death to those insects having soft and delicate bodies while the harder stronger insects show no detrimental effects. Knowing the burning sensation which a small amount of nicotine solution will cause when taken into the mouth, it is easy to imagine the effect upon the soft-bodied insect.

Summary

1. It may be safely stated that the use of tobacco, one of the oldest insecticides, is becoming more popular as a destroyer of insects, contrary to the fate of a large number of the insecticides of early origin.

2. A solution of pure nicotine is practically as efficient as the products containing a quantity of extractive matter.

3. Nicotine sulphate possesses no advantage over the uncombined product.

4. A solution of pure nicotine possesses the additional advantage of being free from the other constituents of tobacco which are nauseous and injurious.

[This completes the Proceedings.—Ed.]

ERRATA

Inadvertently the numerals 17 and 18 were omitted in numbering the plates in volume 4—the sequence jumping from 16 to 19. The references to plate 17 on pages 427 and 429 relate to the plate numbered 19.

AN ANNOTATED LIST OF THE LITERATURE ON INSECTS AND DISEASE FOR THE YEAR 1911

By R. W. Doane, *Stanford University*

During the year 1911 important advances were made in our knowledge of the relation of insects to disease. As during the past few years, most interest has centered around the studies in regard to Sleeping Sickness.

Several of the papers and reports give much additional information in regard to the bionomics of the tsetse flies, their haunts, habits and relation to man and other animals. It is now known that some of the vertebrates other than man may harbor *Trypanosma gambiense* and that there is a possibility of these being transmitted to man.

Certain experiments have shown that *Glossina morsitans* may act as a host for a human trypanosome which is probably identical with *T. gambiense.* This seems to account for many of the cases of Sleeping Sickness in regions where *G. palpalis* does not occur and indicates that the disease may spread over yet wider areas.

An interesting account of the development of *T. gambiense* in *G. palpalis* is given in one of the reports of the Sleeping Sickness Commission. Two days after biting an infected animal the fly becomes incapable of infecting other animals and remains so for about 22 to 28 days when it again becomes infective and may remain so for at least 96 days. During the infection period the salivary glands are found to be invaded with the type of the trypanosome that is found in the vertebrate blood.

The *Journal of Tropical Medicine and Hygiene,* November 1, 1911, announces that a new commission has been appointed to study Sleeping Sickness in Nyassaland where *G. palpalis* has not been found. It is hoped to determine whether the parasite that causes the disease is distinct from *T. gambiense* or whether other species of tsetse flies may transmit this parasite.

The recent outbreak of pneumonic plague in Manchuria and North China has created world-wide interest. Although this type of plague is not dependent on fleas for its transmission, being directly contagious, it can usually be traced more or less directly to an outbreak of plague in some other animals. This outbreak originated in the tarabagans, a kind of squirrel in Manchuria and was spread over an extended region by the hunters who trapped these animals.

Cantlie, Jour. Trop. Med. & Hyg. Feb. 15, 1911, gives the following summary of the way in which plague may appear:

(1) As a disease in animals.
(2) Pestis minor, conveyed by infected insects.
(3) Bubonic plague, sporadic cases, carried from animals to man by insects.
(4) Epidemic bubonic plague carried from man to man by insects.
(5) Pneumonic plague passing from man to man directly, or conveyed by insects.

The latter is regarded as the culmination and the most to be dreaded as it may pass over a region as the Black Death.

The Public Health Reports show that the work against the ground squirrels in California is being pushed vigourosly and that infected squirrels are still being found. One death from plague occurred in California during the past year which was directly traceable to infection from the squirrels. Two other cases, both of which recovered, were also probably the results of squirrel infection.

October 23, 1911, press dispatches announced the arrival of another ship in Hawaii on which a yellow fever patient had died. Soon after this we read of Doctor Blue being sent to these islands and of the energetic fight that was begun to control the mosquitoes there. It is to be hoped that such warnings as these will be heeded by the inhabitants of these islands and that more determined efforts will be made to get rid of this constant and ever increasing source of danger.

Sir Robert Boyce's paper in regard to the prevalence and significance of the yellow fever mosquito in Africa has caused considerable discussion in the medical journals.

The appearance of Doctor Howard's book on the housefly and the reports of Graham-Smith and others given in the Reports of the Local Government Board for Great Britain are important additions to our literature in regard to the housefly and its relation to various diseases. Doctor Stiles' experiments showing the ability of the fly to issue even when the larvæ is buried under six feet of sand is certainly a strong argument against the effectiveness of the dry system of disposal of fæces.

Late in the summer a second field commission for the investigation of pellagra was organized with Doctor Sambon at its head. He was joined by workers from several different countries and a study was made of the disease and the conditions surrounding it in Roumania, Hungary, Austria, Italy, Spain and France. The interim report which they have made seems to indicate that they found some evidence both for and against Sambon's theory that this disease is transmitted by Simulidæ.

The studies of Sanders and Long on the relation of insects to the transmission of Leprosy are of considerable interest as they both reach the conclusion that the bedbug may be an important factor in spreading the disease.

Studies on the relation of ticks to spotted fever have been directed mostly toward learning more about the distribution and biology of the so-called "Spotted fever tick." Maver's work, however, seems to show that at least four other species are capable of transmitting the disease.

The appearance of part II of the "Monograph of the Ixodoidea" by Nuttall and co-workers was welcomed by all interested in this work. It is an exceedingly helpful and important work.

Wenyon's report on his studies on the Oriental Sore in Bagdad adds much to our knowledge of this disease and shows how some of the insects may play an important part in transmitting it.

We all read with pleasure the announcement of the bestowal of knighthood upon Major Ronald Ross. His important contributions to medicine, particularly his studies on malaria have placed him in the foremost ranks of the benefactors of mankind.

In June came the sad news of the death of Sir Robert Boyce. Boyce was one of the principal founders and organizers of the Liverpool School of Tropical Medicine and perhaps the foremost leader in the practical study and the fight against tropical diseases. He made a particular study of Yellow fever and published several papers and reports on his investigations. His "Mosquito or Man," 1909, and "Yellow Fever and Its Prevention," 1911, are his two most important books. He began the publication of the *Yellow Fever Bulletin* and was at work on the manuscript of the second number when he was suddenly taken ill. His death, which occurred two days later, was due to cerebral hemorrhage.

Surgeon-General Walter Wyman, who has done so much to build up the United States Public Health and Marine Hospital Service, died in Washington November 21, 1911. He had been in the service since 1876 and under his direction much has been accomplished for the betterment of the sailors' conditions and several notable and successful fights have been made against epidemics. With two of these, the fight against yellow fever in New Orleans and against plague in San Francisco, Dr. Rupert Blue was closely associated and it was a distinct pleasure to all interested in this work to learn that Doctor Blue was appointed to fill the important post left open by the death of Doctor Wyman.

The following list makes no claim to completeness but records such books and articles as I have noted in my reading. It contains but few of the Continental papers. It may be regarded as a second supplement to the bibliography given in my "Insects and Disease." The first supplemental list appeared in Vol. 4, No. 4 (1911) of this Journal.

BIBLIOGRAPHY

Text or Reference Books

Austen, E. E. A Handbook of the Tsetse flies (Genus Glossina) British Museum, London, 1911. General characteristics and distribution, descriptions of 15 species and notes on biology.

Boyce, R. Yellow Fever and Its Prevention: a manual for medical students and practitioners. John Murray, London, 1911. E. P. Dutton & Co., N.Y., 1911. Deals very largely with the relation of mosquitoes to this disease and the methods of controlling an outbreak.

Doty, A. H. Prevention of Infectious Diseases. D. Appleton & Co., N. Y., 1911. Among many other things he considers the rôle of insects in the transmission of infectious diseases.

Duncan, P. M. Our Insect Friends and Foes. Methuen & Co., 1911. A chapter relating to the part that insects play in transmitting diseases.

Howard, L. O. The House-fly—Disease Carrier. Stokes & Co., N. Y., 1911. An account of the zoölogical position, life-history and habits of this species. Its natural enemies; how it disseminates diseases; remedies and preventive measures. Bibliography.

James, S. P. and **Liston, W. G.** A Monograph of the Anopheline Mosquitoes of India. Thacker, Spink & Co., Calcutta, 1911.

Melville-Davison, W. Some new and interesting points in Ships' Hygiene. Wright & Sons, Bristol, 1911. Discusses the screening of ships and other measures to keep mosquitoes out.

Nuttall, G. H. F.; **Warburton, C.**; **Cooper, W. F.**; and **Robinson, L. E.** Ticks—A monograph of the Ixodoidea, part II, the Ixodidæ (Pt. I the Argasidæ appeared 1908) Cambridge Univ. Press, 1911. Deals with classification, biology and relation to disease. Contains also some of the papers published in Parasitology in 1911.

Nuttall, G. H. F.; **Robinson, L. E.**; and **Cooper, W. F.** Bibliography of the Ixodoidea. Camb. Univ. Press, 1911. 2004 titles dealing with ticks and their relation to disease. Notes in regard to some of the references.

Ross, E. H. Reduction of Domestic Mosquitoes. P. Blackiston's Son & Co., Phil., 1911. "Instructions for use of municipalities, town councils, health officers, sanitary inspectors, residents of warm climates."

Contributions to Medical Science by **Howard Taylor Ricketts.** Chicago Univ. Press, 1911. Contains most of his contributions to medicine and pathology together with articles of some of his collaborators especially on spotted fever.

Fourth Report Wellcome Trop. Research Laboratories. Pub. for Dept. Edu. Sudan Govt., Khartoum, 1911. Vol. A. Medical Papers on work of Sleeping Sickness Com. and Kala-azar Com. Trypanosomiasis, Spirochætosis, etc. Vol. B. contains report of the Ento. section; insects injurious to man, etc.

Review of some of the recent advances in Tropical Medicine, Hygiene and Tropical Veterinary Science. Balfour and Archibald and others. Supplement to the 4th Rept. of the Wellcome Tropical Research Laboratories.

The Eleventh Report of the Sleeping Sickness Commission of the Royal Society. H. M. Stationary Office, London, 1911. (Rev. in Sleep. Sick. Bu. Bull no. 32.) This brings together many papers already published in the Proc. Roy. Soc. and summarized in Sleep. Sick. Bu. Bulletins.

Yellow Fever: a compilation of various Publications. Results of the work of Major Walter Reed, Medical Corps U. S. Army, and the Yellow Fever Commission. Senate Docu. 822, 61st Cong., 3rd Session, Washington, 1911. A bringing together of the publications of Reed and his associates; also publications of Carroll after Reed's death and articles by Gorgas, Finlay and Havard.

Mosquitoes

Ayers, E. A. Mosquitoes as Sanitary and Engineering Problems. Jour. of Med. Soc. of New Jersey, VIII; 7, Dec. 1911.

Bruck, C. Ueber das Gift der Stechmucke Ein Beitrag zur "Muckenfrage." Deutsche Medizinische Wochenschrift XXXVII no. 39 Sept. 28, 1911. Discusses the poison of mosquito and midge bites. Has isolated a toxin from the mosquito which he calls culicin. Finds that mosquitoes can carry *Spirochæta pallida* on their feet.

Edwards, A. How we pulled the teeth of the tropics, Outlook 98: pp. 961–9, Aug. 26, 1911. A good account of the work against the mosquitoes in the canal zone.

Holmes, S. J. The Reactions of Mosquitoes to Light in Different Periods of Their Life-history. Jour. Animal Behavior Vol. I no. 1, 1911. Larvæ usually swim down no matter whether it is toward the approaching object or not. They are usually attracted to the light side of the vessel. The adults show positive phototaxis.

Howard, L. O. Remedies and Preventives against Mosquitoes. U. S. Dept. Agric. Farmers' Bull. 444, Apr. 1911. Protection from bites; smudges; catching adults; remedies for bites; destroying breeding places, killing larvæ, etc.

Howard, L. O. Menacing Mosquito. Country Life 20: 29–30 Aug. 15, 1911. Dangers from Mosquitoes; remedies, etc.

Jackson, E. S. Mosquito-borne diseases in Queensland. Jour. Trop. Med. & Hyg. XIV. 18 Sept. 15, 1911. Brief notes on some of these diseases.

Knab, F. Ecdysis in the Diptera. Proc. Ento. Soc. Wash. Vol. XIII (1911) p. 32. Refers to earlier paper (Same Vol. XI–1909 p. 68) telling how various Diptera issue from pupa. This paper gives further information. Mosquitoes burst their pupa case and continue to expand and force themselves out by swallowing air. This passes into the "food reservoirs" the function of which is discussed. They serve this purpose, also store food.

Knab, F. Food habits of *Megarhinus.* Psyche 18 no. 2 pp. 80–82, 1911. Structure of mouthparts and observations lead the author to believe that they feed wholly on sweets of flowers. Sheath of the labium is chitinized and rigid.

Ludlow, C. S. The Philippine Mosquitoes. Psyche XVIII no. 4 Aug. 1911. List of Phil. species and notes and descriptions of new species.

Melville-Davison, W. Mosquito Screening of Ships. Yellow Fever Bulletin. Vol. I: 8, Dec. 1911. Danger of ships carrying disease or infected mosquitoes; objections to use of SO_2: the advantages of a system of screening ships.

Reardan, T. B. Crusade against Anopheles. Cal. St. Jour. of Med. Feb. 1911.

Smith, J. B. Report on Mosquito Work for 1910. Rept. of Ento. Dept. of N. J. Agr. Coll. Ex. Sta. for 1910 (pub. 1911). Reports on the Azolla investigations and on local conditions; directions for using carbolic acid and gum camphor for fumigating to kill hibernating mosquitoes; notes on habits of several species.

Smith, J. B. The Mosquito Campaign as a Sanitary Measure. Ann. Amer. Acad. Pol. & Soc. Sci. Mar. 1911. pp. 424–435. Notes on life history and habits of several species and methods of control.

Williams, H. Disinfection of ships in Relation to Plague, Yellow Fever and Cholera. Jour. Roy. San. Inst. XXXI p. 603, 1911.

Malaria

Bently, A. and **Watson, M.** Drainage and Malaria. Nature 85; pp. 471–3. Feb. 1911. Points out that other factors must be considered when summarizing the work of drainage or other anti-malarial measures.

Henson, G. E.; Van Hood, E.; and **Warren, E. W.** Malaria, Its Prevention and Control. State Bd. Health Fla. Publication 84 June 1911.

Howard, L. O. Some facts about Malaria. U. S. Dept. Agric. Farmers' Bull. 450 Apr. 1911. The cause of the disease, method of infection, prevention and cure.

Stephens, J. W. W. Methods for Detecting Sporozoits and Zygotes in Mosquitoes Infected with Malaria. Bull. Ento. Research II p. 1, May 1911. Methods of capture, dissection, staining, etc. Problems concerning infection which need further investigation.

Wilson, J. H. Is Plasmodium Malariæ Conveyed to the Human System Through Any Other Avenue than the Mosquito? Jour. Del. Med. Soc. Mar. 1911.

The Prevention of Malaria in the Federated Malay States. Pub. by the Liverpool School of Trop. Med. 1911. (Rev. in Trop. Med. & Hyg. Feb. 15, 1911.) Describes efforts to control the Mosquitoes by clearing land, draining, etc.

Yellow Fever

Boyce, R. The Prevalence, Distribution and Significance of *Stegomyia fasciata* in West Africa. Bull. Ento. Research I pt. 4 Jan. 1911. Breeding places, characters of larvæ and adults, life-history, habits, distribution. Relation to Yellow Fever. This paper is discussed in the early numbers of the Jour. Trop. Med. & Hyg. 1911.

Boyce, R. The History of Yellow Fever in West Africa. Brit. Med. Jour. Jan. 28 and Feb. 4 and 11, 1911. Much the same data as in his article on this subject in Tr. Soc. Trop. Med. Dec. '10.

Boyce, R. Note upon Yellow Fever in the Black Race, and bearing upon the Question of the Endemicity of Yellow Fever in West Africa. Ann. Trop. Med. Parasitol. Apr. 20, 1911. Immune only because had disease in childhood.

Boyce, R. History of Yellow Fever in West Africa. Brit. Med. Jour. Feb. 4, 1911. See also same Feb. 11, 1911.

Craig, C. F. On the Nature of the Virus of Yellow Fever Dengue and Pappataci Fever. N.Y. Med. Jour. Feb. 25, 1911. All transmitted by an insect; in yellow fever and pappataci the virus undergoes a cycle of development in the insect, this point still undetermined in dengue, all due to filterable viruses. Author believes that when these organisms are found they will be found to be Protozoa.

Grimshaw, R. Stamping out Yellow Fever in Brazil. Sci. Amer. S. 72; 325 Nov. 18, 1911. Brief account of the work in Brazil.

Lindsay, Forbes. A Harvest of Tares. Lippinc. 87: 474–7 Apr. 1911. The possible dangers attending the opening of the Panama Canal and the bringing of this region into closer communication with the Pacific Islands and China.

Ross, Ronald. Yellow Fever in the Old World. Trans. Soc. Trop. Med. & Hyg. IV: 8 July 1911. Shows how the presence of "metaxenous" diseases, the parasites of which need a change of host,—depends upon the conditions of each of the two hosts. He formulates three laws: "(1) The metaxenous disease will not continue to exist in a locality unless both hosts are numerous enough; (2) a small increase of the numbers of one of these hosts above this point which may be called the critical point, may cause a severe epidemic among the other species of host; (3) the disease will tend to reach a limit depending on the constants."

Seidelin, Harold. Protozoan-like bodies in the Blood and Organs of Yellow Fever Patients. Jour. of Path. & Bact. XV p. 282, Jan. 1911. Rev. in Yellow Fever Bull. Vol. I: 2, June 1911. Describes certain bodies which he believes may prove to be the cause of the fever.

Stephens, J. W. W. Yellow Fever. Jour. Trop. Med. & Hyg. XIV: 17 Sept. 1, 1911. Refers to the relation of the disease to mosquitoes. Discussion by various doctors.

Stephens, J. W. W. and others. Discussion on Yellow Fever on the West Coast of Africa. Brit. Med. Jour. Nov. 11, 1911, p. 1263, also in Yellow Fever Bu. Bull. Vol. I: 8 Dec. 1911. Among other things discusses the part that *Stegomyia fasciata* may play in its spread.

Yellow Fever Bureau Bulletin. Published by Yellow Fever Bureau of the Liverpool School of Tropical Medicine. Published monthly. The first number appeared in May 1911. "It will contain abstracts of papers dealing with the subject of Yellow Fever, laboratory reports, investigations, yellow fever statistics and antistegomyia measures." The eight numbers that appeared in 1911 are all full of interesting notes and articles.

Distribution and Prevalence of Yellow Fever in West Africa. A discussion by various doctors. Tr. Soc. Trop. Med. Jan. and Feb. 1911. A discussion of Boyce's paper on this subject which appeared in the December, 1910, number of the same journal.

Yellow Fever in Hawaii Oct. 23, 1911. Press dispatches announce the arrival of another ship in Hawaii on which a patient had died from yellow fever. Ship from Central America; held in quarantine.

Possible, but Preventable, Legacy of the Panama Canal. R. of R's. 43: 483–4 Apr. 1911. Quotations from, and comments on, Lindsay's article in Lippincott's Apr. 1911.

Leprosy

Currie, D. H. Mosquitoes and Flies in Relation to the Transmission of Leprosy. Jour. Trop. Med. & Hyg. XIV: 9 May 1, 1911. Abstract of Pub. Health Bull. no. 39, 1910.

Currie, D. H. and **Hollmann, H. T.** A Contribution to the Study of Rat Leprosy. Pub. Health & Mar. Hospt. Serv. Pub. Health Bull. 41, pp. 13–32 pub. 1911. Believe that certain mites (*Lælaps echidninus*) may possibly be concerned in transmitting the disease.

Long, E. C. A Note on the Transmission of Leprosy. Jour. Trop. Med. & Hyg. XIV: 17 Sept. 1, 1911. Finds lepra bacilli in bedbugs that have fed on lepers; cites a case where a certain man slept in a hut formerly occupied by a leper. He was bitten by bugs then and later developed the disease.

Long, E. C. Transmission of Leprosy. Brit. Med. Jour. Sept. 2, 1911. Bedbugs allowed to bite lepers in the neighborhood of leprous nodules and on examination the alimentary canal was found to contain bacilli similar to *B. lepræ*.

Sandes, T. L. Mode of Transmission of Leprosy. Jour. Trop. Med. & Hyg. Aug. 1, 1911. See also Brit. Med, Jour. Sept. 2, 1911. Thinks that flies, fleas, mosquitoes and other insects may accidentally carry the bacilli, but believes that the bedbug may be a very important agency in spreading the disease.

Housefly

Bacot, A. On the persistence of bacilli in the gut of an insect during metamorphosis. Trans. Ento. Soc. London 1911 part II p. 497. Experiments show that certain species of bacilli ingested during the larval period of *M. domestica* can retain their existence while their host is undergoing the process of metamorphosis and continue their existence in the gut of the adult fly but their number diminishes suddenly after emergence.

Bacot, A. W. The Persistence of *Bacillus pyocyaneus* in pupæ and images of *Musca domestica* raised from larvæ experimentally infected with the bacillus. Parasitology IV, 1, Mar. 1911 p. 68. Quotes from Faichnie's paper (Jour. Roy. Army Med. Corps XIII. 1909) showing how *B. typhosus* may thus persist, and gives the results of his own experiments which show that pupa or images reared from larvæ that had been infected with *B. pyocyanesus* may contain this bacillus. Addendum by J. C. G. Ledingham confirms these conclusions and states that he has recently isolated *B. typhosus* from pupa, the larvæ of which have fed on this organism.'

Coker, W. C. Necessity of Water for Flies. Nature Study Rev. VII: 9, Dec. 1911. His experiments show that flies must have water frequently, as often as every day in warm weather.

Croy, H. Most Dangerous Animal in the World. Ladies H. J. 28: 18 June, 1911. Showing that the fly carries disease and giving methods of control.

Crumbine, S. J. Beware the Fly. Delin. 78: 185, Sept. 1911. Showing how filthy and dangerous they may be. Quotations from Merchants' Assn. of N. Y. as to methods of control; directions for making a substitute for sticky fly paper.

Flexner, S. and **Clark, P. F.** Contamination of the Fly with Poliomyelitis Virus. Jour. Amer. Med. Assn. 56 (1911) no. 23 pp. 1717–1718. Shows that flies contaminated with the virus harbor it in an infectious state for at least 48 hours.

Gaddie, D. W. What Shall We Do With the Housefly? Ky. Med. Jour. May 1, 1911.

Gerhard, W. P. Flies and Mosquitoes as Carriers of Disease. Reprint from "The Country Gentleman" pub. by the author, N. Y., 1911. Treats of methods of control of these insects, particularly in the country.

Graham-Smith, Nicoll, Copeman and others. Further reports (no. 4) on Flies as Carriers of Infection. Rept. to the Local Govt. Bd. on Pub. Health & Med. Subjs. n. ser. (1911) no. 53. Relation of flies to bacteria; relation to parasitic worms; flight of flies, etc.

Graham-Smith, G. S. Further Observations on the ways in which Artificially Infected Flies Carry and Distribute Pathogenic and Other Bacteria. In Repts. to Local Gov. Bd. New Series no. 53. 1911. Recovered *B. anthracis* from blow flies bred from larvæ fed on meat infected with the organism but failed to recover *B. typhosus* and *B. enteritidis*.

Graham-Smith, G. S. Some Observations on the Anatomy and Function of the Oral Sucker of the Blow Fly (*Calliphora erythrocephala*). Jour. Hyg. XI: 3, Oct. 1911. An excellent account of the structure of the mouth-parts of this fly and a comparison with the housefly. Tells how small and large particles are taken into the intestinal canal.

Gudger, E. W. Further Early Notes of the Transmission by Flies of the Disease called Yaws. Science 33 (Mar. 17, 1911) p. 427. Cites two other references published in 1769 and 1817 in which this disease is referred to as being carried by flies in Brazil.

Hatch, Edw. The Housefly as a Carrier of Disease. Ann. Amer. Acad. Pol. Soc. Sci. Mar. 1911. pp. 412–423. A review and summary of the dangers of the fly and methods of control.

Herms, W. B. The Housefly in Its Relation to Public Health. Bull. 215 Cal. Agr. Exp. Sta. 1911. Notes on Life-history, habits, and methods of control.

Hodge, C. F. Exterminating the Fly. California Outlook Sept. 30, 1911. From La Follette's. Describes various means of trapping, believes this to be the most effective way of getting rid of this fly.

Howard, L. O. Houseflies. U. S. Dept. Agric. Farm. Bull. 459 July 31, 1911. Life-history, carriage of disease, control measures.

Howard, L. O. Flies as Carriers of Infection. Science, n. s. 34: 24–5 July 7, 1911. Rev. of Rept. of Local Govt. Bd. New Series No. 53.

Hutchinson, Woods. How Doth the Little Busy Fly. The many dangers that lie in the prevalence of this common little pest and how they may be evaded. Country Life, 20: Aug. 15, 1911. pp. 31–33. Dangers of this pest and methods of control.

Ledingham, J. C. G. On the Survival of Specific Micro-organisms in Pupæ and Imagines of *Musca domestica* raised from experimentally infected larvæ. Experiments with *B. typhosus.* Jour. Hyg. XI: 3, Oct. 1911. The typhoid bacillus was found in larvæ and pupæ but not in adults.

Lumsden, L. L. and **Anderson, J. F.** The Origin and Prevalence of Typhoid Fever in the District of Columbia (1909–1910). Pub. Health & Mar. Hospt. Ser. Hyg. Labor. Bull. 78, Oct. 1911. Reviews the part flies played in the dissemination of this disease in these years. "Taken altogether, the evidence seems quite strong that flies, though not playing the major part, still do a considerable part in the spread of typhoid infection in Washington."

Nicoll, W. On the Part Played by Flies in the Dispersal of the Eggs of Parasitic Worms. In Repts. to Local Govt. Bd. on Pub. Health & Med. Sub., New Series 53, 1911. Shows that the ova of some of these worms may sometimes be swallowed.

Nicoll, W. On the Varieties of *Bacillus coli* Associated with the Housefly (*Musca domestica*). Jour. Hyg. XI: 3, Oct. 1911. May carry at least 27 varieties of *B. coli.* These appear to be derived about equally from excremental and from other sources.

Parkes, L. C. The Common Housefly. Jour. Roy. San. Inst. May, 1911. (From Repts. of the Local Govt. Board). Anatomy of alimentary canal, mode of feeding, infection experiments, etc. Enteric fever, cholera, dysentery and ophthalmia doubtless transmitted by flies and some evidence that summer diarrhoea also transmitted by them.

Ranson, B. H. The Life-history of a Parasitic Nematode, *Habronema muscæ.* Science U. S. XXXIV No. 881 Nov. 17, 1911. Life history of this parasite, the young stages of which are found in the housefly, the adult in the horse. Suggests that this may help to determine the proportion of houseflies that breed in horse manure

Sandwith, F. M. Danger of Housefly. Clinical Jour. XXXIX: 4. Nov. 1, 1911.

Smith, R. I. How to Suppress Houseflies. Press Bull. 23 N. C. Ex. Sta. June, 1911. Recommends one tablespoonful of formalin in a half pint of equal parts of milk and water. This to be exposed in plates, better with a piece of bread in the middle.

Smith, R. I. Formalin for Poisoning Houseflies Proves very Attractive When Used with Sweet Milk. Jour. Eco. Ento. Oct. 1911. Much the same data as in Press Bull. 23 of N. C. Exp. Sta.

Stiles, C. W. and **Miller, H. M.** The Ability of Fly Larvæ to Crawl through Sand. Public Health Reports Aug. 25, 1911. Further experiments to show that flies may issue when the larvæ have been buried under 48 and 72 inches of sterilized sand.

Wallman, E. Contribution à la connaissance du role des microbes dans les voies digestives. Ann. Inst. Pasteur XXIV: 1 Jan. 1911. pp. 1–96. Experiments with flies reared in aseptic conditions.

Washburn, F. L. The typhoid fly on the Minnesota Iron Range. Pop. Sci. Mo. Aug. 1911, p. 137. Describes conditions in this locality.

The domestic flies. Ed. in Brit. Med. Jour. Aug. 26, 1911, p. 449. Refers to dangers of this pest and to methods of control.

Literature on Flies. Jour. Amer. Med. Assn. June 24, 1911, p. 1900. Gives a list of various state boards of health that have published on this subject and a list of books and articles that may be consulted.

Breeding Places for Flies as Nuisances; Disposal of Wastes in a Non-sewered Town. Jour. Amer. Med. Assn. Sept. 23, 1911, p. 1076. Questions in regard to the above are answered and references are given.

A Campaign Against Flies. Nature Study Review. Jan. 1911. Tells how an Illinois town carried on a campaign of education in fighting this pest.

Myiasis

Banks, N. The Structure of Certain Dipterous larvæ with particular reference to those in Human Foods. U. S. Dept. Agric. Bu. of Ento. Tech. ser. 22, 1911. Descriptions of larvæ occurring in human foods and thus apt to occur more or less commonly in the alimentary canal.

Pellagra

Beall, K. H. The Etiology of Pellagra. Jour. Amer. Med. Assn. LVII No. 21 Nov. 18, 1911. Refers to cases of pellagra many miles from streams, considers this evidence against Sambon's theory that it is transmitted by *Simulium.*

Caccini, A. Pellagra as we see it in Italy: Old and New Theories: Report of Cases seen in New York City. Med. Record Mar. 1911. Regards Sambon's theory as a mere suggestion rather than a theory.

Carletti, M. V. Sandfly transmission of Pellagra. Gazetta degli Ospedali e delle Cliniche, Milan. May 28, 1911 XXXII No. 64. Criticises Sambon's theory in regard to likeness to syphilis, Kala azar and other protozoan diseases. Also his experimental evidence that the sandflies are responsible. Believes that the parasitic theory has much in its favor and that inoculating experiments should be made. Sambon has not been able to isolate the parasite and assumes that it is ultramicroscopic.

Johannsen, O. A. Simulium and Pellagra. Bull. 187 Me. Agric. Exp. Sta. Jan. 1911. Notes Sambon's theory, habits of larvæ of Simulium, distribution of *S. reptans* in western hemisphere (recorded only from Greenland): notes Alessandrini's theory in regard to drinking water as opposed to Sambon's theory.

Roberts, S. R. Sambon's New Theory of Pellagra and its Application to Conditions in Georgia. Jour. Amer. Med. Assn. June 10, 1911. Presents evidence in support of this theory. Conditions in Georgia similar to those in Italy.

Thorington, C. Mosquito and Pellagra. Va. Med. Semi-monthly July 21, 1911.

Thorington, C. Etiology of Pellagra. New Orleans Med. & Surg. Jour. Sept. 1911. Suggests that mosquitoes are probable factors in the conveyance of this disease.

Wall, F. Sand-fly fever in Chitral. Indian Med. Gazette, Feb. 1911.

Recent Pellagra Investigations by the British Pellagra Commission. Jour. Trop. Med. and Hyg. Dec. 15, 1911. Notes in regard to a meeting in which an interim report was given of the recent work in Roumania, Hungary, Austria, Italy, Spain, and France. Some evidence, both positive and negative was found to support Sambon's theory.

Attempts to Produce Experimental Pellagra. Ed. Sci. Am. 105: 490, Dec. 2, 1911. Results of some experiments made by Dr. C. H. Lavinder and Drs. Anderson and Goldberg: negative as regards Sambon's theory.

Pellagra. Ed. in Jour. Am. Med. Assn. Sept. 2, 1911. Been reported from more than thirty states, worst in Ky., Tenn., N. and S. Car., Ga. where it is increasing. One of the most important problems of the day. Sambon's theory little accepted here, but see Jour. Am. Med. Assn. June 10, 1911, p. 1713.

Phlebotomus or Sandfly Fever

Marett. Life-history of the Phlebotomus. Jour, of the Royal Med. Corps XVII July, 1911. Life history of the three species occurring in Malta and remedial measures to lower the incidence of "sand-fly" fever.

Newstead, R. The papataci flies (Phlebotomus) of the Maltese Islands. Bull. Ento. Research II pt. 1 May 1911. Study of the breeding places and habits of this fly; prophylactic measures, characters and morphology of the genus; description of the species; references.

Newstead, R. Papataci Flies (Phlebotomus) of Maltese Islands. Ann. Trop. Med. and Parasit. Aug. 1911.

Sandwith, F. M. Phlebotomus Fever. Clinical Jour. XXXIX: 9. Dec. 6, 1911.

Trypanosomes, Tsetse Flies and Sleeping Sickness

Bagshaw, A. G. Communication Relating to Some Recent Experiments on the Transmission of Sleeping Sickness. Brit. Med. Jour. Nov. 11, 1911, p. 1263. Refers to the experiment which seems to show that *Glossina morsitans* may transmit this disease.

Bagshaw, A. G. Recent Advances in Our Knowledge of Sleeping Sickness. Read before Soc. Trop. Med. Hyg. Oct. 23, 1911. Abs. in Jour. Trop. Med. & Hyg. XIV: 21, Nov. 1, 1911. Gives results of late studies and experiments.

Castellani, A. Remarks on the Possible Plurality of Species of the Trypanosomes Affecting Man in Africa. Jour. Trop. Med. and Hyg. XIV: 2, Jan. 16, 1911. Believes that *G. palpalis* may transmit more than one species of human trypanosomes and that these have been regarded as only one species.

Darling, S. T. Murrina, a Trypanosomal Disease of Equines in Panama. Jour. of Infec. Diseases, Chicago, June, 1911. See also Parasitology June 1911. A disease similar to nagana, surra, etc., believed to be carried by flies mechanically to wounds.

Darling, S. T. The probable Mode of Infection and the Methods Used in Controlling an Outbreak of Equine Trypanosomiasis (Murrina) in the Panama Canal Zone. Parasit. IV: 2 June 1911. Same data as given in Jour. Infec. Diseases June, 1911.

Foy, H. A. A Third Report on Experimental Work on Animal Trypanosomiasis. Jour. Trop. Med. and Hyg. XIV: 20, Oct. 16, 1911. Work conducted in northern Nigeria. Gives list of flies and records of experiments.

Hindle, E. The Passage of Trypanosoma gambiense Through Mucous Membranes and Skin. Parasitology IV: 1, Mar. 1911. Discusses the possibility of this method of infection in man and records experiments with animals in which he obtained infection *per. os, per. vaginam,* and *per. cutaneam.*

Kleine, F. K. and **Fischer, O. W.** Die Rolle der Sangetiere bei der Verberitung der Schalfkrankheit und Trypanosomenbefunde bei Sangetiern am Tanganyka. Zeit. f. Hyg. Infek. LXX pp. 1–23, 1911. (Abs. Sleep. Sick. Bur. Bull. 31 pp. 402–407 and 417–418) Sheep and goats shown to be susceptible to *Trypanosoma gambiense* and may serve as reservoirs. The usual life duration of the female *Glossina palpalis* in captivity was found to be about 4 1-2 months.

Mohler, J. R. and **Thompson, W.** A Study of Surra Found in an Importation of Cattle, Followed by Prompt Eradication. 26th Annual Rept. of Bu. of Animal Ind. for 1909 (pub. 1911) (Abs. in Sleep. Sick. Bu. Bull. 28, July, 1911). See also Sleep. Sick. Bu. Bull. 30, Oct. 1911, p. 366. Some imported cattle were found infected on arrival and others later. Author suggests that the latter may have been infected by horse flies or stable flies carrying the parasites.

Newstead, R. A Revision of the Tsetse Flies based on a Study of the Male Genital Armature. Bull. Ento. Research II, pt. 1, May 1911. Des. and figures, synopsis of the species.

Taute, M. Experimentelle Studien uber die Beziehungen der *Glossina morsitans* zur Schlafkrankheit. Zeit. of Hyg. and Inf. Oct. 1911. (Abs. Sleep. Sick. Bu. Bull. 31). Records that the human trypanosome may be transmitted by *G. morsitans* and that these flies act as definite hosts for the parasite.

Thompson, J. D. Note on the Transmission of Trypanosomes. Sleep. Sick. Bu. Bull. No. 31, Nov. 1911. Gives evidence against mechanical transmission and points out that the human trypanosome may be transmitted by more than one species of fly.

The Sleeping Sickness Commission composed of David A. Bruce, E. A. Hamerton, H. R. Bateman, and F. P. Mackie, published the following papers in the Proc. Roy. Soc. series B, vol. 83, 1911:

Experiments to ascertain if antelope can act as a reservoir of the virus of sleeping sickness (*T. gambiense*) 564 pp. 311–327. Antelope easily infected and flies feeding on them pass the infection to other animals; none found infected in nature.

Experiments to ascertain if the domestic fowl of Uganda may act as a reservoir of the virus of sleeping sickness. 564 pp. 328–334. Results negative.

Experiments to investigate the infectivity of *Glossina palpalis* fed on sleeping sickness patients under treatment. 565 pp. 338–344. Treating patients with arsenic and other drugs did not keep the flies that fed on them from becoming infective.

Experiments to ascertain if *Trypanosoma gambiense* during its development within *Glossina palpalis* is infective. 565, pp. 345–348. Rev. in S. S. Bull. 26 p. 155. *T. gambiense* retains virulence for two days (ascertained by direct inoculation) lost then for 22 days. Salivary glands of the fly invaded by virulent forms 36 days after it had fed on infected blood, without this invasion of the salivary glands the fly does not become infective.

Further researches on the development of *Trypanosoma gambiense* in *Glossina palpalis*. 567, pp. 513–527. (Abs. in S. S. Bull. 28, also in Jour. Trop. Med. and Hyg. July 1, 1911) The parasite undergoes a definite development in the fly; the salivary glands, but not the proboscis, becoming involved. After a very short time the flies which have been fed on an infected animal become incapable of conveying infection by their bites, and this non-infectivity lasts for some 28 days when a renewed infectivity takes place and remains for at least 96 days. At this time the salivary glands are invaded by the type of trypanosomes found in vertebrate blood.

Trypanosoma lewisi and Rat Fleas

Minchin, E. A. and **Thomson, J. D.** On the Occurrence of an Intracellular stage in the development of *Trypanosoma lewisi* in the Rat Flea. Brit. Med. Jour. Aug. 19, 1911. Account of the development that takes place in the epithelium of the stomach of the flea.

Minchin, E. A. and **Thomson, J. D.** The transmission of *Trypanosoma lewisi* by the Rat Flea. (*Ceratophyllus fasciatus*). Brit. Med. Jour. June 3, 1911, pp. 1309–1310. Authors refer to Strickland's paper in which he holds that the rats are infected by eating the fleas. Authors' experiments seem to show that this is only exceptional, not the usual means of infection, which is by the fleas feeding on the rats and regurgitating the infective forms of the trypanosomes into the wound.

Strickland, C. The Mechanism of Transmission of *Trypanosoma lewisi* from rat to rat by the Rat Flea. Brit. Med. Jour. May 6, 1911, p. 1049. Infection caused by rats eating infective fleas not by their bites or otherwise.

Swellengrebel, N. H. and **Strickland, C.** Some remarks on Dr. Swingle's paper "The Transmission of *T. lewisi* by Rat-flea" etc. Parasit. June 1911. Believe that Swingle has created an artificial life-cycle for *T. lewisi* in the flea.

Swingle, L. D. The Transmission of *Trypanosoma lewisi* by Rat Fleas (*Ceratophyllus* sp. and *Pulex* sp.) with short descriptions of three new Herptomonads. Jour. Infec. Diseases VIII No. 2 Mar. 1911, pp. 125–146. Shows that this transmission may take place.

Rats, Squirrels, Fleas and plague

Bashford, J. W. Stamping Out the Plague in China. Outlook 98: pp. 249–51. June 3, 1911.

Blue, R. Methods for the Control of Plague with Special Reference to Administrative Details. Jour. Amer. Med. Assn. LVII, No. 16, Oct. 14, 1911. Discusses relation of rats, squirrels and fleas to the plague.

Blue, R.; Heg, E. E.; Snow, W. F. Report of Committee on Methods for the Control of Plague. Jour. Amer. Med. Assn. LVII, No. 16, Oct. 14, 1911. Extermination of rodents and at least a squirrel free zone around all cities.

Cantlie, J. Plague in Manchuria and Its Lessons. Jour. Trop. Med. and Hyg. XIV: 4 Feb. 15, 1911. History of the outbreak. Plague may develop or appear in the following stages: (1) As a disease in animals. (2) Pestis minor conveyed by infected insects. (3) Bubonic plague, sporadic cases, carried from animal to man by insects. (4) Epidemic bubonic plague carried from man to man by insects. (5) Pneumonic plague passing from man to man directly, or conveyed by insects. The latter regarded as the culmination and the most to be dreaded as it may pass over a region as the Black Death.

Cantlie, J. Plague and Its Spread. Jour. Roy. Soc. of Arts. Mar. 10, 1911. History of Plague; different ways in which it may manifest itself, methods of spread and control, discussion by various doctors.

Chick, Harriette, and **Martin, C. F.** The fleas common on rats in different parts of the world and the readiness with which they bite man. Jour. of Hyg. Mar. 1911, XI: No. 1 p. 122. Lists and tables. No reason why *C. fasciatus* would not be as efficient an agent in transmitting plague as *X. cheopis*.

Cunningham, J. The Destruction of Fleas by Exposure to the Sun. Sci. Mem. Med. and Sanit. Depts. India, n. ser. 1911, No. 40. Fleas may be killed if exposed to the heat of the sun at a temperature of 116° or higher.

Gray, Douglas, Septicæmic and Pneumonic plague outbreak in Manchuria and North China. Lancet Apr. 29, 1911. (Summary in Jour. Trop. Med. and Hyg. May 15, 1911.) History of the outbreak which started among those who handled the tarabagan, the animal susceptible to epizootic plague.

Harms, B. *Zur* Naturgeschichte der Flöhe Medizinssche Klinik, Berlin, Aug. 27, 1911. Biology and natural history of fleas and a trap in use in orient; stick smeared with sticky substance and inserted in bamboo stick with just enough of the walls left to keep sticky substance from touching clothes. Traps placed about beds or person.

Howard, L. O. House-fleas. Circular 108 Bu. of Ento. U. S. Dep. Agric. Feb. 11, 1911. Cat or dog flea most common in East; life-history, remedies.

Kawakami, K. K. Fighting the Plague in Manchuria. World Today 20: 711–4, June, 1911. Points out difference between bubonic and pneumonic plague and the methods of combatting each type.

Martin, C. J. The Spread of Plague. Jour. Trop. Med. and Hyg. XIV: 17 Sept. 1, 1911. Brit. Med. Jour. Nov. 11, 1911. Various types of plague and the way in which each may be transmitted. Discussion by various doctors.

McCoy, G. W. The Susceptibility to Plague of the Weasel, the Chipmunk and the Pocket-gopher. Jour. Infec. Diseases VIII No. 1 Jan. 1911. pp. 42–46. Weasel (*Pretorius xanthogenys*) and the chipmunk (*Callosphermophiles chrysodeiru*) quite susceptible; gopher (*Thomomys bottæ*) slightly so.

McCoy, G. W. The Squirrel Plague Problem. Cal. State Jour. Med. Mar. 1911.

McCoy, G. W. Studies Upon Plague in Ground Squirrels. Pub. Health and Mar. Hosp. Bull. 43 p. 7–51, 1911. Discusses plague in squirrels and relation of insects to same. The squirrel flea and the squirrel louse both harbor the plague bacilli when they feed on plague infected squirrels or guinea pigs or white rats and may transmit the disease from one of these animals to another.

McCoy, G. W. A Plague-like Disease of Rodents. Pub. Health and Mar. Hosp. Ser. U. S. Pub. Health Bull. 43, 1911 pp. 53–71. This disease is very similar to plague and may have been confused with it. In laboratory experiments it can be transmitted by fleas.

McCoy, G. W. Bubonic Plague with Special Reference to that of Ground Squirrel Origin. Jour. Amer. Med. Assn. Vol. LVII No. 16 Oct. 14, 1911. Occurrence of plague in rural districts and the relation of this to plague in the ground squirrels.

Mullowney, J. J. The Plague in North China. Jour. Amer. Med. Assn. Mar. 11, 1911. The different types of the disease; how this outbreak originated; rats and fleas not so definitely related to pneumonic type as to bubonic.

Pringle, A. M. N. An Outbreak of Rat Plague in Suffolk. Public Health 24 (1911) No. 4 pp. 126–131. Detailed account of this outbreak.

Raybaud, A. The Danger of Transporting Plague Long Distances Through the Intermediation of the Flea. Presse Med. (Paris) 1911 No. 19 pp. 179–180: Abs. in Jour. Amer. Med. Assn. 56 (1911) No. 15 Apr. 15, p. 1152. Plague germs may remain virulent in the rat flea (*C. fasciatus*) during hibernation for a period of from 30 to 40 days. Infected fleas may take refuge in bales of goods or cracks in boxes and practically hibernate while being shipped long distances.

Reid, S. How to Prevent the Plague. Ind. 70: 1061–4. May 18, 1911. The necessary measures to control the plague as a world wide problem.

Rothschild, N. C. Ceratophyllus selantiewi Wagner, "a plague flea." Ento. Mo. Mag. June 1911 p. 141. A note in regard to this flea from Siberia and Manchuria. Taken from "Tarabagans" which suffer from plague. Recent epidemic in Manchuria started among hunters of these animals. The fleas reported to feed on humans.

Rucker, W. C. Enzootic Plague in U. S. Military Surgeon Jan. 1911.

Russ, R. The Story of Plague. Bull. Cal. St. Bd. Health Feb. 1911. Historical—good.

Shipley, A. E. Rat Fleas. Jour. Econ. Biol. Feb. 1911. (Reprinted from "Country Life"). Notes on common species, life history; list of genera.

Simpson, F. Ground Squirrel Eradication. Bull. Cal. St. Bd. Health Feb. 1911. Different methods adopted in California. (1) Shooting or trapping. (2) Suffocation. (3) Poisoning.

Walter C. Upon the Inoculation of Materia Morbi Through the Human Skin by Flea Bites. Jour. Hyg. XI: 2, July 1911. Results of the experiments mostly negative. Points out the possible bearing of these results on the commonly accepted theory as to the manner in which fleas transmit plague.

Wilder, R. M. Problem of Transmission of Typhus. Jour. Infec. Diseases, Chicago, July, 1911. Disease transmitted by insects, three should be suspected,—flea, bedbug, louse,—latter stands incriminated and preventive measures should be directed against it.

Bubonic Plague in 1911. Cal. St. Bd. Health Bull. Sept. 1911 reports a case of

human infection said to have occurred while hunting ground squirrels in Contra Costa County.

Enzootic Plague in the United States. Editorial in Med. Record Feb. 11, 1911. Reviews the recent outbreaks and shows the danger of other outbreaks unless persistent steps are taken to destroy the hosts that harbor the disease.

Campaign against Plague-infected Squirrels in California. Public Health Rept. Apr. 21, 1911. Data in regard to outbreaks in California since 1900. History of squirrel plague; methods of control; benefits derived as a result of control measures being adopted.

Rats. Ed. Ind. 70: 676–7 Mar. 30, 1911. Points out the dangers of allowing the rats to be present.

The Present Plague Situation. Ed. in Jour. Amer. Med. Assn. Feb. 11, 1911. Review of recent outbreak in China and other countries, now in every continent, menace of the rat plague in England.

Mildness of the Manchurian Plague. Literary Digest Apr. 15, 1911 p. 723. Quotes Doctor Kitasato: This outbreak pulmonary plague: cannot spread through the air; digestive tract plague proof; direct contact necessary; this outbreak worst in history for this type of plague. The Marmot is supposed to be the source of the present outbreak. They are subject to epidemics of this plague, at such times are easily caught and as their fur is valuable the disease is thus easily distributed.

Anti-plague Measures. Ed. in Jour. Amer. Med. Assn. Apr. 29, 1911. Little danger of the outbreak in China extending to the United States. Measures to control ground squirrels on the Pacific Coast. Cost about $1,300,000 since July 1908, nearly 100,000 rodents collected.

Rats and the Plague in England. Contemp. Rev. 99: 170–81, Feb. 1911. History of various outbreaks and the way in which plague is spread, and the means of controlling it.

Reports to Local Govt. Bd. on Pub. Health and Med. Sub. New ser. No. 52. Reports and papers on suspected cases of human plague in East Suffolk and on an epizootic of plague in rodents. 1. Report on suspected pneumonic and bubonic plague in East Suffolk and on the prevalence of plague in rodents in Suffolk and Essex by Dr. Bulstrode. (2) Observations on rat plague in East Suffolk by Drs. Martin and Rowland. (3) Reports on the pathological and bacteriological examination of rodents by Drs. Petrie and Macalester. (Rev. in Brit. Med. Jour. Aug. 26, 1911, p. 448.)

Investigations in Plague. Nature 85: 476–7, Feb. 9, 1911. Liv. Age. 268: 631–3, Mar. 11, 1911. Notes based on a review of the Reports of the Indian Plague Com.

Reports and Papers on Suspected Cases of Human Plague in East Suffolk and on an Epizootic of Plague in Rodents. Repts. to Local Govt. Bd. on Pub. Health and Med. Subjects New series No. 52 (1911).

Ticks and Various Diseases

Baetz, W. A case of American Relapsing Fever. N. Y. Med. Jour. Feb. 4, 1911. A typical case in Canal Zone.

Balfour, A. Feeding Experiments in Fowl Spirochætosis. Lancet, July 22, 1911, p. 223. Chickens were fed infected ticks and under some conditions developed the disease. Likely that the granules penetrate the mucous membrane as granules but possibly as young spirochætes.

Balfour, A. The Role of the Infective Granule in Certain Protozoal Diseases. Jour. Trop. Med. and Hyg. XIV: 17 Sept. 1, 1911. In discussing these refers to the spirochætes in ticks.

Bishopp, F. C. Distribution of the Rocky Mountain Spotted Fever Tick. Bu. of Ento. U. S. Dept. Agric. (Circu. 136) 1911. Occurs in Mont., Idaho, Wy., Utah, Nev., possibly also in Colo., Ore., and a corner of Cal. Calls it *D. venustus* Banks.

Bishopp, F. C. Some New North American Ixodidæ With Notes on Other Species. Proc. Biological Soc. Wash. XXIV (1911) pp. 197–208. Systematic.

Cooley, R. A. Tick Control in Relation to the Rocky Mountain Spotted Fever. Bull. 85 Mont. Agr. Ex. Sta. May 1911. Rev. of the work done, evidence against the ticks, methods of control. Believes that if domestic animals are kept free from ticks this will be sufficient protection.

Darling, S. T. Verurca Peruana. Jour. Amer. Med. Assn. LVII No. 26 Dec. 23, 1911. Discusses this infectious disease which he says is probably transmitted by ticks or other suctorial invertebrates.

Dixon, R. W. East Coast Fever: Its Prevention and Eradication. Agric. Jour. of Union of South Africa. Vol. II (1911) No. 1 pp. 10–22. Character of the disease; the ticks that carry it and dipping as a remdey.

Giltner, H. A. Verruca Peruana or Carrion's Disease. Jour. Amer. Med. Assn. LVII No. 26, Dec. 23, 1911. Describes this disease which he believes will be found to be insect-borne.

Graybill, H. W. Studies on the Biology of the Texas Fever Tick. U. S. Dept. Agric. Bur. Anim. Indus. Bull. 130, pp. 7–42, 1911. Biology and methods of study. Bibliography.

Henshaw, H. W. and **Birdseye, C.** The Mammals of Bitterroot Valley, Montana, in Their Relation to Spotted Fever. Bur. of Biolog. Survey U. S. Dept. Agric. Circular No. 82, Aug. 1911. List of ticks on various mammals. Find that domestic animals are the host for the greatest number of engorged ticks and if they are made tick free by dipping, the chances of men becoming infected will be vastly lessened.

Hindle, E. The transmission of Spirochæta duttoni. Parasit. June 1911. Review of the relation of ticks to Relapsing fever; description of his experiments. Infection results from the entrance of infected material, excreted by the tick while feeding, into the open wound caused by the ticks' bite. Not the result of inoculation of infective material from the salivary glands.

Hindle, E. The Replasing Fever of Tropical Africa. A Review. Parasit. IV. Oct. 1911. A summary of our knowledge of this disease. Bibliography.

Hindle, E. On the Life-Cycle of Spirochæta gallinarum. Parasit. IV: 4 Dec. 1911. The life-history of this parasite in the fowl and ticks. Bibliography.

Howard, C. W. An Experiment in Fumigation of Ticks. Parasit. June, 1911. Experiments with a "Clayton Fumigating Apparatus" generating a sulphur gas proved successful in ship holds, engorged females, however, were not killed.

Hunter, W. D. and **Bishopp, F. C.** Some of the More Important Ticks of the U. S. Year Book of U. S. Dept. of Agric. 1910 (pub. 1911). Economic and biologic notes on ten of the more common species.

Hunter, W. D. and **Bishopp, F. C.** The Rocky Mountain Spotted jever Tick With Special Reference to the Problem of Its Control in the Bitter-root Valley in Montana. U. S. Dept. Agric. Bu. Ento. Bull. 105, 1911. Distribution, life-history and habits, other species; methods of control. Bibliography.

Laws, H. E. Note on Eradication of Ticks by the Starvation Method. Agric. Jour. of Union of S. Africa Vol. I, no. 4, May, 1911 Results of experiments. An appendix gives tables showing the relationship between diseases of S. Africa and the ticks which transmit them.

Maver, M. B. Transmission of Spotted Fever by Ticks in Nature. Jour. Infec. Diseases Vol. 8: no. 3, Apr. 12, 1911. Ticks gathered from cows in Montana infected guinea pigs in the laboratory.

Maver, M. B. Transmission of Spotted Fever by other than Montana and Idaho Ticks. Jour. Infec. Diseases Vol. 8, No. 3, Apr. 12, 1911. Beside the Montana tick *D. venustus* and the Idaho tick, *D. modestus*, three other species, *D. marginatus*, Utah, and *D. variabilis*, Mass. and *Amblyomma americanum*, Mo. were found to be capable of transmitting the disease.

Merriman, G. The Geographical Distribution of *Ornithodoros moubata*. Parasit. June 1911. Gives maps and list of localities.

Moore, J. J. Time Relationships of the Wood-tick in the Transmission of Rocky Mountain Spotted Fever. Jour. Infec. Diseases Vol. 8, no. 3, Apr. 12, 1911. Minimum time for tick to infect guinea pig 1 hr. 45 minutes, average time about 10 hours; 20 hours almost constantly infective. Time necessary for a tick to become infected from feeding on a guinea pig about 25 hours. In nature this time may be much shorter. Minimum incubation period in tick not determined.

Neumann, L. G. Ixodidæ. Das Tierreich, Lieferung 26, 1911. Important monograph.

Nuttall, G. H. F. and **Merriman, G.** The process of Copulation in Ornithodoros moubata. Parasit. IV, 1, Mar. 1911, p. 39.

Nuttall, G. H. F. On the Adaptation of Ticks to the Habits of Their Hosts. Parasit. IV, 1, Mar. 1911, p. 46. Separates the ticks into groups according to their habits and shows how they are particularly adapted to their special mode of life.

Nuttall, G. H. F. On Symptoms Following Tick-bites in Man. Parasit. June 1911. Suggests the name "tick-bite fever" for a fever that frequently follows the bites of ticks.

Nuttall, G. H. F. Parasitology IV: Oct. 1911. Notes on Ticks I. (1) *Ixodes caledonicus*, description of male, together with considerations regarding the structure of the foot in Ixodes. (2) Types of parasitism in ticks, illustrated by a diagram, together with some remarks upon longevity in ticks. (3) Regarding the loss of life in ticks occurring on wandering hosts.

Sant'Anna, J. F. A Disease in Man Following Tick-bites and occurring in Lourenco Marques. Parasit. June 1911. A disease similar to Spirochætosis believed to be due to bite of ticks.

Theiler, A. Diseases, Ticks and Their Eradication. Agric. Jour. of the Union of S. Africa, Vol. I, No. 4, May 1911. Discusses the organisms which cause various diseases of domestic animals in Africa and the ticks which transmit them.

Theiler, A. Transmission of Amakebe by means of Rhipicephalus appendiculatus, the Brown Tick. Proc. Roy. Soc. B. 84: 569 July 20, 1911. Jour. Trop. Med. and Hyg. XIV: 18 Sept. 15, 1911. This disease same as East Coast fever and is shown to be transmitted by this tick.

Watkins-Pitchford, H. Dipping and Tick-destroying Agents. Agricul. Jour. of Union of S. Africa Vol. II, No. 1, July 1911. Summary of two previous reports which were published in Natal Agr. Jour., a full comprehensive account of experiments to prove that a system of dipping will check an invasion of East Coast fever or an outbreak of scab. Believes that the ticks can be eradicated.

Oriental Sore

Wenyon, C. M. Report of Six Months' Work of the Expedition to Bagdad on the Subject of Oriental Sore. Jour. Trop. Med. and Hyg. XIV: 7 Apr. 1, 1911, (From Rept. of Advisory Com. for Trop. Research Fund for 1910). Believes that the disease may be carried mechanically by houseflies, passing from these boils to open wounds but that the parasite is more commonly transmitted by some sucking insect, probably *Stegomyia* sp., possibly by sandflies.

Wenyon, C. M. Oriental Sore in Bagdad Together with Observations on a Gregarine in *Stegomyia fasciata*, the Hæmogregarine of dogs and the Flagellates of houseflies. Parasit. IV: 3 Oct. 1911. A full discussion of the disease and the probable relation of flies, and mosquitoes and other insects to it.

Miscellaneous Articles

Burrill, A. C. The Tsetse Fly and Sleeping Sickness; other insect carriers of disease. Wisconsin Med. Jour. Jan. 1911.

Doane, R. W. An Annotated List of the Literature on Insects and Disease for the Year 1910. Jour. Econ. Ento. Aug. 1911. Discusses principal works and gives list arranged according to subjects.

Gentry, E. R. and **Ferenbaugh, T. L.** Endemic Malta (Mediterranean) fever in Texas and the isolation of the *Micrococcus milentensis* from two patients. Jour. Amer. Med. Assn. 57 (1911); No. 11 p. 889–891. Also No. 13, p. 1045–1048 and No. 14 p. 1127. Report cases of this fever in Texas.

Hutchinson, Woods. The Lesser Perils of Country Life. Munsey Magazine July 1911 p. 507. Insects as foes of mankind, mosquitoes, flies, etc., suggestions for campers. "Sure cures" etc. Poison oak.

Mays, Earl. The Conquest of Germs. The Outlook Jan. 28, 1911 p. 225. Bacteria and disease; malaria and yellow fever and other diseases discussed.

McCaw, W. Comparison of some Diseases Transmitted by Bloodsucking Insects. Old Dominion Jour. of Med. and Surg. Richmond, July '11.

Simpson, J. J. Entomological Research in British West Africa. I. Gambia. Bull. Ento. Research II pt. 3, pp. 187–239. Oct. 1911. Account of expedition giving notes on insect-borne diseases; character of the region; records of blood sucking Arthropods; bionomics of *Glossina*; remedial measures; directions for collecting various kinds of insects.

Snow, W. F. When Commerce and Health Unite. Bull. Cal. St. Bd. Health Feb. 1911. Law in regard to squirrels and methods of enforcing; necessity for such.

Swan, J. M. Tropical Diseases and Health in U. S. Ann. Amer. Acad. Pol. and Soc. Sci. Mar. 1911, pp. 394–411. Tells of the different diseases that may be or have been introduced.

Wellman, C. Insects and Medicine. Cal. St. Jour. of Med. Jan. 1911.

The Public Health Movement. The Annals of Amer. Acad. of Political and Social Sci. XXXVII: 2 Mar. 1911. This whole number is devoted to articles on this subject, some of which are noted under the proper headings.

Petroleum as a pabulum. Entomologists are so accustomed to recommend petroleum or petroleum products for the destruction of insect life that we may have difficulty in classifying this material as a food. Mr. D. L. Crawford (Pomona College Journ. of Entomol. 4:687–97, 1912), adduces evidence to show not only that the larvæ of *Psilopa petrolei* Coq. may survive immersion in crude petroleum, but that they actually develop in this medium so unwholesome to most insect life. This is made possible by certain mechanical and physiological specializations—the former preventing the oil penetrating the tracheal system, the latter enabling the digestive apparatus to extract nutriment from such unpromising material. The record must be regarded as one of the exceptions proving the rule.

E. P. Felt.

OBSERVATIONS ON THE IDENTITY OF THE WHEAT MIDGE

By E. P. Felt, *Albany, N. Y.*

The wheat midge, *Cecidomyia* or *Diplosis tritici* of authors has been the subject of numerous economic accounts dealing with a very serious pest of wheat in America during the early half of the 19th century. One of the most detailed and exact of these comprises some 90 pages of the 6th report of Dr. Asa Fitch, then entomologist of the New York State Agricultural Society. This insect occupied such a prominent place in the earlier days that a desire to ascertain its identity at the present time should not lead to censure. The descriptions plainly indicate that the pest is a Diplosid. Unfortunately, other characters given, aside from biological data, are so general that they may be applied to many species and are therefore of little diagnostic value. The ultimate solution of the problem is not rendered easier by the destruction of Kirby's types, see Trans. Linn. Soc. 4:232. This insect has been referred by recent authors to the genus Contarinia and has been characterized as having an ovipositor twice the length of the body, a development which prevents our referring thereto any American form known to the writer as having been reared from wheat heads. The similarity of appearance among gall midges, even with those not closely allied, and the impossibility of construing too literally the descriptions of earlier writers complicate the situation greatly.

No question need arise in this connection as to the identity of the Hessian fly, *Phytophaga destructor* Say or *Cecidomyia cerealis* Rond., much better known in this country as *Cecidomyia* or *Mayetiola destructor* Say. No American species can be referred to *Contarinia tritici* Kirby, as stated above, and the same is true of the European *Diplosis equestris* Wagner, referable to either Clinodiplosis or Paralellodiplosis, the reddish larvæ of which produce an oval gall on wheat leaves. Two other European cereal midges should be mentioned, namely, *Lasioptera cerealis* Lind. which attacks the stems of rye, and *Epidosis cerealis* Sauter recorded as living in the larval stage on the leaves of barley.

Referring to species reared earlier, either in the New York State collections or loaned by the United States National Museum, we find an interesting condition. One species reared in this State is probably *Thecodiplosis mosellana* Gehin, while specimens preserved by Dr. Fitch and labeled in his handwriting as the wheat midge are described below as *Prodiplosis fitchii*. A third species, characterized as *Itonida tritici*, was what we had supposed up till recently to be the true wheat midge, the *Cecidomyia* or *Contarinia tritici* Kirby. There are one or two other species which have been reared under conditions which led the collectors to consider them wheat midges. There is, in addition to the above, *Lestodiplosis caliptera* Fitch, an undoubtedly predaceous enemy of the wheat midge and possibly another form with similar habits. The evidence at hand is not sufficiently precise to permit a positive opinion as to which species is the destructive wheat midge referred to so frequently in earlier economic literature. It may be any one or all three of the species described in detail below or some other form. The evidence is summarized at this time and the species described in the hope that those working upon grain insects will give special attention to this problem whenever an opportunity presents itself for securing valuable data. It is extremely desirable to obtain rearings, preferably numerous adults, from infested fields in widely separated sections of the country.

Thecodiplosis mosellana Gehin

Midges tentatively referred to the above species by Prof. J. J. Kieffer of Bitch were reared from wheat chaff containing numerous stout, yellowish orange larvæ submitted for identification January 12, 1912, by Mr. E. P. Rumsey, Batavia, N. Y. The insects were responsible, according to Mr. Rumsey, for a shrinkage of 25 per cent in the yield of the field. Nearly every head seemed to be affected just before the grain was cut. The larvæ were so numerous in the sample sent, a fair representative of several bushels collected under the threshing machine, as to give a distinct yellowish appearance. There appears to have been no record or even suspicion that this European species might have become established in this country. Apparently the same larva was found in wheat heads at Belle Isle, N. Y., June 20, 1899.

Larva. Length 2.5 mm., yellowish orange, stout. Head small, rather long; antennæ stout, biarticulate; breastbone bidentate, the teeth diverging, obliquely truncate, the shaft long, slender and tapering posteriorly. Skin coarsely shagreened. Posterior extremity roundly truncate and with two submedian pairs of rather obtuse tubercles, the outer pair distinctly smaller.

Male. Length 1.5 mm. Antennæ a little longer than the body, thickly haired, reddish brown, yellowish basally; 14 segments, the fifth with stems three and four and one-half times their diameters. Palpi; the first segment short, stout, the second with a length fully thrice its diameter, the third a little shorter than the second, the fourth one-half longer than the third. Face yellowish. Mesonotum dull reddish, the submedian lines yellowish, sparsely haired. Scutellum deep red, postscutellum whitish transparent. Abdomen with the basal half deep salmon, the distal segments yellowish transparent. Genitalia a variable yellowish and yellowish red. Wings hyaline. Halteres yellowish transparent, the knob reddish. Coxæ and femora basally, yellowish, the remainder of the legs a variable light straw; claws long, slender, evenly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment long, moderately stout; terminal clasp segment short, stout; dorsal plate short, deeply and triangularly emarginate, the lobes truncate or very broadly emarginate and sparsely setose; ventral plate long, broad, broadly and roundly emarginate, the lobes short, narrowly rounded; style long, slender.

Female. Length 2.5 mm. Antennæ extending to the fifth abdominal segment, sparsely haired, fuscous yellowish, yellowish basally; 14 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length thrice its diameter and slightly constricted near the basal third; terminal segment, basal enlargement with a length thrice its diameter, the appendage stout, fingerlike. Palpi; first segment irregular, short, the second with a length nearly thrice its diameter, the third as long as the second and the fourth about one-third longer than the third. Face yellowish. Mesonotum reddish brown, the submedian lines fuscous yellowish, sparsely haired. Scutellum and postscutellum mostly deep red. Abdomen pale yellowish orange. Halteres pale yellowish, the knob reddish. Coxæ yellowish; femora and tibiæ fuscous straw, the tarsi darker, the pulvilli nearly as long as the moderately stout claws. Ovipositor yellowish, stout, about one-half as long as the abdomen; terminal lobes lanceolate and sparsely setose. Cecida 2252.

Prodiplosis fitchii n. sp.

The specimens described below were found in association with larvæ and shrunken wheat kernels in the New York State collections, labeled "wheat midge" in the handwriting of Doctor Fitch and in all probability date back to the serious outbreaks of this insect studied by him, particularly as the color characters agree closely with his excellent account of this insect. We prefer to regard this species simply as one of the destructive forms, though it may possibly be only an associated midge. Though the specimens are in poor condition, the insect is tentatively referred to the above genus and characterized in the hope that its description will aid in establishing the identity of the midges injurious to American wheat.

Male. Length 1 mm. Antennæ fully one-half longer than the body, thickly haired, whitish; 14 segments, the fifth binodose and having the stems respectively, two and one-half and three times their diameters. Distal node slightly produced, with a length one-fourth greater than its diameter; circumfili apparently rudimentary or wanting. Distal segments possibly binodose, wanting. Palpi; first and second segments probably short, the third with a length about four times its diameter, the fourth a little longer than the third, narrowly oval. Face pale yellowish transparent, eyes large, coarsely granulate, black. Body a nearly uniform pale yellowish, the scutellum, pleuræ and tip of abdomen pale yellowish orange. Wings hyaline, somewhat whitish. Halteres and legs mostly whitish. Genitalic structure indistinct, apparently similar to that of *P. floricola* Felt.

Female. Length 1.25 mm. Antennæ probably nearly as long as the body, sparsely haired, whitish; 14 segments, the fifth with a stem three-fourths the length of the cylindric basal enlargement, which latter has a length two and one-half times its diameter and sparse whorls of long, slender setæ subbasally and apically. Mesonotum yellowish. Abdomen pale yellowish white. The ovipositor stout, apparently with a length about half that of the abdomen; terminal lobes missing. Claws slender, evenly curved, simple, the pulvilli nearly as long as the claws. Other characters nearly as given for the male. Type Cecid 1411.

Itonida tritici n. sp.

This species is a form provisionally referred[1] by the writer to *Cecidomyia tritici* Kirby. The specimens are in the United States National Museum collection at Washington, were labeled *Cecidomyia tritici* Kirby and were presumed to be the midge which caused so much loss to American wheat growers in earlier years, since they were reared by Mr. Theodore Pergande from typical wheat midge material. This can not be the European species, since the ovipositor is short.

Larva. Length 2 mm., moderately stout, reddish orange. Head small, tapering slightly. Antennæ stout, uniarticulate; breastbone distinct, bidentate, the teeth diverging, obliquely truncate; shaft slender, moderately chitinized. Skin coarsely shagreened, posterior extremity subtruncate and with six equidistant, subequal papillæ or tubercles.

Male. Length 1 mm. Antennæ one-half longer than the body, thickly haired; 14 segments, the fifth with stems respectively two and a half and three and a half times their diameters; terminal segment, distal enlargement cylindric, with a length two and a half times its diameter and a stout apical appendage three-fourths as long. Palpi; first segment quadrate, the second with a length three times its diameter, the third and fourth, the latter slightly dilated, each nearly as long as the second. Body yellowish. Wings hyaline, the third vein joining the margin well beyond the apex. Claws slender, strongly curved, the pulvilli shorter than the claws. Genitalia; basal clasp segment moderately stout; terminal clasp segment swollen basally, long; dorsal plate short, very broadly and triangularly emarginate, the lobes diverging, narrowly rounded; ventral plate long, broad, deeply and roundly emarginate, the lobes slender, irregular apically; style long, swollen at the distal fourth.

Female. Antennæ nearly as long as the body, sparsely haired, deep brown or black; 14 segments, the fifth with a stem about as long as the cylindric basal enlargement, which latter has a length two and a half times its diameter and sparse basal and apical whorls of stout setæ. Eyes black, face yellowish. Mesonotum ochre or tawny yellow, darker anteriorly. Abdomen a bright orange or reddish orange. Ovipositor short, the lobes narrowly lanceolate, with a length about four times the width. Other characters nearly as in the male.

The structural details were drafted from specimens labeled *Cecidomyia tritici* and kindly placed at our disposal by Dr. Howard of the U. S. Bureau of Entomology. The color characters were taken from the description published by Dr. Fitch.

In New Haven, Conn., a warfare is being waged against mosquitoes, and about $4,500.00 has been raised by subscription to pay for oiling the breeding pools and for a certain amount of draining in the worst breeding places in the salt marshes. The local board of health has made regulations regarding receptacles such as rain barrels, tin cans, etc., in which mosquitoes may breed on private property.

[1] 1908 N. Y. St. Mus. Bul. 124, p. 414

THE CLOVER MITE

Bryobia pratensis Garman

By F. M. Webster, *Bureau of Entomology*

In preparing circular No. 158 treating upon this species the writer found such a voluminous record of its occurrence and habits throughout the country as to render the information unavailable for that particular publication.

Nevertheless, there is some ground for the criticism of an author who publishes on a species without giving all of the facts in his possession. The situation is usually brought to the front by other writers in after years publishing as new what was already known, but the facts locked up in the unpublished records of some individual or institution.

It has therefore been thought advisable to publish elsewhere the records of the Bureau of Entomology bearing upon this mite.

On December 5, 1878, eggs that afterwards hatched young of this mite were found on the branches of elm, especially about the forks, in the city of Washington, D. C., by Mr. Theo. Pergande, of the Bureau of Entomology. The young mites hatched January 18, 1879, and belong to this species, as afterwards described.

March 8, 1879, there were received from Mr. Charles Fremd, Rye, N. Y., eggs which he found in large numbers on his peach trees and on grapevines in his neighborhood. Young mites of this species were reared from these eggs.

March 21, 1879, full-grown mites were found on elm, also in Washington, and eggs collected at the time developed mites three days later. Full-grown adults were also found on elm in the city on March 24.

On May 6, 1879, six years prior to publication of the description, Mr. Pergande discovered the mite injuring clover on the grounds of the Department of Agriculture and elsewhere about Washington, D. C. This injury was described at the time as giving the leaves of clover, especially the larger and older ones, a diseased appearance, as if attacked by a microscopic fungus. The younger leaves indicated very clearly that this appearance was caused by the feeding of this mite, principally on the upper surface. As they slowly crawled along on the leaf they were observed to leave behind them not only a very fine silky web, but also a discolored narrow line winding irregularly about and imitating to perfection the mines produced by some of the microlepidopterous leaf-mining larvæ.

December 12 of the same year some apple twigs and bark of apple trees were received from Prof. E. J. Wickson, of San Francisco, Cal., upon which were numbers of round red eggs similar to those that had been found in Washington. These eggs the following January developed mites of this species. On March 29, 1880, a piece of bark from an almond tree covered with red eggs, collected by Prof. H. B. Norton, State Normal School, Santa Clara County, Cal., was received through Professor Wickson, and on April 1 these eggs developed the young of this mite. On July 26, 1880, twigs and leaves of apple carrying the eggs and newly hatched young were received from Prof. J. H. Comstock, who had obtained them from Salt Lake City, Utah. A few developed individuals were also found upon these leaves and twigs. In October of this same year Professor Comstock brought them also from California.

January 12, 1881, branches of almond were received from Mr. G. W. Barnes, San Diego, Cal,. upon which were many eggs which afterward developed this mite.

March 2, 1882, twigs of plum were received from Mr. C. H. Dwinell, Berkeley, Cal., which were red with the eggs of this mite. Most of the eggs were empty, showing that many had already hatched.

October 13, 1883, a full-grown female was found by Mr. Pergande under bark of elm, in Washington, D. C., under conditions that seemed to indicate that she was depositing eggs under the bark. She was still ovipositing ten days later, and the eggs hatched April 19 of the following year.

January 28, 1884, a microscopic slide containing these mites, taken from bees, was received from Prof. A. J. Cook, Lansing, Mich. February 8 of the same year specimens were received through the Smithsonian Institution from Mr. W. H. Curtis, Haverhill, Mass. In this case the mites were said to have appeared by thousands in May and again in November, remaining each time for four or five weeks. They were first observed on the bricks outside a residence, but afterwards made their way into the house.

May 28, 1884, the mite was reported with specimens by Mr. George N. Kimball, Waltham, Mass., as found in large numbers in the sitting room of his house. December 9, 1885, eggs of this mite were received from Mr. Albert Koebele on twigs of cherry from Alameda, Cal.

January 12, 1888, a complaint was received from Mr. A. H. Mundt, Fairbury, Ill., that these mites were infesting houses. They were supposed to have come from willow trees growing in close proximity to the windows of the house.

May 26, 1888, the writer observed these mites literally swarming in some of the residences of Lafayette, Ind. Adults and young were observed infesting grasses on lawns in Lafayette on September 26.

December 13, 1888, specimens were received from Mrs. A. B. Wimer, Franklin, Mich., with the complaint that they had made their way into houses in large numbers. Five days later Mr. Pergande found the mite in all stages of development, from egg to adult, some of the eggs just hatching, on the trunk of an arborvitæ in the grounds of the Department of Agriculture.

February 18, 1889, mites were received from Mr. C. L. Hall, Carpentaria, Cal. These were marked "Malva-weed mite." April 29 a section of twig of plum with eggs and one full-grown mite were received from Mr. J. H. Casterline, Santa Rosa, Cal.

June 6, some twigs of an unknown tree or shrub infested by these mites were received from Mr. E. Shipley, James Valley P. O., Oregon.

August 21, a piece of bark of cottonwood completely covered with the eggs of these mites was received from Mr. H. W. Turner, Valley Springs, Cal. The specimen was said to have come from Tuolumne County, Cal., at an elevation of 8,000 feet.

On December 12, 1889, the writer, then stationed at Lafayette, Ind., observed these mites swarming into a residence through crevices about doors and windows. When they first appeared, about the 5th inst., they seemed to be full grown, but later there were many young also making their way into the houses. They showed no disposition to infest roses or geraniums growing in pots in windows, but would swarm upon the glass of these same windows.

January 28, 1890, specimens of the mite were received from Mr. L. H. Ellis, Wilmington, Ohio. On May 26, 1890, an empty egg-mass belonging to a species of spider, taken from the stone foundation of a house, contained numerous young of these mites. They were received from Mr. B. H. Roberts, North Chili, N. Y.

February 19, 1892, specimens of this mite were received from Mrs. I. Smith, Williamsport, Ind., with the complaint that houses were badly infested by them. April 15, eggs of this mite were received on a branch of cherry from Mr. J. C. Sharps, Portland, Ore. May 17, the same mite was received from M. E. Russell, Hartford, Conn.

July 28, 1893, section of branches of pear covered with eggs of this mite were received from Canon City, Col., by Mr. G. M. Dubois, who stated that the mite was rapidly increasing in numbers, threatening to destroy large pear and apple trees. December of the same year, specimens were received from Mr. D. W. Coquillett, Los Angeles, Cal., who found them in houses April 28, and eggs found upon prune trees hatched these mites on May 10.

June 12, 1894, a piece of apple twig covered with eggs of this mite was received from Prof. T. D. A. Cockerell, Las Cruces, N. M. October 16, 1894, alcoholic specimens were received from Prof. F. L.

Washburn, Corvallis, Ore., together with the statement that mites and eggs were found under burlap bands that had been placed upon the trunks of apple trees.

June 13, 1894, a lot of these mites was received from Mr. Geo. W. King, Lawrence, Mass. Mr. King stated that they came into the courthouse and were found on the window-sills every year. September 8, 1894, alcoholic specimens were received from Fort Collins, Col., from Prof. C. P. Gillette, who reported them very abundant on the limbs and trunks of pear, apple, plum and cherry at Fruita, Grand Junction, Delta, Canon City, and Denver, Col. December 10, 1894, a piece of apple twig covered with eggs of this mite was received from Mr. N. A. Jacobson, Payette, Idaho.

In May, 1895, a correspondent from Garfield, Ohio, complained that these mites were swarming in his house and covering the walls near the door. Two pine trees growing near the house were swarming with them. This was the third year that they had occurred in this way. September 13 of the same year twigs of pear covered with the eggs of this species were received from Mr. A. Engberg, Salem, Utah, with the statement that they seriously retarded the growth of fruit trees.

March 12, 1896, a small branch of apple carrying eggs of this species was received from Mr. T. A. Hitt, Weiser, Idaho. March 20, a section of bark of pear with eggs of this mite was received from Mr. Robert Milliken, Nampa, Idaho. October 22, 1896, twigs of peach with egg-shells and cast-skins of this mite thereon were received from Prof. G. McCarthy, Raleigh, N. C.

November 21, 1896, specimens of the mite were received from Rachel Berry, McCook, Neb., with a statement that they had been annoying her for a long time by collecting upon the window-sills, especially on the sunny side of her house. December 11 of the same year both mites and eggs were received from Mr. H. Russell Hill, Williamsport, Pa., with the statement that they had appeared in "hundreds of thousands" upon the walls of the city hall of that place, creeping through the cracks of the windows into the offices to deposit their eggs. Eggs were hatching when received.

February 17, 1897, eggs of the mite were received on a cherry twig from Mr. B. L. Berman, Salem, Mass. On April 2, twigs of pear with eggs of this mite were received from Rep. John C. Bell, of Colorado. June 1, 1897, specimens were received from Mr. Paul Fischer, Utah Agricultural Experiment Station, Logan, Utah, with a statement that the mites were very destructive to apple, pear, and cherry trees in Utah. July 13, leaves of apple grown on the foothills of Yucaipa, Cal., were received from Mr. S. A. Pease, with the statement that the leaves and twigs had much the appearance of having been affected with mildew. August 4, leaves of plum injured by this mite were received from Mr. W. N. Cole, Salt Lake City, Utah. Mr. Cole stated that they also injured the leaves of apple. On the 31st a section of bark of pear covered with eggs of this mite was also received from Mr. Cole. September 11, a section of bark of apple or pear covered with the eggs of the mite was received from Mr. J. P. Sorensen, Salt Lake City, Utah. December 13, Mr. W. H. Owen, of Catawba Island, Ohio, sent twigs of peach infested with the eggs of this species. The writer also observed the eggs in great abundance upon the twigs of both peach and plum on Catawba Island at about this time or a little later.

March 5, 1898, apple twigs bearing the eggs of this species were received from W. McOrr, Fruitland, Ontario, Canada. April 13, 1898, twigs of *Prunus simonii*, with eggs of this mite attached, were received from Mr. U. G. Keeney, Queens Grove, Ind. May 20, 1898, a mite was received from Mr. Marcus J. Smith, Squaretop, Pa., together with the statement that it attacked radishes, lettuce, onions and small buckwheat, but appeared to be worse on small onions. November 16, 1898, the eggs of this mite were received on chestnut from Parry Bros., nurserymen, Parry, N. J. December 22, 1898, Dr. James Fletcher, Dominion Entomologist, Ottawa, Canada, transmitted specimens received from a Mr. Shepherd, Richmond, Kan., who stated that they appeared in myriads in November of that year and stayed throughout the winter until the following June.

January 13, 1899, eggs of this species were sent by Mr. H. C. Peck, Brighton, N. Y., on twigs of plum. Three days later the eggshells of this mite were received from California through Mr. M. D. Pierce, of the California Department of Vegetable Pathology. May 19, dead specimens of the mite were sent by Mr. W. Holden, Aurora, Ill., with the report that there were millions of them, and that they crawled into the house, covering the window casings and glass. June 28 of the same year specimens were received from Mr. J. E. Butler, Mesa, Ariz., on leaves of peach. September 8, twigs of pear with numerous eggs of this species were received from Mr. H. P. Olcott, Deming, N. M., with the complaint that the mites were destroying the fruit trees in that vicinity. They were at the time working on the Bartlett pear, apple, and yellow egg-plum. The pest had not previously been observed in that locality. October 5, pieces of bark of almond infested by eggs of this species were received from Mr. F. Austin, Escondido, Cal. December 27, a twig containing eggs of this insect was received from Mr. G. G. Atwood, Geneva, N. Y. January 23, 1900, mites which were evidently infesting a bed-chamber were received from Mr. G. H. Buffum, Denver, Colo. August 11, 1900, eggshells of this mite were received from Mr. C. B. Simpson, Weiser, Idaho, on a twig of pear. Under date of May 18, 1901, Prof. Fabian Garcia, Mesilla Park, N. M., sent twigs of apple, the leaves of which were blighted by this mite. June 7, 1901, specimens were received from Mr. Thomas J. Morrell, Ogunquit, Me., with the complaint that they were very destructive to plants and vines in that neighborhood. Under date of October 25, 1907, Mr. M. J. Ellis, of Wausau, Wis., forwarded a complaint to the Bureau that this mite attacked people while in bed—the only instance on record of this character. The house appeared to have been swarming with the mite. This occurrence was in April, 1906.

Mr. C. N. Ainslie, of the Bureau of Entomology, found swarms of these mites in Washington on the grounds of the United States Department of Agriculture and about the Washington Monument April 22, 1908. Mr. James A. Hyslop, also of this Bureau, found the mites excessively abundant on volunteer oats at Grant Road near Washington, D. C., April 17, 1909. The infested leaves were thickly dotted with white spots, which he attributed to the work of this mite. Mr. T. H. Parks, of this Bureau, found the mites excessively abundant in the alfalfa fields about Wellington, Kan., during April, 1910. He counted as many as fifteen mites on the top of one alfalfa leaf. Mr. E. O. G. Kelly, also of this Bureau, April 17, 1911, found that these mites caused slight injury to the leaves of alfalfa. The writer has known them to take possession of a newly erected farmhouse in Ohio during autumn.

These mites were also observed attacking blue grass at Nashville, Tenn., December 28, 1911, by Mr. G. G. Ainslie of the Bureau of Entomology.

Eriococcus borealis in Colorado. In Journ. Econ. Ent., Oct., 1910, p. 428, I recorded an undetermined *Eriococcus*, represented only by males, from Tolland, Colorado. Mr. E. Bethel has now sent me good females, which he collected at Tolland, October 7, 1911, on *Betula glandulosa*. The species proves to be *Eriococcus borealis* Ckll., as was expected. The following measurements, in microns, are from the Tolland specimens; Antennæ 7-jointed, joints (1.) 18, (2.) 40–45, (3) 53–55, (4) 53–60, (5) 20–28, (6) 18–23, (7) 33–40; hair at end of last joint 45; larger dermal spines 48; setæ of caudal lobes 125; labium 130 long and about 100 wide at base; hind leg with femur + trochanter 200 long, tibia 125, tarsus 130, width of femur 63.

On Aug. 23, 1911, I collected *Erium lichtensioides* Ckll., on *Artemisia tridentata* near Tolland at an altitude of about 9000 ft.; very high both for the coccid and the plant.—T. D. A. Cockerell, *Boulder, Colorado.*

GIPSY MOTH FROM JAPAN—A WARNING

By C. Gordon Hewitt, *Dominion Entomologist*

In a shipment of nursery stock, consisting of Thuya, Cherries, Maples, Clematis, etc,. imported into Canada from Japan by the Yokohama Nursery Company and inspected at Vancouver, where all Japanese stock is being inspected and fumigated in accordance with the requirements of The Destructive Insect and Pest Act (see Jour. Econ. Ent. Vol. IV., pp. 358–362), Mr. R. C. Treherne, our officer in charge, recently found eight egg clusters of the Japanese Gipsy Moth. One of these clusters was broken and the larvæ had hatched. Six of the remaining egg clusters were sent to the Division of Entomology, Ottawa, and on arrival it was found that several hundred of the larvæ had hatched *en route*. The infested shipment was, of course, burnt. Apart from the presence of Gipsy Moth, we find in our inspection work that nursery stock from Japan is exceptionally infested with Bagworms, Tortrix larvæ, Coccidæ, etc. It is important, therefore, that all those who have charge of the inspection of imports of nursery stock should pay special attention to shipments from Japan.

Ottawa, 24th April, 1912.

ENTOMOLOGISTS' EMPLOYMENT BUREAU

As stated in the last number of the Journal, pursuant to an action of the Association at the Minneapolis meeting, the above named Bureau was established. A word of explanation regarding this project may not be out of place at this time. The writer has consented to assume the direction of this work with some hesitation for one year only as an experiment, because there seemed to be no one ready at this date to shoulder the responsibility. As previously stated, the idea embodied in the project is to get institutions which need entomologists, in touch with entomologists seeking positions, without the latter being obliged, in the case of election, to pay large fees or percentages of the first year's salary to an agency. With that thought a fee of $4 has been established, to be deposited with the Bureau at the time of filing application, statement and qualifications, experience, references, and character of work desired. This money is to cover the expenses of book-keeping, filing, clerk hire, stationary, etc., and is not returnable in case of lack of success. No further dues of any kind are required, and the figure above quoted might be changed at any meeting of the Association if experience should show that it was desirable to do so.

The application of any candidate will be treated with the utmost confidence. A candidate, however, must bear in mind that the very fact of the Bureau's placing his name and qualifications before a would-be employer releases the fact of his seeking employment from the confidential records of the Bureau, and the possible employer who receives the information he seeks from the Bureau is not bound to observe the confidence of the applicant assumed and respected by the Bureau itself. Any suggestions upon this point, or along any lines connected with the work will be gladly received by the writer.

F. L. Washburn.

Scientific Notes

Queen Bees and Other Insects in the Mails—Postmaster General Hitchcock has amended Paragraph 7, Section 496, Postal Laws and Regulations, by substituting for the first clause thereof the following:

Queen bees and their attendant bees, when accompanied by a copy of a certificate of the current year from a State or Government apiary inspector to the effect that the apiary from which said queen bees are shipped is free from disease or by a copy of a statement by the bee-keeper made before a notary public or other officer having a seal that the honey used in making the candy used in the queen mailing cage has been diluted and boiled in a closed vessel.

The whole paragraph as amended reads as follows:

7. Queen bees and their attendant bees, when accompanied by a copy of a certificate of the current year from a State or Government apiary inspector to the effect that the apiary from which said queen bees are shipped is free from disease or by a copy of a statement by the bee-keeper made before a notary public or other officer having a seal that the honey used in making the candy used in the queen mailing cage has been diluted and boiled in a closed vessel; beneficial insects, when shipped by departments of entomology in agricultural colleges and persons holding official entomological positions; other live insects, when addressed to the Bureau of Entomology of the United States Department of Agriculture, to departments of entomology in State agricultural colleges, and to persons holding official entomological positions, and dried insects and dried reptiles, may be sent in the mails when so put up as to render it practically impossible that the package shall be broken in transit, or the persons handling the same be injured, or the mail bags or their contents soiled.

Anthrenus verbasci Linn. is, as is well known, a common museum pest capable of subsisting on a considerable variety of dry animal and vegetable substances. Three years ago* we recorded the continuous breeding of this insect during a period of seven years, dating from April 4, 1902, in a two quart Mason jar kept tightly closed and with no moisture aside from that in the somewhat dry corn it contained. The conditions are practically the same as those recorded three years ago, aside from the fact that there is more brown, honeycombed, sponge-like debris in the bottom of the jar. There yet remains much uneaten corn and the insects, if anything, are more abundant than three years ago. This record now covers a period of ten years and, judging from conditions at present obtaining, may easily continue for another decade or possibly longer. It is of interest, since it throws some light upon the possibilities of insects living for long periods under unfavorable conditions.

E. P. Felt.

*1909 Econ, Ent. Journ. 2:193.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

Attention is called to the announcement of the Entomologists' Employment Bureau on another page. This disinterested effort on the part of a few should be loyally supported by both employers and employees. Any such means for bringing the two together can not but react beneficially.

A second installation of the classified bibliography on insects and disease appears in this issue. The subject is of vital importance to the general welfare of the country, and such a compilation will greatly assist entomologists keeping in touch with progress along this line. Reference to the bibliograpny shows that there are still a number of problems worthy of study in cooperation with the medical fraternity, since without the assistance of the latter, material progress is impossible aside from general studies upon the biology and methods of controlling pathogenic forms.

A study of methods of illustration is not an unpromising subject. One need only to look over entomological bulletins and reports, or better still, recently published general works to see the great diversity obtaining. Photographs of various degrees of excellence and an even greater range of magnification appear here and there. The same is true of line and wash drawings, and, to a certain extent, of colored illustrations. These differences are greatly emphasized when inharmonious illustrations are assembled in some general work under conditions precluding the preparation of a large series of original figures. With many laboring under very diverse conditions, we must expect great differences. Is it not possible, through a recognition of certain fundamentals, to eliminate some of the more glaring inconsistencies? The degree of magnification has an important effect on appearances. No illustration should be larger than necessary to bring out important characters—mere size is not valuable in a figure, be it line, wash or colored. Nothing should be published unless some valuable feature is clearly shown. An illustration unintelligible without a legend to any one excepting possibly the artist and the author is of little service, yet such occasionally appears. The selection of method must depend in large measure on the subject, the ability of the artist, the paper to be used and local resources. A good line or wash drawing is better than a poor colored plate. American illustrations of recent years average much better than those of earlier days, though there is still room for improvement.

Reviews

J. R. Inda. **La conchuela del frijol** (*Epilachna corrupta* Muls.), Circl. 33, Estacion Agricola Central, 1910.

This circular deals with the most important insect enemy of beans in Mexico. On account of the extensive use of beans among the Mexicans the damage by this insect is of great importance. The species is said to occur in ten of the northern states of Mexico and undoubtedly is to be found in other districts in the republic. In addition to geographical distribution the circular discusses injury and methods of control. Principal stress is placed upon hand picking of the eggs and larvæ and the use of copper sulphate or kerosene emulsion.

G. Gándara. **Informe de la comision desempeñada por el Senor G. Gándara en Jamiltepec, Oaxaca, para combatir una plaga de gusanos en el algodon.** Bull. 43, Estacion Agricola Central, 1910.

This bulletin deals with a special trip undertaken by Professor Gándara to investigate damage by the cotton worm (*Alabama argillacea* Hbn.) in a locality in the state of Oaxaca about 200 miles south of Mexico City. The publication is of special interest because it gives the first information regarding the seasonal history of the cotton worm in any region south of the United States. In the portion of the state of Oaxaca where the observations were made the cotton is usually planted at the beginning of September. Generally damage by the worm is not noticed until October or November. In 1909, however, the insects appeared in September, although it was not until the 15th of November that the outbreak assumed serious proportions. With the use of Paris Green Professor Gándara checked the damage almost immediately.

A. Madariaga. **Estudio de una plaga de parasitos en las gallinas de la estacion agricola central.** Circl. 26, Estacion Agricola Central, 1910.

This circular deals with an outbreak of fowl parasites at the Central Experiment Station near Mexico City. The principal species concerned was *Dermanyssus gallinæ*. Two Mallophagids, *Goniodes hologaster* and *Menopon biseratum* were found in much smaller numbers. A number of experiments were performed with kerosene emulsion, turpentine, pyrethrum and other substances without very satisfactory results. It was found, however, that a kerosene emulsion with turpentine added was much more effective than anything tried. This mixture is recommended for use against the mites. For the Mallophagids the fumigation of the fowls with sulphur in special cages through the tops of which the heads are allowed to protrude is advised.

G. Gándara. **La plaga de las garrapatas y medios para combatirla.** Circl. 22, Estacion Agricola Central, 1910.

This circular deals with the cattle tick which occurs throughout Mexico and causes enormous losses. Dipping vats are described in detail and an outline is given of a method of pasture rotation which is practicable under Mexican conditions.

L. de la Barreda. **Doryphora de la patata.** Bull. Estacion Agricola Experimental de Rioverde, San Louis Potosi, 1910.

This bulletin deals with observations and experiments on *Leptinotarsa decemlineata* made on plots of potatoes growing on the grounds of the experiment station at Rioverde. The writer sets forth in a skillful manner considerable elementary information regarding the life history of the insect, with the intent of interesting the readers in observations on injurious insects of various kinds. After a discussion of historical and biological matters, the bulletin proceeds to an account of experiments made with Paris green which destroyed the beetles although the plants succumbed later to the attacks of fungus enemies.

R. Ramirez. **Mosquitas de la fruta.** Circl. Estacion Agricola Central, 1909.

This leaflet deals with several species of Drosophila which appear to follow rather than to cause injury to fruits of various kinds. The colored plate which accompanies this circular is evidently incorrect in showing some Coleopterous larva as the larva of Drosophila.

Guillermo Gándara. **Enfermedades y Plagas del Naranjo.** Boletin No. 31, Estacion Agricola Central, 1910.

Professor Gándara presents a comprehensive treatment of the diseases and insect enemies of the orange in Mexico. The bulletin covers 51 pages and is accompanied by 60 illustrations, many of which are colored plates. Among the insects 32 species are discussed of which 16 are coccids. The list includes in addition one Aleurodid, one Aphid, three Hemipterons, one Dipteron, one Lepidopteron, two ants, five Coleopterons and one Acarid.

Of most interest to American entomologists is the discussion of *Trypeda ludens*. The pest is said to be restricted to the state of Yautepec and other localities in the "tierra caliente." Reference is made to the former absolute quarantine against Mexican oranges in the state of California and the statement is made that the interdiction was found to be entirely unnecessary because of the biological impossibility that the insect would be able to develop in that state.

Julio Riquelme Inda. **El Gusano de los Sauces.** (*Clisiocampa azteca* Neum). Boletin No. 63, Estacion Agricola Central, 1911.

This bulletin deals with a local pest (*Clisiocampa azteca* Neum) of the weeping willow. In the vicinity of Mexico City this insect frequently defoliates the willows during the months of March and April. In addition to the injury to these important shade trees, the species is a pest on account of the numerous urticating hairs which it bears. The bulletin discusses geographical distribution, amount of injury and methods of control. It is accompanied by four plates.

E. Lopez Vallejo. **Estro del Carnero.** Boletin No. 21, Estacion Agricola Central, 1909.

This bulletin deals with *Oestrus ovis* which is said to be very abundant throughout the republic of Mexico. In Mexico City it appears that the majority of the sheep and goats which are slaughtered are infested with this parasite. Considerable information regarding life history and development is given and preventive and direct measures of control are discussed.

Francisco Lopez Vallejo. **Algunas Enfermedades del Ganado Ovino.** Boletin No. 49, Estacion Agricola Central, 1910.

The author discusses the diseases of sheep in general but a large portion of the bulletin is devoted to the insect and Acarid parasites of these animals. The species included are *Sarcoptes scabei; Psoroptes communis, Trichodectes* sp. and *Melophagus ovinus.* Appropriate methods of treatment are given in the discussion of each species.

W. D. Hunter.

Butterfly-Hunting in Many Lands, Notes of a Field Naturalist, by George B. Longstaff. Longmans, Green, & Co., 1912, pp. XVIII—724,, 16 plates (7 colored)

The author has given us in this bulky volume, a narrative account of his experiences in collecting insects in widely separated countries, such as Asia, South Africa, Canada, India, Australia and New Zealand. The work is enlivened by incidental and more or less irrelevant notes relating to achievements or experiences, such as climbing a volcano and the results of an earthquake. Nearly 500 pages are devoted to this form of record, the butterflies hardly receiving more attention than the moths, and there being in addition, observations on numerous other insects belonging to various orders. The time spent in each country was necessarily limited and the lists of species are of little value so far as indicating geographical distribution.

The more important observations on habits, ets., are discussed in a chapter on bionomics, which gives considerable data on scents, color, juices, tenacity of life, mutilation, experiments on palatability, mimicry, etc. An appendix gives translations of twelve papers by Fritz Muller, dealing with the scent organs of butterflies and largely inaccessible to naturalists, since they were published in the Archivos do Museu Nacional do Rio de Janeiro or other nearly as inaccessible journals. The plates are excellent and the value of the work materially enhanced by a comprehensive index. This volume will appeal mostly to general collectors and students of bionomics.

The More Important Insects and Fungous Enemies of the Fruit and Foliage of the Apple, by A. L. Quaintance and W. M. Scott. U. S. Department of Agriculture, Farmers Bulletin 492, p. 1–48, 1912.

This popular bulletin gives summary accounts of a number of the more important insects, such as the codling moth, plum curculio, canker worms, and of such diseases as apple scab, bitter rot, apple blotch and cedar rust. There are a few brief remarks on the possibility of controlling San Jose scale by the use of dilute lime-sulfur washes, otherwise this insect is ignored, and the reason is probably due to this pest being considered mostly as an enemy of the branches rather than of fruit and foliage. We fear many fruit growers will be slightly misled by the title.

The country is a large one and it is extremely difficult to make general recommendations which apply equally well to all sections. This is apparent in the somewhat elaborate schedule of spray applications at the outset, admittedly very elastic, which, nevertheless, recommends some six sprayings in all and gives little indication that in some sections of the country fewer treatments would be nearly, if not quite as effective. Among other things, we find one spray advised "eight to nine weeks after the petals fall (about June 25–30)." The dates are probably those of latitude 38° or 39° and four weeks early for latitude 43°, comprising some important fruit growing sections. Dates, if given, should certainly be inclusive for typical regions. Might it not be well to admit that in some important fruit sections serious injury by apple scab and early leaf feeders, such as the plum curculio, canker worms, bud moth, case-bearers and tent caterpillars is extremely unlikely if the trees are sprayed annually for the codling moth? We fear that in some instances entomologists have recommended more spraying than fruit growers find of value when subjected to the practical test of experience.

Current Notes

Conducted by the Associate Editor

Mr. John A. Grossbeck has given to the American Museum of Natural History his entire collection of Geometridæ, in addition to the series previously donated.

Mr. T. H. Jones, of the Bureau of Entomology, has been appointed assistant entomologist of the Porto Rico Sugar Planters' Experiment Station at Rio Piedras.

W. P. Fraser has been appointed lecturer, and P. I. Bryce assistant, in biology at MacDonald College, St. Anne de Bellevue, Montreal, P. Q.

According to the *Experiment Station Record*, the new entomology building of the New Jersey Station and College has been completed and the equipment of the department installed therein.

Dr. William C. Gorgas, chief sanitary officer of the Panama Canal Zone, will be the speaker at the annual Commencement exercises at Johns Hopkins University, June 11th.

An honorary degree in medicine was conferred upon Sir Ronald Ross on the occasion of the celebration of the seventy-fifth anniversary of the founding of the University of Athens, April 10th.

Professors William M. Wheeler and Roland Thaxter, both professors at Harvard University and members of this association, were elected members of the National Academy of Sciences, at a meeting held in Washington April 18th.

Professor Philip P. Calvert, Dr. Henry Skinner and Dr. W. J. Holland have been appointed delegates from the Academy of Natural Sciences of Philadelphia to the Second International Congress of Entomology, Oxford, England, August 5–10.

Professor Thomas H. Montgomery, Jr., professor of Zoology in the University of Pennsylvania, a prominent investigator, and the author of a number of papers on spiders and insects, died on March 19th of penumonia, at the age of thirty-nine years.

The state mosquito extermination work at the New Jersey Agricultural Experiment Station has been placed in charge of Mr, Herman H. Brehme, who has been appointed acting executive officer. Mr. Brehme was for several years assistant to the late Professor John B. Smith, and was engaged in this kind of work.

According to *Science*, Mr. C. W. Leng has placed "his valuable collection of 'long-horned' beetles (Cerambycidæ) at the disposal of the American Museum of Natural History for use in filling gaps in its collections. This means a gift of some 870 specimens covering nearly 300 species not hitherto acquired."

Professor W. M. Scott, formerly State Entomologist of Georgia, and recently pathologist of the Bureau of Plant Industry of the U. S. Department of Agriculture, a member of this Association, will now take charge of a newly established department of the Thomsen Chemical Company. Baltimore, Md. Professor Scott will be engaged in research and special service in connection with the insects and fungous diseases of fruits and truck crops.

Mr. William Beutenmuller, for many years Curator of Entomology, at the American Museum of Natural History, New York City, is no longer connected with the Museum. Mr. Beutenmuller is soon to start on an extensive collecting trip in the mountains of North Carolina. Any one desiring material from that locality should communicate with him at his residence, 879 Whitlock Avenue, Bronx, New York City.

The following have been appointed delegates to represent the Entomological Society of America at the Second International Congress of Entomology to be held at Oxford, England, August 5–10, 1912: Prof. J. H. Comstock, Cornell University, Ithaca, N. Y.; Dr. Henry Skinner, Academy of Natural Sciences, Philadelphia; Dr. P. P. Calvert, University of Pennsylvania, Philadelphia, Pa.; Prof. Herbert Osborn, Ohio State University, Columbus, Ohio; Prof. V. L. Kellogg, Leland Stanford Jr. University, Palo Alto, Cal.; Dr. W. J .Holland, Carnegie Museum, Pittsburg, Pa.

Professor F. M. Webster, in charge of cereal and forage insect investigations of the Bureau of Entomology, Washington, D. C., represented the Entomological Society of Ontario, of which he is a corresponding member, at the celebration of the Centenary of the Foundation of the Academy of Natural Sciences, Philadelphia.

The following ordinance for the purpose of controlling the house fly nuisance has been enacted by the Board of Aldermen of New Haven, Conn: "Section 343 of the Ordinances of the City of New Haven is hereby amended by adding at the end thereof the following: No person shall place, leave, or suffer to remain upon any premises in said city any stable manure (except for fertilizing purposes) or refuse matter in which flies may breed, unless the same is enclosed in a tight box, pit or other receptacle which shall be kept closely covered so as to exclude all flies at all times except when said manure or refuse matter is being placed therein or removed therefrom. During the months of May, June, July, August, September, October and November it shall be unlawful for any person to allow said stable manure or refuse matter to remain unremoved for a period of over seven days. The foregoing is a true and correct copy of record and said ordinance will become operative and in effect April 26, 1912."

According to *Science*, the names of Dr. A. Agramonte and Dr. C. J. Finlay have been presented to the Nobel Prize Commission by the Academy of Science, the medical faculty of the University of Havana, and several other scientific societies and institutions, as candidates for the prize to be awarded in 1912. A resolution recommending their names states that Doctor Finlay was the first to claim that yellow fever is transmitted by the bites of mosquitoes, and Doctor Agramonte is the only remaining member of the United States Army Board, consisting of Doctors Reed, Lazear, Carroll, and Agramonte, which investigated and finally demonstrated the correctness of this theory.

At Cornell University, G. W. Herrick and W. A. Riley were recently promoted to the rank of full professors, and Robert Matheson and George C. Embody were promoted from instructors to assistant professors in the department of entomology.

Mr. E. L. Jenne, Entomological Assistant engaged in Deciduous Fruit-Insect Investigations, Bureau of Entomology, U. S. Department of Agriculture, died at Walnut Creek, Cal., May 10th, 1912, at the age of twenty-seven years. Mr. Jenne was known by his work on the codling moth, and his more recent studies on the plum Curculio will soon be published. He graduated from Washington State College and from Cornell University.

The total appropriations for the Bureau of Entomology, as recommended by the Senate Committee on Agriculture and Forestry, for the Fiscal year beginning July 1, 1912, amounts to $691,840, allotted as follows:

Salaries	$58,750.00
Deciduous Fruit Insects	40,600.00
Cereal and Forage Insects (including the alfalfa weevil)	85,000.00
Southern Field Crop Insects	47,160.00
Forest Insects	44,750.00
Truck Crop and Stored Product insects (including sugar beet insects)	39,500.00
Bee Culture	15,000.00
Citrus Fruit Insects (including the white fly)	21,500.00
Investigation of the Mediterranean Fly (immediately available)	35,000.00
Miscellaneous Insects	19,740.00
Preventing Spread of Moths	284,840.00
Total	$691,840.00

The Committee has recommended an increase of $15,000 for the investigation of insects affecting truck crops and stored products, including sugar beets, under the direction of Dr. F. H. Chittenden, and an increase of $35,000 (of which sum $10,000 is to be immediately available) for the investigation of insects affecting cereal and forage plants, including the alfalfa weevil. This work comes under the supervision of Prof. F. M. Webster, in charge of Cereal and Forage Insect investigations.

William H. Patterson, Agricultural School, Imperial Department of Agriculture, St. Vincent, W. I., we are advised, has accepted the post of Government Entomologist to the Gold Coast Colony, West Africa. He will spend three months in England prior to commencing work in the new field.

Science mentions an article printed in *London Times* regarding the experiments of the Liverpool School of Tropical Medicine, containing the report of the Luangwa Sleeping Sickness Commission. Human trypanosomes were found in the blood of game animals, and these are transmitted by a fly, *Glossina morsitans* Westw., approximately five per cent of the flies becoming permanently infected and capable of transmitting the infection. An infected fly retains the power of transmitting the infection during its life. Certain species of buck, viz., waterbuck, hartebeest, mpala, warthog, and a native dog were found to be infected with human trypanosomes.

Mailed June 1 , 1912.

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

A bi-monthly journal, published February to December, on the 15th of the month, devoted to the interests of Economic Entomology and publishing the official notices and proceedings of the American Association of Economic Entomologists. Address business communications to the Journal of Economic Entomology, Railroad Square, Concord, N. H.

TERMS OF SUBSCRIPTION. In the United States, Cuba, Mexico and Canada, two dollars annually in advance. To foreign countries, two dollars and fifty cents ($2.50) annually in advance. Single copies, fifty cents. To members of the American Association of Economic Entomologists, one dollar annually in advance. 50 cents extra postage to foreign countries.

MANUSCRIPT for publication should be sent to the Editor, E. Porter Felt, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. Burgess, Melrose Highlands, Mass.

Vol. 5 AUGUST, 1912 No. 4

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Published by
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
Concord, N. H.

Entered as second-class matter Mar. 3, 1908, at the post-office at Concord, N. H.,
under Act of Congress of Mar. 3, 1879.

CONTENTS

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Vol. 5 AUGUST, 1912 No. 4

THE POSSIBLE ETIOLOGICAL RELATION OF CERTAIN BITING INSECTS TO THE SPREAD OF INFANTILE PARALYSIS[1]

By Charles T. Brues, *Bussey Institution, Harvard University*, and Philip A. E. Sheppard, M. D., *Special Medical Investigator for the Mass. State Board of Health, Boston, Mass.*

Nothing has as yet been definitely shown regarding the channels of infection in acute epidemic poliomyelitis (infantile paralysis), though much has been encountered of a suggestive nature in our earlier Massachusetts studies.[2]

Owing to the frequent histories of insect bites of various kinds, it

[1] A Report to the Massachusetts State Board of Health, October, 1911, briefly abstracted in the Monthly Bulletin of the Board for December, 1911, p. 338–340 (1912).

[2] Lovett, R. W. The Occurrence of Infantile Paralysis in Mass. in 1907. Boston Med. & Surg. Journ., July 30, 1908.

Lovett, R. W. The Occurrence of Infantile Paralysis in Mass. in 1908. Boston Med. & Surg. Journ., July 22, 1909. Reprint in Monthly Bulletin of the Mass. State Board of Health, July, 1909.

Emerson, H. C. An epidemic of Infantile Paralysis in Western Mass. in 1908. *Ibid.* l. c. Reprint *Ibid.* l. c.

Lovett, R. W. The Occurrence of Infantile Paralysis in Mass. in 1909. Boston Med. & Surg. Journ., July 14, 1910. Reprint in Monthly Bulletin of the Mass. State Board of Health, June, 1910.

Lovett, R. W. and P. A. E. Sheppard. The Occurrence of Infantile Paralysis in Mass. in 1910. Boston Med. & Surg. Journ., May 25, 1911. Reprint in Monthly Bull. Mass. State Board of Health, May, 1911.

Rosenau, M. J., P. A. E. Sheppard, and H. L. Amoss. Anterior Poliomyelitis: Attempts to Transmit the Disease to Monkeys by Inoculation with the Nasal, Pharyngeal and Buccal Secretions of Eighteen Human Cases. Boston Med. & Surg. Journ., May 25, 1911. Reprint in Monthly Bull. Mass. State Board of Health, May, 1911.

Sheppard, P. A. E. Acute Epidemic Poliomyelitis (Infantile Paralysis); A Study of the Epidemic in Springfield, Mass., in 1910. Infantile Paralysis in Mass. during 1910, pp. 95–140. (Boston, 1912.)

Hammond, J. W. Jr., and P. A. E. Sheppard. An Investigation of the Blood in Cases of Acute Epidemic Poliomyelitis (Infantile Paralysis). Infantile Paralysis in Mass. during 1910, pp. 141–144. (Boston, 1912.)

was deemed advisable that the entomological part of the field work should be thoroughly investigated.

The writers, together, during the months of August, September and October of 1911, visited the Massachusetts cities and towns named hereunder, undertaking a careful and intensive study of the insect life and history in the environment of cases. With very few exceptions all the cases in the various towns were located either in dirty, unsanitary parts of the town, or were characteristically rural.

CITIES AND TOWNS VISITED

Date of 1st Visit	Towns	No. of Cases
July 30	Waltham	2
Aug. 13	Tewksbury	6
Aug. 15	Winthrop	3
Aug. 17	Woburn	14
Aug. 24	Somerville	10
Aug. 26	Newton	4
Aug. 30	Winchester	2
Aug. 31	Pocasset	2
Sept. 6	Hamilton	1
Sept. 6	Marblehead	1
Sept. 7	Marlboro	6
Sept. 16	Lowell	14
Sept. 16	Westford	1
Sept. 20	Roxbury	4
Sept. 25	Winchendon	1
Sept. 26	Fall River	13
Sept. 26	New Bedford	4

In attempting to discover and elucidate any connection between insects and the spread of acute epidemic poliomyelitis, there are a number of facts, which must be considered. Much that has already been learned from clinical and epidemiological investigations can be turned to account, not only to reduce the number of insects which might be suspected of transmitting this disease, but to also suggest certain *a priori* conclusions to be tested out, both in the field and by experimentation.

Perhaps it may be as well to outline briefly the data which suggest insects as carriers, as well as to enumerate such facts as appear significant from an entomological standpoint.

1. The sporadic occurrence of the cases; this is not easily explained on the basis of ordinary contact infection, at least in many instances.

2. The seasonal distribution of the disease which shows the largest incidence during the warmer months, when insects of all sorts are most prevalent.

3. The failure on the part of many investigators to ascertain that the disease spreads where a number of children are regularly in close contact, as it seems, from reports so far published, to be the exception rather than the rule for several in a family to contract the disease.

4. The characteristic rural nature of the disease, which is apparently always less prevalent in large cities where the proportion of insects to the human population is less than it is in more sparsely settled or in rural districts.

5. The fact that in towns in Massachusetts, where the disease has been most prevalent, the proportion of animals to the population is greater than in cities, where the disease is less prevalent. This in itself implies a larger number of biting and parasitic insects which affect man as well as the animals.

Total number of animals assessed in twenty-five cities and towns where the disease was *least* prevalent, *i. e.*, in the larger cities and towns.		Total number of animals assessed in the twenty-five cities and towns where the disease was *most* prevalent, *i. e.*, in the smaller cities and towns.	
Total population	943,614	Total population	142,639
Total number of cows	11,160	Total number of cows	12,801
1 cow to 84.5 inhabitants		1 cow to 11 inhabitants	
Total number of horses	29,519	Total number of horses	10,352
1 horse to 32 inhabitants		1 horse to 14 inhabitants	
Total number of swine	3,288	Total number of swine	2,374
1 swine to 287 inhabitants		1 swine to 60.5 inhabitants	
Total number of fowls	41,887	Total number of fowls	79,797
1 fowl to 22.5 inhabitants		1 fowl to 1.75 inhabitants	
Total number of dogs	23,854	Total number of dogs	5,865
1 dog to 39.5 inhabitants		1 dog to 24.3 inhabitants	

These facts seem to point very strongly to an insect-borne disease.

Other facts which bear out the supposition that the disease might be insect-borne are added, although they do not appear to be less easily explained in other ways, at least when considered separately. These are:

1. The greater incidence of the disease among children, which are more apt to be bitten by insects than are adults under ordinary conditions.

2. The apparent biennial recurrence in the incidence of the disease in localities where it has been epidemic. This, as will be seen from considerations presented later in the report, would seem to imply a secondary connection with ticks, if there be any foundation in the belief that there is a relationship between animal and human paralyses.

In addition to these data, there is a negative evidence afforded by the failure of investigators satisfactorily to account for the spread of anterior poliomyelitis through the other channels of infection that are concerned in the dissemination of most infectious diseases in temperate regions.

It is apparent, therefore, that an investigation of the insect fauna associated with cases of the disease seemed advisable, with a view

TABLE I.

LIST OF THE BETTER KNOWN INSECT-BORNE DISEASES WITH THEIR CARRIERS.[1]

GROUP A. CHARACTERISTICALLY INSECT-BORNE

Disease	Animal affected	Principal distribution	Carrier[2]	Group to which carrier belongs	Other ordinary sources of infection	Pathogenic organism
Rocky Mountain spotted fever	Man	Western United States	*Dermacentor venustus*	*Acarina*	None	
African tick fever	Man	South Africa	*Ornithodoros moubata*, *O. savignyi*	*Acarina*	None	*Spirochata duttoni.*
Typhus fever	Man	Cosmopolitan	*Pediculus vestimenti*	*Hemiptera*	None(?)	
Sleeping sickness	Man	Equatorial Africa	*Glossina palpalis*	*Diptera*	None	*Trypanosoma gambiense*
Yellow fever	Man	American and African tropics	*Aedes calopus*	*Diptera*	None	*A spirochate ?*
Malarial fever	Man	Tropicopolitan	*Anopheles* spp. (*sens. lat.*)	*Diptera*	None	*Plasmodium* spp.
Filariasis	Man	Tropicopolitan	*Culex fatigans et al*	*Diptera*	None(?)	*Filaria* spp.
Dengue	Man	Tropocopolitan	*Culex fatigans*(?)	*Diptera*		*A spirochate ?*
Phlebotomus fever	Man	Tropicopolitan	*Phlebotomus papatasii et al.*	*Diptera*	(?)	
Barbiero fever	Man	South America	*Conorhinus megistus*	*Hemiptera*	None	*Schizotrypanum cruzi*
Leishmaniosis	Man	Eastern tropics	*Cimex rotundatus*, *Cimex lectularius*	*Hemiptera*	None(?)	*Leishmania donovani*
Bubonic plague	Man, rat, ground squirrel	Nearly cosmopolitan	*Lœmopsylla cheopus*	*Siphonaptera*	Probably other fleas and biting insects	*Bacillus pestis*
Surra	Horse	Asia, Africa	*Tabanus*, *Stomoxys*, *Hæmatobia*	*Diptera*	Probably other insects	*Trypanosoma evansi*
Nagana	Domestic animals	Central and Southern Africa	*Glossina* spp., *G. palpalis*	*Diptera*	None	*Trypanosoma brucci*
Filariasis	Various animals	Tropicopolitan	*Culex* spp.	*Diptera*	None(?)	*Filaria* spp.
Texas fever	Cattle	Southern U. S., S. Africa	*Margaropus annulatus*	*Acarina*	None	*Piroplasma bigeminum*
East Coast fever	Cattle	South Africa	*Rhipicephalus appendiculatus et al.*	*Acarina*	None	*Piroplasma parvum*
Equine piroplasmosis	Horse	Eastern tropics	*Rhipicephalus evertsi*	*Acarina*	(?)	*Piroplasma equi*
Spirochætosis	Fowls	Tropicopolitan	*Argas miniatus*	*Acarina*	(?)	*Spirochate gallinarum*

GROUP B. OFTEN INSECT-BORNE.

Typhoid fever	Man	Cosmopolitan	Usually house fly (*Musca domestica*[3]	*Diptera*	Infected foods, water, etc.	*Bacillus typhosus*
Cholera	Man	Cosmopolitan	*Musca domestica*[3]	*Diptera*	Infected foods, water, etc.	*Vibrio choleræ*
Dysentery	Man	Cosmopolitan	*Musca domestica*[3]	*Diptera*	Infected foods, water, etc.	
Diarrhæ	Man	Cosmopolitan	*Musca domestica*[3]	*Diptera*	Infected foods, water, etc.	Several bacteria
Tuberculosis	Man	Cosmopolitan	*Musca domestica*[3]	*Diptera*	Infected food, dust, etc.	*Bacillus tuberculosis*
Septicæmia	Man, animals	Cosmopolitan	Bugs. Various predaceous and carrion-feeding insects	*Hemiptera*, *Coleoptera*, etc.	Contact through lesions	

GROUP C. POSSIBLY INSECT-BORNE

Anthrax	Man, sheep, cattle, etc.	Widespread	Biting flies(?)	*Diptera*	Contact through lesions	*Bacillus anthracis*
Rabies	Man, dog, and other domestic animals	Cosmopolitan	Biting insects(?)		Contact through lesions	*A Rhizopod Protozoan*(?)
Pellagra	Man	Europe and North America	*Simulium* spp.(?)	*Diptera*	Ingestion of mouldy corn	*Aspergillus fumigatus*(?)
Filariasis	Man		Mosquito; tick	*Diptera*, *Acarina*	(?)	*Filaria perstans*
Hookworm	Man	Europe and North America	*Musca domestica*	*Diptera*	Enter skin from infected soil	*Anchylostoma duodenale*, *Necator americanus*
Blackwater fever	Man	Tropicopolitan	Ticks(?)	*Acarina*	(?)	
Relapsing fever	Man	Africa	Tick(?)	*Acarina*	(?)	*Spirochæta recurrentis et spp. al.*
Beriberi	Man		*Pediculus capitis*(?)	*Hemiptera*	(?)	
Infantile Kala-azar	Man	India	(?)	(?)	(?)	*Leishmania infantum*
Bovine gall sickness	Cattle		Ticks(?)	*Acarina*(?)	(?)	*Anaplasma marginale*
Equine infectious anemia	Horse	Europe, North America	*Stomoxys*(?)	*Diptera*	(?)	(?)
Heartwater	Sheep		*Amblyomma hebræum*	*Acarina*	(?)	
Malignant jaundice	Dog		*Hæmaphysalis leachi*	*Acarina*	(?)	*Piroplasma canis*

[1] In addition to the diseases listed, there are a considerable number of others which are not so well known, or which affect animals of less economic importance. It is believed, however, that no group of insects which has been associated with the transmission of disease has been omitted. As a matter of fact, almost every group of insects which by their life history and habits are suited to transmit infection, have been connected with the spread of some disease.

[2] In the case of some widespread diseases, other species related to the one cited are evidently implicated.

[3] More rarely other species of *Musca*, such as *M. cutæniata*, and other muscid flies are also concerned.

toward eliminating as many species of insects as possible, and at the same time ascertaining if any might seem of sufficient importance to warrant more detailed field work and experimental tests in the laboratory. In entering upon such an investigation one is naturally led to pass in review such insects or groups of insects as have been proved to be factors in the transmission of other diseases. So far as our present definite knowledge extends, the accompanying tabulation is submitted. (See Table 1.)

From Table 1 it will be seen that the following groups of insects have been implicated in the transmission of diseases among man and domestic animals, including also ticks, which are, of course, not true insects, but, owing to their similar habits and other characteristics, are usually dealt with by entomologists: Acarina, Hemiptera, Coleoptera, Diptera, Siphonaptera.

Of these, only the Acarina (ticks), Hemiptera (true bugs) and Diptera (mosquitoes, flies) are known to include specific carriers, that is to say, insects upon which the pathogenic organisms are parasitic, and the presence of which is necessary for the organisms to complete their life cycle before they can again normally reënter their mammalian hosts. The members of the other groups, as well as a number of those belonging to the Diptera, are known to transmit some diseases casually or accidentally, simply by carrying the bacteria upon their bodies, feet or mouth-parts. Their relation is simply that of moving objects to which the bacteria may adhere, but they are nevertheless very commonly mechanical carriers for certain diseases, the organisms of which occur often in materials that they frequent. Most important among these is the common housefly, which is eminently suited to play a part in such transmission as it regularly feeds upon both food and fecal matter.

While it cannot be so stated definitely, it seems probable that practically all insect-borne diseases will be found to depend for their spread upon insects belonging to the groups enumerated in Table 1. These various groups exhibit much in common in their mode of life and a comparison of such facts, with what has been learned concerning the spread of anterior poliomyelitis, serves to eliminate many insects which by reason of their mode of life cannot be suspected as carriers. Still following the assumption that the disease is insect-borne it is thus possible to curtail greatly the list of insects which would seem to require investigation.

Among the Hemiptera, the groups so far shown to contain species acting as disease carriers, all include either wingless insects (lice, bedbugs, etc.), or else large bugs of rather rare occurrence in our region, which are characterized by such painful bites (Reduviid bugs, kissing-bugs, etc.) that their presence could hardly be overlooked. The sporadic occurrence of the disease and its failure to spread mainly in infected houses, serves to eliminate the wingless species, and the failure generally to find a history of painful insect bites, shows that Reduviid bugs cannot be to blame.

The Coleoptera do not ordinarily frequent substances which contain bacteria and it is only in rare instances that they can cause infection by biting, and it is very unlikely that any species will ever prove to be specific carriers of any human disease.

The Diptera include the largest number, and far and away the most widespread and important disease carriers among insects. These group themselves from an entomological standpoint into several series.

Mosquitoes. These insects serve as specific carriers of such diseases as yellow fever, malaria and filariasis, and might readily be suspected in the present connection, since numerous species are common in all regions where acute epidemic poliomyelitis occurs. Malarial fevers and yellow fever occur normally in epidemic form, each associated with the presence of the particular species of mosquito which is necessary to the completion of the life cycle of the pathogenic organism. The mosquito obtains it from the blood of one patient, and later injects it into another person, after the life cycle has been completed within the body of the mosquito. The malarial organism is a well-known protozoan and its development within the body of its insect host is quite familiar, but the organism of yellow fever, is a filterable virus concerning which we know nothing definitely, except that a twelve-day incubation period is required in the mosquito before its bite becomes infectious to a second person. It will be noticed that this organism resembles the virus of anterior poliomyelitis in being filterable.

There are several facts associated with mosquito-borne diseases which are at great variance with some observed in studies of poliomyelitis. In the first place, yellow fever and malaria spread rapidly in infected districts and quickly involve a large percentage of the population unless rationally controlled, and this is to be expected from the universal abundance of the insect hosts and the great opportunities of infection enjoyed by them in the presence of a human case of the disease. Such is not true of poliomyelitis, for although this becomes truly epidemic, it is never disseminated so thoroughly and rapidly throughout a community. In the second place, adults are fully as apt to be bitten by mosquitoes as are children, yet poliomyelitis has been considered essentially a disease of childhood and young adult life. (This assumes equal susceptibility to infection at all ages, which may, of course, not be the case; at the present time we have no means of knowing.) And thirdly, while the abundance of mosquitoes agrees to some extent with the distribution of the disease, the two are not so closely correlated as would be expected were mosquitoes the carriers of the infection. This will be more fully dealt with on a following page.

It would appear, therefore, that while the mosquito cannot be entirely ignored as a possible carrier of acute poliomyelitis, it is not open to great suspicion. Nevertheless, mosquitoes should be carefully collected during an entire season and continually kept in mind as a possible, but not probable, source of infection.

Another important group of Diptera concerned in the transmission of disease are various biting muscid flies commonly known as "tsetse flies." These belong to a single genus *Glossina*, and, as is well known, are the carriers of sleeping sickness in man and various trypanosome diseases among domestic animals. They are the specific alternate hosts of the various trypanosomata and thus, so far as we know, absolutely necessary to the spread of such diseases. These flies are not native to America, but there is one common biting muscid, the stable fly, *Stomoxys calcitrans* L., common to Europe and America, which is very closely related to the tsetse flies, both in structure and habits. It has been quite definitely associated with the spread of surra and may reasonably be suspected of transmitting any disease represented by organisms in the blood. As is mentioned later in this article, this fly has been found in the environs of practically every case of anterior poliomyelitis examined with this in view, and may quite possibly prove to be the insect responsible for its spread. So far as can be ascertained at the present time, the comparative abundance of this fly during the summer months coincides closely with the incidence of poliomyelitis, as the fly appears in small numbers early in the summer, and persists in increasing numbers until quite settled cold weather in the fall. Such a seasonal fluctuation has been observed in the disease, which appears in early summer, increases toward the early fall and then practically disappears during the late fall, winter, and very early spring. Such increase during the course of the season is not common to all insects, but is characteristic of such as have a short life cycle, permitting a number of consecutive broods to mature each season. It is, of course, also common to mosquitoes, house flies, etc., although less strikingly so in the case of mosquitoes. There is some discrepancy in the autumnal disappearance of the flies and the disease, as the latter appears regularly to drop off a little sooner than might be expected. This seems easily explainable, however, on the basis of a lessened activity on the part of flies in cool weather, and the shorter time spent outdoors by the children for the same reason, and because many are in school during a great part of the day soon after the first of September. It seems to us, therefore, that the fact cannot be ignored that the greatest seasonal expression of acute epidemic poliomyelitis agrees strikingly with the greatest growth of *Stomoxys* and the school vacation period when children of all ages live a comparatively out-of-door life in parks, in bathing, etc. There is one habit of *Stomoxys* which should receive consideration also. In feeding, it very regularly passes from animal to animal during a single feeding and the opportunities for it to transmit micro-organisms in a mechanical way upon its mouth-parts are thus greatly increased.

It thus appears impossible upon *a priori* grounds to rule out *Stomoxys* and a final decision must await the results of experiments now in progress in which an attempt is being made to transmit the disease among monkeys by means of *Stomoxys.*

It is interesting to note in connection with the above remarks on *Stomoxys,* that it may quite possibly be associated with the spread of equine infectious anemia. The initial attack of this disease usually occurs in July, August and September and no causal relation appears to exist between its incidence and such ordinary sources of infection as food, water or contact. It is a blood disease, not infectious through ingestion of the virus into the alimentary tract, but readily communicable by intravenous inoculation. Such conditions immediately suggest *Stomoxys,* or possibly, but less probably, *Hæmatobia,* or *Tabanus,* as carriers, especially since experiments with *Margaropus annulatus,* the carrier of Texas Fever, have given negative results.

Belonging to another closely related family, the Anthomyidæ, is a much smaller insect known as the horn-fly (*Hæmatobia serrata*) which exhibits biting propensities similar to those of the stable fly, but confines its blood-sucking almost exclusively to domestic animals. On this account it is almost entirely restricted to barnyards and pastures or more rarely to stables where the adults attack the animals and gorge themselves with blood. In visiting cases of anterior poliomyelitis during the summer of 1911 we have looked for this fly, but found it in the neighborhood in only a very few instances. This fact, coupled with its rare occurrence upon man, renders its association with poliomyelitis very unlikely.

There remain several other groups of biting Diptera; one of them, the horse flies (Tabanidæ) have been associated with several diseases of domestic animals. None are known to be specific carriers, but on account of their blood-sucking habits may carry the virus of diseases in a casual way from one animal to another. It is possible that these Tabanidæ may also take part in the transmission of anterior poliomyelitis, especially as they have been found abundant in certain maritime districts where epidemic poliomyelitis has occurred. The seasonal distribution of these flies is not exactly like that of Stomoxys, since the horse flies do not have such brief life cycles and their greatest abundance is rather in midsummer than in the early fall. If both should prove to be associated with poliomyelitis, then there is perhaps good evidence that neither Stomoxys nor Tabanus is a specific carrier, as the two are quite different insects and it would be very unlikely for the same parasite to affect both.

Another group, the Simuliidæ, includes small biting flies which sometimes appear in enormous numbers in certain localities, particularly in the spring of the year. In Europe one of these, *Simulium reptans* has been thought to transmit pellagra, but this suspicion has not yet been proved, and American investigators are inclined greatly to doubt it. The larvæ of these flies breed exclusively in swiftly running brooks, and the adults are on the wing mainly in the spring of the year, so that their association with anterior poliomyelitis would be very improbable, as poliomyelitis is not confined to such localities and its greatest seasonal incidence does not correspond with the seasonal abundance of these insects.

Among the midges, another extensive family of small flies, (Chironomidæ), which are generally innocuous, are a few species which suck blood. These are quite vicious biters and might perhaps be associated with the spread of poliomyelitis, although we have not been able to demonstrate their presence in the vicinity of many cases. Also, these flies are very small and rarely, if ever, bite animals, so that any infection from animals could not ordinarliy be due to them. They thus appear to be much less likely than mosquitoes as carriers of poliomyelitis, aside from the fact that they have never yet been associated with any disease.

Somewhat similar small flies belonging to still another family, the Psychodidæ, are blood-sucking in habits. These are included in the genus *Phlebotomus* and its allies, but they occur rarely, if at all, in our region, and need not be considered in the present connection.

The Siphonaptera, a group of small wingless epizoic parasites known as fleas, have been associated as casual carriers of bubonic plague and are known to be the most common agents in the transfer of this disease. They have been suggested by Conn [1] as the possible carriers of acute epidemic poliomyelitis, but their habits and seasonal distribution appear in no way to bear out such a supposition. Their relative abundance in summer and winter does not coincide with the incidence

[1] Rept. State Bd. Health, Connecticut, 1910–11 (1912).

of the disease for the falling off of poliomyelitis in winter is far more noticeable than the lessened abundance of fleas. Also, fleas would tend to distribute the disease more generally throughout families than actually occurs, although they might, of course, account for its carriage to considerable distances through the migration of animals to which they might be attached.

It seems probable, therefore, that fleas play no role in the transmission of poliomyelitis.

There remains only one other important group of insect-like animals, the ticks or Acarina, which must be considered, as some of these have been shown to be specific carriers of several diseases both of man and domestic animals.

At the beginning of the present investigation it was suspected that ticks might quite likely be associated with the spread of acute epidemic poliomyelitis, and an attempt was made to determine the presence of these in the immediate environment of all the cases. It was also ascertained with as great accuracy as possible whether the patient had actually been bitten by these animals, or whether it could reasonably be supposed that he might have been. As the work progressed, it became increasingly difficult to formulate such a theory in accordance with the observed facts, however, and it had to be abandoned for the present. Nevertheless, one peculiarity has been observed in the recurrence of the disease in epidemic form which appears inexplicable on any other basis: there seems to be a well-marked tendency for a region where acute epidemic poliomyelitis has been abundant one season, to be comparatively free from the disease the following year but to show a well-defined epidemic the second season. Such a recurrence every other year is not always very pronounced, but is still noticeable, and if this is the expression of factors involved in the spread of the disease, seems to find no explanation except on the basis of infection carried by some insect which requires two years to mature. The commonest tick met with on domesticated animals in Massachusetts is *Amblyomma americanum*, and according to Bishopp[1] this tick usually requires two years to attain maturity in this region. It rarely affects man, and could thus hardly be the primary cause of human cases, even had we not failed to demonstrate its presence commonly about cases this summer. Several assumptions are therefore necessary to associate it with acute epidemic poliomyelitis, and, although these involve the matter in such great doubt, it seems worth while to outline briefly what these are:

1. That human cases are the result of infection from animals, at

[1] *In lit.*, Sept. 20, 1911.

least such primary cases that form a nidus from which infection may later spread.

2. That, while the tick may be the general carrier of the disease among animals,[1] some other carrier such as *Stomoxys* is necessary to transmit the virus to human cases.

3. That the introduction of the disease into Massachusetts is so recent that there has not yet been time for it to become equally abundant each year. Such a condition of approximately equal annual incidence must necessarily come about finally, on the basis of the above assumption, as a result of hold-over cases, and of irregularities in the length of the life cycle of the tick.

One habit of this tick might throw doubt upon such an hypothesis, since unlike the cattle tick, *Margaropus annulatus, Amblyomma* drops from its host to molt and must frequently attach itself to several animals during its lifetime. If it remained attached to the same animal continuously as does the cattle tick, a biennial reinfection would necessarily result, since with Texas Fever fresh animals are infected by the Piroplasma parasite only through young or seed ticks hatching from eggs laid by infected female ticks capable of transmitting the disease to their offspring through the eggs which they deposit. In the light of Lounsbury's observations, however, such an objection loses its force.

Account of the Area Investigated

In the following short accounts of the towns visited during the summer we have endeavored to give only such data as appear to have a bearing upon the foregoing discussion.

Waltham. Population approximately 28,000.

Waltham is in Middlesex County on both sides of the Charles River, ten miles west of Boston. It is connected with Boston through Newton, both by trolley and by the Fitchburg division of the Boston and Maine Railroad. It is principally engaged in the manufacture of watches, although there is also a large cotton mill, a bleachery and dye works in the town.

[1] In this connection it is instructive to note that Lounsbury has shown that canine piroplasmosis in South Africa which is transmitted by a tick (*Hæmaphysalis leachi*) is not transmissible until after a complete life cycle of the tick. Thus it is spread not by the larvæ from infected mother ticks, but only by those which, reared from eggs deposited by infected mother ticks, have passed through two preparatory stages and attained the adult condition. Here, contrary to what prevails in the spread of Texas Fever, recurrences of cases from individual infections are delayed till a complete life cycle of the tick has been undergone. If we have to deal with a tick having a two-year life cycle, such a fact is at least significant in relation to the apparent biennial fluctuation of acute epidemic poliomyelitis.

Only two cases occurred here, giving an incidence of .07 per 1,000, one in a very unsanitary house in the yard of which many *Stomoxys* were seen ten days after the patient became paralyzed.

TEWKSBURY. Population approximately 6,000.

Tewksbury is in Middlesex County between the Merrimack and Concord rivers, five miles southeast of Lowell and 22 miles northwest of Boston. It is connected with Boston by the Boston and Maine Railroad, and with the surrounding towns and villages by trolley. The population of the town proper, which is about 4,000, is principally engaged in agricultural pursuits and the manufacture of cotton machinery, but the State Infirmary with 200 inmates is also located in Tewksbury.

Six cases occurred here giving an incidence of 1 per 1,000; or 2 in the infirmary and 0.50 in the population of the town. One death occurred, in the infirmary, that of a child, a state ward. No sickness could be discovered among the animals on the Institution grounds, although several fowls died after the first case occurred. The cause of death of these fowls could not be ascertained. A child transferred from the institution to the Children's Institution, Boston, reported well at the time, boarded out in a family in Malden, later developed acute epidemic poliomyelitis. In this family another ward, a probable secondary case, developed a facial paralysis.

At the time of our visit on September 16th, all the cases reported from the institution had occurred. The usual domestic insects were observed, also an unusual abundance of *Stomoxys*, some of which were seen upon a screened enclosure in the grounds in which the children had frequently been placed before they were attacked.

WINTHROP. Population approximately 10,000.

Winthrop is in Suffolk County, five miles northeast of Boston, situated on a peninsula in Massachusetts Bay. It is a summer resort and to some extent frequented by transient visitors to an ocean beach, which borders the town on the east. It is connected with Boston by the Revere Beach and Lynn Railroad, and also by trolley.

Three cases occurred here, giving an incidence of .30. They were associated with the usual household insects, in addition to which small horse flies (*Tabanus*) were common along the beach frequented by the children and also reported in one house where a case occurred.

WOBURN. Population approximately 15,000.

Woburn is a small manufacturing town in Middlesex County, ten miles northwest of Boston, whence many trains of the Boston and

Maine Railroad run daily, passing through Winchester, Somerville and several other towns, and connecting with the line for Lowell at Winchester. Trolley cars run from Woburn through Winchester to Boston, and also connect it with Lowell. The principal industry is the tanning and manufacture of leather, and the refuse from these establishments is disposed of in open fields about the town. A settling tank from one tannery forms a public nuisance near the central part of the town, occupying a field about which are ranged at least four of the cases of epidemic poliomyelitis.

The town is a thickly settled center with three outlying villages, and an area occupied by a small rural population. The central portion is connected with the metropolitan sewer system, and obtains its water supply from Horn Pond, a large body of water upon the outskirts of the town proper.

In this town of 15,000 inhabitants 14 cases were discovered (an incidence of practically 1 per 1,000 of population), two deaths, *i. e.*, about 14% fatal. The homes of the cases in this and other towns mentioned later we visited and investigated thoroughly. A detailed analysis of all the cases will later be made in a general report of the year's work. In the environment of each case, biting flies, mosquitoes and the ordinary series of domestic insects were observed. In one case in a typically rural district an epidemic disease among pigs, characterized by paralysis, was reported earlier in the season than the date on which the case of acute epidemic poliomyelitis occurred in the child. In this neighborhood were a number of the stable flies and a few house flies.

In another case situated in the town proper, within 20 yards of the railroad yard a cat was reported to have been paralyzed before the child took the infection. Some biting flies were discovered on this house. A second case had its origin in the immediate neighborhood.

Somerville. Population approximately 77,000.

Somerville is in Middlesex County, situated as are Woburn and Winchester in the Mystic Valley. It is very intimately connected with Boston by the Boston and Maine Railroad and by seven lines of electric cars. Much of the teaming and railroad traffic between Boston and Woburn, Winchester and Lowell passes through Somerville in both directions. Its activities are mainly of an urban character, including various manufacturing industries.

Ten cases occurred in this town, an incidence per 1,000 of approximately .13. The usual series of domestic insects were observed in the environment of these cases, including *Stomoxys*. In one case a history was obtained that one month before the attack in July the child was stung between the shoulders by a strange insect, about eight o'clock in the evening, and at the same time an adult member of the same family was bitten in the same way. The sting was accompanied by a very sharp pain and was probably the bite of some species of *Tabanus*, although it may possibly have been *Stomoxys* or some other biting insect. Two horses were kept in a dry clean stable at the rear of the house.

No sickness or disease among domestic animals was discovered. In two instances the fathers were teamsters, and in one, two older boys in the family were also teamsters. Another home was situated on a dirty, narrow court open to a freight yard of the Boston and Maine Railroad where various cars were stored at the time of our visit.

NEWTON. Population approximately 40,000.

Newton is in Middlesex County seven miles west of Boston, on the Charles River and the line of the Boston and Albany Railroad. It contains the residences of many persons engaged in business in Boston, and is thus in close contact with the latter both by railway and road traffic, while to the westward its railroads and highways pass on to Worcester and Springfield. Its industries are varied, including the manufacture of foundry products, paper, print cloth, boots and shoes, glue, dyes, ink and soap. A part of the town is quite rural in character.

Four cases occurred here, giving an incidence of (.10) per 1,000. In one case, which occurred on the outskirts of the town, several cows were reported to have been lame in the hind quarters two months before the child was taken sick. These cows belonged to a dairy and were pastured in a field adjoining the house where the patient lived, and frequently escaped into the back yard of this house. No further information concerning the cows could be obtained and they had presumably recovered completely.

In the house occupied by a second case in the thickly settled residential part of the town, a cat was kept, but had not been sick. Associated with each case was the usual series of domestic insects, including mosquitoes and biting flies.

WINCHESTER. Population approximately 9,000.

Winchester is in Middlesex County, eight miles northwest of Boston on the line of the Boston and Maine Railroad, not far from Woburn. It is also connected with Woburn, Lowell, and Boston, as well as with other nearby towns, by frequent trolley service. It is principally engaged in tanning and the manufacture of furniture, parts of the town being well settled, but the rest quite sparsely populated.

Two case occurred here, giving an incidence of .22 per 1,000 of population. The first case was located on the main thoroughfare along which the trolley cars from Woburn pass, and situated only a block or two from the railroad which goes through Woburn. No definite connection could be traced with any case in Woburn, although the family traveled to and fro between Woburn and Winchester. In the second case a similar history was obtained, and the child was said to have eaten bananas purchased in Woburn. On the premises of both these families *Stomoxys* was seen in abundance. No sick animals could be found in the neighborhood.

Pocasset.

Pocasset is a village or a section of the town of Bourne. It is a small summer resort in Barnstable County on the eastern shore of Buzzards Bay. Its resident population is 208, but is greatly augmented during the summer months.

Two cases occurred in this town, one among the permanent inhabitants and another in the family of a summer resident from Brockton, Mass. The usual domestic insects characteristic of such a maritime town, including mosquitoes, *Stomoxys* and small horse flies (*Tabanus*), were seen on the premises of the second case. The first case originated much earlier in the season, known to us at the time of our visit, but not reported until afterwards.

Hamilton. Population approximately 1,750.

One case occurred in this small rural community, giving an incidence of .57 per 1,000. The father was a coachman on a neighboring estate and had been in close contact with his employer's child, who did not contract the disease. Mosquitoes and biting flies were present on the premises, the latter quite abundantly so.

Marblehead. Population approximately 7,000.

Marblehead is in Essex County, 18 miles northeast of Boston, three miles east of Salem, and four miles northeast of Lynn. It is situated on Massachusetts Bay and by reason of this location is a yachting center and summer resort. Its industries are mainly the manufacture of shoes. With Boston it is connected by the Boston and Maine Railroad, and with the neighboring towns, including Hamilton, by trolley lines, as well as by considerable traffic on the highways.

The single case which occurred in this town developed at Marblehead Neck, near the apex of the peninsula, some distance across the water from the town, in a family from Salem summering there. A case of earlier incidence was reported from Salem. It could be associated with no other case in any way, although a later case reported elsewhere may have originated in Marblehead.

Insects, except mosquitoes, houseflies and *Stomoxys*, were not seen, although an insect described as resembling a tick had been seen on the infant and had bitten it, before the symptoms of poliomyelitis developed. *Stomoxys* had been killed in the patient's bedroom.

MARLBORO. Population approximately 14,000.

Marlboro is in Middlesex County on the Fitchburg division of the Boston and Maine Railroad, and also on the line of the New York, New Haven and Hartford Railroad. It is engaged mainly in the manufacture of boots and shoes, half of its 7,000 wage earners being engaged in this industry.

Three cases occurred in the town proper, in the families of which the fathers were operatives in these factories. In one family in which four cases occurred, the father was a farmer and the locality typically rural and well removed from the town. In this latter family two deaths occurred, and one of the cases, a girl 13 years of age, had suffered a previous attack of poliomyelitis ten years ago, when an infant three years of age. The question of second attacks will be treated of in another paper.

Stomoxys was unusually abundant about the premises and barnyard of this farm, and was also seen in the house and in the bedrooms with the patients.

LOWELL. Population approximately 106,000.

Lowell is in Middlesex County at the junction of the Merrimack and Concord rivers. It is connected with Boston by the Boston and Maine Railroad and by trolley lines, both passing through Somerville and Winchester, and is also connected with Woburn by electric cars.

It is a manufacturing town, engaged mainly in textile industries, although it also contains many foundries and machine shops, and some boot and shoe factories. Its population, therefore, consists in great part of the lower working classes, living in rather closely settled districts surrounded by more sparsely peopled rural communities.

Fourteen cases occurred in this town, an incidence of approximately .13 per 1,000 of population. The usual series of domestic insects were observed in the environment of these cases, including *Stomoxys*. In one case a cat became paralyzed at about the same time that the child was paralyzed, and this child had played with the cat intimately. This cat was driven out of the neighborhood and could not be found at the time of our visit.

At least six cases in the city occurred later, several of which were in the immediate neighborhood of the above case. It is interesting to note that nearly all of these cases were distributed along the main artery of traffic between Woburn and Lowell, and situated either on or near enough to the main thoroughfare to be within easy fly distance of it—that is, if biting flies are shown to be carriers of the infection, it is not unreasonable to suppose that infected flies may have followed horses or have been carried on vehicles coming from Woburn into Lowell. The distance of the cases from the main thoroughfare was not in excess of their ordinary range of flight. In several other cases animals were discovered, but no sickness among them. The father of one case, a milkman, delivered milk in a family where a case later developed.

WESTFORD. Population approximately 3,000.

Westford is in Middlesex County on the Boston and Maine Railroad, six miles southwest of Lowell and 33 miles northwest of Boston. It is composed of six smaller villages whose population is engaged mainly in agriculture.

Only one case occurred here, on a small farm situated in a district with sparse rural population, giving an incidence of .33 per 1,000. Mosquitoes were present and also *Stomoxys* in the patient's bedroom and upon the front door screens and exterior of the house.

WINCHENDON. Population approximately 6,000.

Winchendon is in Worcester County, situated on the Miller River, 18 miles northwest of Fitchburg and 36 miles north by west of Worcester. It contains three villages, and, although in part quite thickly populated, is entirely destitute of any system of closed municipal sewers. It is principally engaged in the manufacture of woodenware, toys, cotton goods and wood-working machinery.

Only a single case occured here, several miles from the town on the country highways between Winchendon and Royalston. Since that time a case has developed in the latter town, but has not yet been investigated by us. The house where the child was taken sick is in a very rural district, just across a small brook from an establishment where old rags are sorted for use in a shoddy mill. The premises were very dirty and unsanitary, and suffering from a plague of mosquitoes and flies, both house flies and *Stomoxys*. Near the house was a large depression, previously dry for some years, but this season dammed and filled with water.

FALL RIVER. Population approximately 119,000.

Fall River, which is in Bristol County, is an important railroad centre, and also a port of entry which thus suggests a possible importation of the infection from abroad by immigrants or from other American ports. This city is on the Rhode Island border, on the eastern shore of Mount Hope Bay, the northeast arm of Narragansett Bay, and the Taunton River, 20 miles from the sea. It is intimately connected with Boston and Providence, and the intervening districts by railways, and there is much interurban traffic carried on with Taunton, New Bedford and Newport, R. I., also. From Boston it is 48 miles distant, but from Providence only 20 miles.

Fall River is a typical city of small manufactures, employing nearly 25,000 operatives in the production of cotton goods which form its principal industry. It is rather densely populated in parts, but covers a large area, embracing over 40 square miles and including many squalid districts. In these, most of the cases occurred. The water supply is derived from Watuppa Lake, a body of water ten miles in length on the eastern side of the city. It has a good system of sewers, but, owing to the character of a great part of its population, is not as cleanly as might be desired.

NEW BEDFORD. Population approximately 96,000.

New Bedford is a manufacturing town in Bristol County, near the mouth of the Acushnet River. It is on the line of the New York, New Haven and Hartford Railroad, 56 miles south of Boston, and is connected with New York City and the islands of Vineyard Sound by a regular steamboat service. Its industries are largely the manufacture of cotton goods, and in this trade nearly all (18,000) of its wage earners are engaged.

Four cases occurred in this city, an incidence of approximately .04 per 1,000 of population. The usual series of domestic insects were observed in the environment of these cases, including *Stomoxys*. One adult case, female, 35 years of age, a mill hand, reports that the overseer loom fixer, who lived within a block of her home, had a child sick and unable to walk for three weeks. No diagnosis was obtained in the case of the child, nor was it reported as a case of poliomyelitis.

It may be stated, then, in a general way for all cases where *Stomoxys* was seen, that this fly was observed in the house, on the house, on the outhouses and barns; and occasionally in the patient's bed chamber.

Thirteen cases occurred in this town, an incidence of approximately .10 per 1,000 of population. The usual series of domestic insects were observed in the environment of these cases, including *Stomoxys*. In nearly every case domestic animals were seen and in four of these sickness in cats was reported. One case in the city gave a history of a strange cat straying into the house and being petted a good deal by the child. The cat later died, and within six weeks of this cat's death the child became sick and was paralyzed. Another case in the rural district, Meridian St., was found to have Herpes Zoster complicating acute epidemic poliomyelitis. The father, a teamster in business for himself, kept four or five horses in the stable at rear of house. *Stomoxys* was unusually abundant here, as were also mosquitoes, but no sick animals. The child had marks of bites on his body. A month before the attack the family were living at a nearby beach. The child was often placed on the horses' back and led around the grounds. An interesting case in an adult male, 73 years old, was seen, which gave a history of bites by stable flies, followed in a week by febrile attack and paralysis of one arm.

Summary

Nothing absolutely definite has hitherto been ascertained regarding the channels of infection of acute epidemic poliomyelitis.

Many facts connected with the distribution of cases and the spread of epidemics of this disease together with histories of insect bites suggest at least that the disease may be insect-borne.

Field work during the past summer together with a consideration of the epidemiology of the disease so far as known, points strongly toward biting flies as possible carriers of the virus. It seems probable that the common stable fly (*Stomoxys calcitrans* L.) may be responsiale to a certain extent for the spread of acute epidemic poliomyelitis, possibly aided by other biting flies such as *Tabanus lineola*. No facts which disprove such a hypothesis have as yet been adduced, and experiments based upon it are now in progress.

If the disease should prove to be common to any species of domestic animals, as is now strongly suspected, a secondary connection of ticks in spreading the disease among such animals seems probable, as has been mentioned earlier in this paper.

From the investigation during 1911 it has become apparent that if acute epidemic poliomyelitis is an insect-borne disease, there must exist some factors in its spread which are as yet far from clear; and from the knowledge so far gained, apparently more complex than those involved in most of the insect-borne diseases hitherto elucidated.

The relation between human paralysis and animal paralysis or kindred diseases, is as yet very imperfectly understood, and it seems possible that studies along this line, if undertaken from an entomological standpoint, might serve to advance our knowledge concerning the spread of acute epidemic poliomyelitis in man.

THE ACTIVITY OF PROSPALTELLA BERLESEI HOWARD AGAINST DIASPIS PENTAGONA TARG. IN ITALY

Diaspis pentagona Targ., or the white scale of the mulberry, was first observed in Italy by Professor Targioni Tozzetti of Florence upon some branches of mulberry which were sent to him from communes in the province of Como (Proserpio, Asso, Canzo). They were mentioned in a letter dated May 10, 1886 addressed to Prof. Franceschini and published in the Rivista di Bachicultura, volume VIII.

Since that time *Diaspis pentagona*, only feebly antagonized by adverse indigenous conditions and by the activity of the agriculturists, has spread with an increasing rapidity and occupies almost all the centers of mulberry culture in Italy, and certainly all of north Italy. We have then all of north Italy infested, together with a good part of central Italy, and centers of infestation in south Italy.

Targioni was the first to suggest, in 1892, that *Diaspis pentagona* was of Japanese origin, and now every one holds this opinion. The species was described for Japan by Sasaki, of Tokio, in 1894, under the name *Diaspis patelleformis*, and for Australia by Tryon in 1889 under the name *Diaspis amygdali*. In America it was described by Morgan and Cockerell in 1892 under the name *Diaspis lanatus*.

The spread of this species in Italy reached such proportions that the Italian government was obliged in 1891 to promulgate a law against the Diaspis, compelling tree owners in infested localities to fight the insect by mechanical means (scraping the trunk and the infested branches, pruning, sterilizing by fire), and by insecticidal solutions. In spite of these expensive measures, the ravages of the scale were not sensibly diminished, and its rapid and intense propagation apparently could not be stopped by artificial means.

In this deplorable state of affairs *Prospaltella berlesei*, reared by Professor Berlese from *Diaspis amygdali* from America and described by Doctor Howard, was introduced into Italy. As early as 1902 Professor Berlese thought that the great spread of this species in Italy was due to the lack of natural enemies which held it in check in its native country. Considering that all of the Diaspine scales are energetically attacked by internal parasites (which destroy at least 90 per cent) and that *Diaspis pentagona* had no parasite in Italy, he supposed that there must be in some part of the world an especial enemy of this species which could fight it in Italy as well as in its native country. In the month of May, 1906, Professor Berlese received the first living individuals of *Prospaltella berlesei* How. from the United States, whence they had been sent by Doctor Howard's kindness. He liberated them at Milan; in 1908 he was able to obtain the same species from Japan, and these individuals were liberated at Genoa, at Casale Monferrato, and at Milan (Vanzago), at Caserta, and at Pisa.

At Genoa the parasite was liberated in small numbers (perhaps about thirty) upon a mulberry tree which was one of a series of eleven great broad-branched trees badly infested by the Diaspis.

In December, 1909, and in January, 1910, the Diaspis had almost entirely disappeared from these mulberries, and almost all the females were found infested by the Prospaltella. Two thousand sections of branches were cut off and distributed in the north of Italy.

At Vanzago the small number of parasites put out in 1908 upon a mulberry tree in the middle of about thirty others on the lands of Sig. Vago had given rise in March, 1909, to a very slight progeny. In July of the same year the percentage of parasitism was more than eighty, and already the scales on the neighboring trees were attacked by the Prospaltella. At the end of 1910 this little parasite unaided was propagating itself upon all of Mr. Vago's mulberries, and even upon neighboring lands, abundantly infesting the Diaspis on three rows of mulberries of more than thirty trees over a space of 2000 square meters. Professor Berlese cut off 600 pieces of infested branches. He estimated then that the increase of the Prospaltella from April, 1908, to April, 1910, had progressed as from 1 to 5000; that is to say seventy times yearly.

The increase of the Diaspis from one year to another is much smaller, and Berlese has calculated that four years will suffice to destroy this most injurious scale over all of Italy by the aid of the Prospaltella.

Deducting the material from the nurseries at Genoa and Vanzago, there were established in 1910, by the aid of traveling professors of agriculture, societies, co-operatives, schools, municipalities, the following centers of distribution of Prospaltella:

Liguria	57
Piedmont	600
Lombardy	809
Venetia	700
Emilia	55
Marche	60
Umbria	40

About a hundred branches were sent to places outside of Italy, among others to Locarno, from which no late news has been received.

Here are the results obtained at the end of the year 1911, according to the account of Professor Berlese, who has himself visited the localities in upper Italy where mulberries are cultivated:

The region in which the spread of the precious parasite has been the most effective and the most efficacious, thanks to the indefatigable efforts of the traveling professors of agriculture, is upper east Italy. We have already said that in 1910 four hundred pieces of branches were sent to this region. In 1911 the number was increased to 1160. The destruction of the Diaspis by the parasite has been so intense that this region will be the first to be cleared of the scale. In some localities, especially at Vincenza and at Verona, where the Prospaltella was placed in 1909, the multiplication has been such that they already claim the total destruction and disappearance of the Diaspis as the result of the work of the parasite.

Brilliant results have been obtained by Professor Orsi in the suburbs of Riva, where centers of spread of the Prospaltella have been established since 1908.

The most marvelous results have been noticed in the centers of spread established in 1910. Here one finds the Diaspis still on the bark, but all destroyed by the parasite.

Professor Berlese visited Lombardy also, where the most perfect centers of spread were found at Vanzago and at Venegono Inferiore. At Vanzago upon the estates of Cav. Vago he was not able to find a healthy Diaspis, but only traces of the scale killed by the parasite. Around this estate the Diaspis was found to a distance of several hundred meters, but always infested by the Prospaltella, which had spread unaided. Professor Berlese estimates that in 1912 all the Diaspis will be destroyed for a distance of several kilometers from the center.

In 1911, 7614 branches carrying the Prospaltella were distributed in Italy, and this is the list of localities to which this infested material was sent:

Liguria	210
Piedmont	1218
Lombardy	2784
Venetia	2812
Emilia	254
Marche	196
Umbria	50
Tuscany	90

The great success obtained in the work against the Diaspis by the spread of Prospaltella is due to certain peculiarities of this parasite.

The Prospaltella, like all special or general internal parasites, does not attack a single particular individual scale, but searches continually and actively until the last individual is found and oviposited in. The scale is attacked at all ages—larva, nymph, and adult, but the females especially are parasitized. This is of especial importance from the point of view of economy of the forces of the parasite. The destruction of the males would be worth little, for the Diaspis is parthenogenetic; the Prospaltella is also parthenogenetic—the males of this species are not even known. So the reproductive forces are not wasted in the production of males which would be useless in destroying the Coccid. This precious parasite is very active and prolific, having four or five generations a year, each female carrying about one hundred eggs in its abdomen. Professor Berlese has been able to find no enemy or disease of the Prospaltella except predaceous insects.

One of the most striking characteristics of the Prospaltella is its migratory power, which helps enormously in its spread. Emigration takes place during the hot season, and the insects will fly to relatively great distances in order to lay their eggs, and often pass over walls, hedges, ditches and other obstacles. The early and late generations are lazier and remain near the birth place.

After his inspection trip to verify the results of the parasitic work, Berlese has reported the following conclusions:

(1) *Prospaltella berlesei* is perfectly adapted to the climate of upper Italy. It multiplies most actively in the milder regions (Genoa, Lac de Garde) rather than in the colder regions (Piedmont) where it has probably one or two generations less.

(2) Excessive cold is not injurious to the parasite.

(3) The diffusive intensity of the parasite is so great that it will disperse throughout upper Italy even without being aided artificially. Professor Berlese prophesies that during 1912 Liguria and Venetia will be for the great part freed from the Diaspis, and that the same condition will be reached for Lombardy in 1913 and for Piedmont in 1914.

(French abstract by Dr. Caterina Samsonoff; English translation by L. O. Howard.)

STOP-BACK OF PEACH

By E. A. Back and W. J. Price, Jr., *Virginia State Crop Pest Commission, Blacksburg, Virginia*

For many years, nurserymen have been troubled by a disease of peach nursery stock known as "Stop-back" resulting in the death of the tender terminal bud of the principal shoot. The injury to the terminal shoot forces the development of lateral shoots, the terminal buds of which may in turn be affected in a similar manner. When this trouble is spreading at its greatest rapidity, not a single terminal, and even many of the lateral buds, of both the principal and lateral shoots are killed and the plant remains dwarfed and fails to develop into a tree designated by the nursery trade as A No. 1. Frequently the trees are so stunted by the successive deaths of the terminal buds that they are absolutely worthless. Many trees, however, are only sufficiently affected to make them undersized and very crooked, and while they may make as good trees for orchard planting, they must be sold at a price which means a substantial loss to the nurseryman—a loss that in 1911 in Virginia amounted to about $5,000, and in Pennsylvania to about $15,000.

From time to time, various creatures have been said to cause this Stop-back. Prof. M. B. Waite in a paper before the Biological Society of Washington during 1897 stated that a mite was responsible for the injury. In 1896, Prof. W. G. Johnson noted many stunted peach trees during his inspection work in Maryland and upon examination, found a minute mite associated with the trouble. Dr. J. B. Smith in 1899 believed that Stop-back in New Jersey was caused by "Peach Thrips."

Prof. W. B. Alwood of the Virginia Agricultural Experiment Station, who had observed Stop-back since 1891, considered Thrips responsible for the injury. Mr. J. L. Phillips, formerly of this Commission, in the fifth report of the Virginia State Entomologist, stated that he considered that mites were the causative agent. Messrs. Webster and Mally, in an article on "Insects of the Year in Ohio," read in August, 1899, stated their belief that Stop-back was due to the work of the common tarnished plant-bug, *Lygus pratensis* L., since they found no mites present and the extent of injury to peach in proportion to the abundance of the bug. Prof. A. L. Quaintance in a paper on "The Peach Bud Mite" published as part six of Bulletin 97 of the U. S. D. A., B. E., Feb., 1912, states that a mite is apparently responsible for Stop-back. He has had the mite in question identified by Mr. Banks as *Tarsonemus waitei* Banks, and discusses its systematic relationships, and other allied economic species of mites belonging to the same family, *Tarsonemidae.* Those interested in this malady of peach nursery trees, are referred to the above mentioned bulletin by Prof. Quaintance which contains besides valuable observations, excellent descriptions and illustrations, a reference to previously published articles and a resume of their more important statements.

The purpose of this article is to give what the writers consider definite proof that Stop-back of peach in Virginia, at least, is not caused by the tarnished plant-bug, *Lygus pratensis* L. So far as is known, no reliable data has been given to fix the responsibility on either *Tarsonemus waitei* Banks or *Lygus pratensis* L. To quote from Prof. Quaintance.

"Prof. Waite's careful observations, and those of Messrs. Johnson, Phillips, and others, indicate clearly that the *Tarsonemus waitei* is the cause of the so-called "stop-back" affection of peach nursery stock. It may also be true that injury practically identical in effect on the trees is caused by thrips, as stated by Dr. Smith and Prof. Alwood. Young thrips, principally *Euthrips tritici,* are very commonly found in the tender growing tips of various kinds of vegetation, and are especially common on peach nursery trees. In blocks of trees infested with the mite, the thrips larvae have been found by the writer in great abundance, but never, so far as could be determined, killing the tips of the shoots. The writer is inclined to the belief that the injury in Ohio, New Jersey, and Virginia (as shown by Phillips) is due to the *Tarsonemus*, its small size, agility, and habits contributing to its oversight. Any injury to the growing tip of a peach shoot, as by plant-bugs, would naturally produce a similar effect in causing the cessation of growth and the development of lateral shoots, but the comparative scarcity of such insects in injured blocks in the territory under consideration does not warrant their association with the trouble."

To be considered with the above statements, the following are offered:

In early May, 1911, the senior writer was notified that "Stop-back" was at work in a nursery near Richmond. He was not able to make an examination until about June 10th, at which time he was told that the trouble was not spreading much. A very large percentage of the peach trees were affected. No insect was sufficiently abundant to attract special attention, but tiny mites, thrips and *Lygus pratensis* were collected. *Lygus pratensis* was observed sucking the juices from terminal buds, but was not in sufficient numbers to appear to be responsible for the wholesale injury. All things considered, mites, from their abundance, were thought most likely to have caused the injury. No further observations were made during 1911.

On May 8, 1912, information was received that Stop-back was beginning to appear in blocks of peach trees near Richmond. On May 21st, the writers visited the nursery in question and found that *Lygus pratensis* was abundant in sufficient numbers to warrant the belief that they were causing the Stop-back. They were found sucking the sap from the terminal buds. There were noted perfectly healthy terminals from which bugs were sucking the sap, slightly and badly wilted terminals, as well as dried and blackened terminals. Close observation over a large area clearly indicated that *Lygus pratensis* was causing the damage. The injury was, generally speaking, in proportion to the abundance of bugs as previously noted by Webster and Mally in Ohio. In some instances, leaves close to the terminal bud were blackened as a result of the feeding of the bug while the bud itself was unaffected. Several hundred affected buds showing all stages of Stop-back were collected and of these, one hundred were examined by the senior writer in the laboratory and but one mite and three thrips were found. The bugs were noted to thrust their beaks into the tip of the tender shoots to their full length. Examination of shoots dying but not yet blackened, showed discolored streaks in the plant tissues corresponding in length with the beaks of the bugs.

An examination of the trees at 2 p.m., sun bright and hot, gave the results in Table I.

Table No. 1. Relation Between Number of Trees Affected and Abundance of the Tarnished Plant-Bug

Block	Variety	No. Trees in row	No. Trees affected	No. bugs counted per row
No. 1	Belle of Ga.	691	531	197
	Belle of Ga.	756	412	223
	Alexander	546	301	83
	Ray	669	292	96
	Globe Va.	694	397	. .
No. 11	Albright's Winter	195	81	17
	Carmen	212	86	19
	Bilyeu's Late	184	72	15

In some instances, as many as seven bugs were found on one plant. As the insects flew from the plants on the slightest provocation, it is thought that the number counted was smaller than was actually present. On June 1st, the trees were again examined and over 99 per cent of the trees in Block No. I were found affected, and but four bugs were found on one row of trees as compared with 223 on May 21st. Had one only the observations made on June 1st to judge by, it would have been impossible to associate *Lygus pratensis* with the injury.

The injury as observed on May 21st, was so clearly caused by *Lygus pratensis* that cages made of cheese cloth stretched over wooden frames were placed over the trees in the nursery rows and the following observations made:

Cage No. 1. May 23, 3 p. m. Cage placed over three plants apparently free from injury. Nine specimens of *L. pratensis* were placed in cage.

May 24, 4 p. m. Terminal buds on all three plants wilted and show same injury as newly affected plants on outside.

May 25. Terminal buds of five lateral branches on tree No. 1; four on tree No. 2, and five on tree No. 3, affected.

May 26. Terminal buds of both main and lateral shoots have turned black.

May 27. All terminals affected. Injury identical with that of plants throughout nursery.

Cage No. 2. May 23, 3.15 p. m. cage placed over six plants which showed no injury. All *L. pratensis* excluded.

May 24. No injury apparent.

May 25. " " "

May 27. " " "

Cage No. 3. May 23, cage placed over nine plants; five of the nine plants plainly affected; four not affected. Dead terminal buds of affected plants carefully cut away. All insects excluded.

May 24. No new development of Stop-back.

May 25. No change.

May 27. Non-affected plants still unaffected and affected plants from which injured terminals were cut, show no further injury.

Cage No. 4. May 23, cage placed over seven plants; four affected, three not affected, all insects excluded and affected terminals not removed.

May 24. No change.

May 25. " "

May 27. No further spread of injury on affected plants, and non-affected plants still uninjured.

Cage No. 5. May 25. Two very healthy non-affected plants caged and six bugs placed in cage. Tree No. 1 has main and 7 lateral shoots. Tree No. 2 has main and 16 lateral shoots.

May 27. On tree No. 1, terminal buds of main and six lateral shoots affected. On tree No. 2, terminal buds of main and twelve lateral shoots affected.

May 28. On both trees terminal buds of all shoots affected, and turning black.

Cage No. 7. May 28, cage placed over six plants, three affected, three not affected. Insects excluded.

June 1st. No further spread of injury, non-affected trees growing rapidly, with terminal shoots crowding against top of cage.

Cage No. 8. May 28. Cage placed over six non-affected trees and nine bugs added.

June 1st. All terminal and many lateral buds of both main and lateral shoots injured, showing characteristic appearance of Stop-back.

Although *Lygus pratensis* was disappearing from peach trees in Eastern Virginia by June 1st, it was found to be increasing in abundance on peach nursery stock at Blacksburg, where the season, due to an elevation of 2200 feet, is fully three weeks later. But few specimens of *pratensis* could be found at Blacksburg on May 24th. To produce typical Stop-back in the laboratory, six specimens of *pratensis* were placed in a rearing cage with seven shoots of peach on June 3rd. By June 7th, all shoots had developed typical Stop-back. The bugs were closely watched at intervals and were seen to puncture the terminal buds. Check shoots developed no Stop-back.

Stop-back has never been abundant enough to attract much attention at Blacksburg during past years. To produce typical Stop-back in a block of nursery trees showing but slight affection from this trouble, two cages were placed over trees after a manner similar to that at Richmond with the following results:

Cage No. 10. June 10. Caged five non-affected trees; all bugs excluded.
June 17. No Stop-back has developed.
Cage No. 11. June 10. Caged five non-affected trees; eleven bugs placed in cage.
June 13. Terminal buds of main shoots wilted.
June 17. No examination made since the 13th. All terminal buds of main shoots affected and blackened. Comparatively few terminal buds of the large number of lateral affected.

From the above experiments, the writers believe that there is no room for doubt regarding the causative agent of Stop-back of peach, at least in Virginia during the season of 1911 and 1912. The fact that they could produce Stop-back at will in field and laboratory by using *Lygus pratensis* and were never able to find *Tarsonemus waitei* in even what could be called slight numbers, at a time when the trees were being injured most, warrants this conclusion. And they believe that there is sufficient evidence in published statements to lead one to seriously doubt the conclusions drawn by others regarding *T. waitei*, unless very different conditions exist in other states.

The only experimental evidence thus far presented is that given by Mr. Phillips.[1] Since Mr. Phillips did not state whether he covered the plants about which he placed affected shoots, and since *L. pratensis* is known to occur at Blacksburg, there is no assurance that mites caused the subsequent injury. That too few specimens of *pratensis* have been found by observers to cause them to disregard it as the causative agent does not appear to have much weight, inasmuch as *pratensis* appears in large numbers in a comparatively short time, does its greatest damage and then largely disappears. Had the writers made their observations during June rather than May of this year, they would have been at as great a loss to know the cause of Stop-back as they were during 1911. Most growers, especially men who have charge of a large acreage, do not notice injury of the nature of Stop-back until it is far advanced and by the time an expert is called upon, the injury is done and the bugs largely gone. As in the examination of newly affected buds, no mites have been found while more

[1]Fifth Report, Va. State Ent. & Plant Path., 1906, page 50.

have been found several weeks after the injury is first evident, indicates that the mites are either secondary or breeding only in the tissues killed by the bug.

Prof. Quaintance records the failure to discover any difference in affection during the summer of 1906 between peach stock sprayed with lime sulphur before the buds opened and unsprayed trees. He also states that notwithstanding the fact that one large nursery firm has sprayed peach trees for some years during the dormant period with a miscible oil used at full winter strength, its trees have suffered seriously from Stop-back. Rather than ascribe the failure of these sprays to the hibernation of the mites elsewhere, it would seem more likely to disregard the mites and attribute the failure of sprays mentioned to the presence of *Lygus pratensis* which is known to exist from Canada to Mexico, to be especially fond of tender peach growth, and on account of the ease with which it migrates from place to place, entirely unaffected by winter sprays.

No attempt was made to control *Lygus pratensis* on trees near Richmond during May, 1912, by the writers. Certain rows were sprayed with self-boiled lime sulphur by the grower but no difference could be observed in the abundance of bugs or of diseased trees several weeks later. Judicious pruning, advocated by Mr. Phillips, was found to be worthless during the period of greatest activity of *pratensis*, for as fast as a new shoot was formed, the terminal bud was at once killed. Some method of driving the bugs from the blocks of peach should first be tried, and be followed later by pruning after the majority of the bugs have disappeared.

Summary

Stop-back of peach in Virginia is caused principally by the tarnished plant bug, *Lygus pratensis*. This insect is present on peach stock in largest numbers only for a comparatively short time, although it causes some injury throughout the season. Unless one is present in the nursery when injury is taking place most rapidly instead of making examinations several weeks later, *Lygus pratensis* is easily overlooked as the causative agent. Mites in Virginia, presumably *Tarsenomus waitei*, but not determined, are absent from freshly killed terminal buds, but later may be found in numbers in the blackened decaying tips. In the nursery, the extent of injury from Stop-back was found, in general terms, to be in proportion to the abundance of *Lygus pratensis*. In eleven cage experiments carried on in the field, no Stop-back developed in any cage from which *Lygus pratensis* was excluded, but all or many shoots developed Stop-back in cages into which specimens of this bug had been introduced.

SOME FURTHER NOTES ON THE WHEAT-HEAD ARMY-WORM

Meliana albilinea Hubner

By R. L. Webster

A few additional observations have been made by the writer on this insect in Iowa since the publication of Bulletin 122 of the Iowa Agricultural Experiment Station, as well as a brief paper in the Journal of Economic Entomology.[1] In order to make these a matter of record they are brought together in this article. The notes used for this paper represent work done at the Iowa Agricultural Experiment Station at Ames.

Early in 1911 it looked as if this pest might again become common. Adults were noticed rather numerous at lights in May, being captured on the 14th, 21st and 23rd, of that month at Ames. They were most common May 21. In June I found larvae common in several places in Iowa, but they did little damage.

Parasites

Pentarthron retorridum Girault MS. This tiny egg parasite was reared abundantly in the fall of 1910, emerging from eggs from August 30 to September 14. One lot of parasitized eggs, collected at Pocahontas, in northwestern Iowa, harbored these parasites through the winter in the insectary cold room, these emerging April 16. All of these were males, winged and wingless; the winged forms predominating; 52 individuals were counted here, and only 32 eggs, so there must have been some eggs with more than one parasite.

From another lot of eggs, collected September 13 at Corwith, Iowa, these parasites emerged September 14. This is probably about the limit for the fall emergence of the insect, since the lot collected September 16 wintered over in the host eggs.

Microgaster auripes Prov. In the fall of 1910 several white parasite cocoons, exactly like those of this species, were placed in a cage in the insectary cold room. No Microgasters emerged from these cocoons, however, only a species of *Mesochorus* (H. L. Viereck determination) came out. I have previously recorded the former species as a parasite on the wheat-head army-worm.

Microplitis melianae Vier. Since the publication of Iowa station bulletin 122 on the wheat-head army-worm Mr. H. L. Viereck[2] has

[1] Journ. Econ. Ent. vol. iv. p. 179.

[2] Proc. U. S. Nat. Mus. vol. 40. p. 185. 1911.

named and described this parasite. The species was reared from cocoons collected in several Iowa localities in the summer of 1910. From cocoons collected in October and kept in the insectary cold room, the adults emerged in March 1911.

Mesochorus nigrisignis Vier. This insect, also recently described by Viereck,[1] is a secondary parasite on *Microplitis melianae.* Only two specimens have been reared, one August 8, 1910, the other April 16, 1911. In the latter case the parasite spent the winter in the insectary cold room within the cocoon of its host.

Omorgus sp. A single parasite, so determined by Mr. H. L. Viereck, emerged May 5, 1911 from an insectary cage in which a number of wheat-head army-worms were placed the October before. It has presumably some relationship to that insect, but what this may be is entirely a matter of conjecture.

NOTES ON SAPERDA CALCARATA SAY IN SOUTH CAROLINA

By Wilson P. Gee

Saperda calcarata is one of the largest of our native species of the very destructive genus Saperda, and cases where it has been reported its damage seems to have been of a rather severe nature. The notes available on the life history of this form are exclusively northern or eastern in their application, and since there is a difference in those localities and this of a couple of months in the emergence of the adults, these few observations have been considered as of sufficient value to be made available for general use.

On April 20, 1912, investigation was made of a reported outbreak of a poplar borer at Whitmire, S. C., with the result that some 1,200–1,400 handsome Carolina poplars (*Populus deltoides* Marsh) were discovered to be almost hopelessly infested with *Saperda calcarata* Say. The attention of the mill authorities at this place, on whose property the trees were found, was directed to this damage only after several trees had broken off, a distance of some seven to nine feet above the ground. Examination revealed the fact that practically the entire lot of ten-year old trees were in a condition to be similarly mutilated upon being subjected to heavy winds.

The distribution of this species is quite general east of the Rocky Mountains according to Felt (Monograph of the Genus Saperda, New York State Museum, Bull. 74), who reports having seen speci-

[1] Ibid, p. 192.

Work of *Saperda calcarata*, a pupa *in situ*.

mens from as far south as Texas and South Carolina. According to him "the adult makes a small slit in the bark and deposits its eggs underneath the surface." In many places along the trunk patches of dead bark were observed, the removal of which showed the old marks of the larvæ having bored in the inner bark and outer sap-wood some months before. From these places large openings leading to irregular galleries through the outer sap-wood and into the heart were observed. In the trunks of the broken trees careful cutting showed only well advanced pupæ at this date. A conservative estimate would place the number of such pupæ found in one tree examined with this end in view at about sixty within a distance of four feet in length of the trunk. In Albany, N. Y., Felt states that in early June he has found pupæ, but no beetles bred therefrom until into July. From pupæ gathered on the above mentioned date, April 20, and placed, some of them in sawdust well moistened, the others remaining in the wood brought in, beetles were bred out May 6, a couple of months ahead of the emergence period reported from New York. This wide difference in the emergence period between New York and South Carolina is perhaps to be explained as the cumulative effect of the higher average temperatures of this locality, shortening the life cycle by some sixty days or more. The completion of the life history is recorded by Felt as requiring three years.

The pupæ found were in cells well toward the centre of the tree. Felt in describing the pupal chamber of this form says, "the top is smoothly cut and the other end is packed closely with coarse fibres which are attached to the side of the gallery at one end, and the portion next the pupa is packed with much finer borings and then coated with very fine sawdust." The accompanying figure, plate 8, shows a pupa *in situ*.

The damage done by this form consists in its weakening effect on the trunk of the tree, together with the fact that it spoils the wood of the tree for uses as lumber. Digging out the borers is an impractical proposition, since the irregular galleries extend well in toward the heart of the tree. The control measures necessarily are the application of repellent washes during the breeding season, or some caustic wash applied at frequent enough intervals during the breeding season to destroy the eggs or newly hatched larvæ.

INSECTS AND SPIDERS IN SPANISH MOSS

(Some Additional Data)

By A. H. Rosenfeld, *Tucuman, Argentine Republic*

In the "Journal of Economic Entomology," Vol. IV, No. 4,[1] the writer gave a list of a large number of insects and spiders collected in Spanish Moss during the winter of 1908–09 and the summer of 1909. All of this moss was collected at Mansura, in the Aroyelle's Parish, which is located near the centre of the State of Louisiana.

Having records of the examination of one additional lot of moss, which was taken just across the river from Baton Rouge, La., shortly after the boll-weevil appeared in the Parishes of East and West Baton Rouge, it has been thought well to publish these also. This moss was collected on January 26, 1910, by Prof. Wilmon Newell, the insects and spiders listed, representing the quantity taken from a lot of 14 1-4 pounds.

The methods of examination of these lots, and of the calculations were described in the article above mentioned. As with the other lots, all insects found in this moss were living, and in the adult state, unless otherwise mentioned. Acknowledgments are due to the same gentlemen as were mentioned in the preceding article on this subject. The results of these examinations are given in the following table:

January; 26, 1909, 14.5 lbs. Tillandsia usneoides

Insecta

Species	No. found in Lot	Approximate No. per ton.
Paromius longulus	18	2,484
Blattid, immature	8	1,104
Megilla maculata	5	690
Nysius californicus	3	414
Phalacrus penicellatus	3	414
Anthonomus suturalis	2	276
Gryllid, immature	2	276
Harmostes fraterculus	2	276
Ceutorynchus sp.	1	138
Chalybion caeruleum	1	138
Elaphidion parallelum	1	138
Entylia sinuata	1	138
Haltica ignita	1	138
Largus succinctus	1	138
Lixus musculus	1	138
Scymnus collaris	1	138
Total Insects	51	7,038

[1] Pages 398–409 inclusive.

ARACHNIDA

Chiracanthium inclusum	5	690
Philodromus diversus	4	552
Dendryphantes octavus	3	414
Anyphaena sp. (young)	2	276
Grammonota maculata	2	276
Oxyopes scalaris (young)	2	276
Mimetus interfector (young)	1	138
Xysticus piger (young)	1	138
Total Spiders	20	2,760

Remarks on Insects

In this lot of moss we find that there were 16 genera and species of insects as compared with 24 and 26, respectively, from the same quantity of moss taken from Mansura on January 27, 1909, the nearest comparative date. The actual number of insects, however, taken in the Mansura lot, was considerably greater than from the lot taken near Baton Rouge.

Eleven of these species occurred in the winter lots of moss collected at Mansura, nine of which were in the lot collected January 27. Among these are *Paromius longulus* and *Nysius californicus*, which occurred in all of the winter lots taken at Mansura, and, also, *Phalacrus penicellatus*, *Anthonomus suturalis* and *Lixus musculus*, which occurred in five of the six winter lots from Mansura.

The five species collected which had not been previously recorded from the moss, were *Megilla maculata*, *Chalybion caeruleum*, *Elaphidion parallelum*, *Entylia sinuata* and *Scymnus collaris.*

Remarks on Spiders

Of spiders we find that there were eight genera and species, or the same number as was found in the Mansura moss of January 27. The actual number of individual spiders taken was also about the same as the number taken from the Mansura lot of comparative date. Six of these spiders had been collected from other winter lots, four being recorded for the lot of January 27.

The two species which had not yet been taken from moss were, *Chiracanthium inclusum*, and *Xysticus piger.* Two species, *Philodromus diversus* and *Grammonota maculata*, had occurred in six of the previously recorded winter lots, and one, *Dendryphantes octavus*, had occurred in four.

Estacion Experimental, February 17, 1912

Proceedings of the Second and Third Annual Meetings of the Pacific Slope Association of Economic Entomologists

Owing to an extended absence from the State on the part of the Secretary, the proceedings of the Second Annual Meeting of the Pacific Slope Association of Economic Entomologists was not published and is here given only in part.

The second annual meeting occurred March 31st and April 1st, 1911, in Berkeley at the University of California in affiliation with the newly organized Pacific Association of Scientific Societies. The Entomology Building served as headquarters for the members. The following extracts are taken from the minutes of the meeting.

Friday, 9.30 a.m., March 31, 1911

Altho a preliminary business meeting had been arranged for 11 o'clock, this was postponed in order to attend the special University meeting held at this hour.

Friday, 1.30 p.m., March 31, 1911

The meeting, convening in the lecture room of the Entomology Building, was called to order by Professor C. W. Woodworth, President of the Association.

On motion of Secretary Herms, seconded by Mr. J. T. W. De Jong, a special business session was called for 7.30 p.m. of that day.

The following papers were then read and discussed.

1. "Some Insect Pests of California Oaks," by Professor R. W. Doane, Leland Stanford University. (Appears in this number of the Journal.)

2. "California Redwood attacked by Termes flavipes Koll.," by W. B. Parker, U. S. Dept. of Agriculture, Bureau of Entomology. (Pub. in Journal of Economic Entomology, Vol. 4, No. 5.)

3. "Development and Life History of Red Scale (*Chrysomphalus aurantii* Mask.)." Professor H. J. Quayle, University of California. (See Bulletin 222, University of California Experiment Station.)

4. "The Leakage Problem in Fumigation." Professor C. W. Woodworth, University of California. (Pub. in Vol. 4, No. 4, Journ. of Economic Entomology.)

5. "The Fructification of the Fig by Blastophaga." C. P. Rixford, U. S. Dept. of Agriculture, Bureau of Plant Industry. (Appears in this number of the Journal.)

6. "How long do Hymenopterous parasites live" (read by title). Prof. S. B. Doten, University of Nevada. (See Technical Bulletin No. 78, Agr. Exp. Station, Univ. of Nevada.)

7. "Field Work in Argentine Ant Control." L. J. Nickels, University of California. (Pub. in Vol. 4, No. 4, Journ. of Economic Entomology.)

Recess until 7.30 p.m.

Friday 7.30 p.m., March 31, 1911

Meeting called to order by President Woodworth, reading of reports having been made a special order.

a. Report of President, by Professor C. W. Woodworth.

b. Report of Secretary-Treasurer, by Professor W. B. Herms. The secretary reported a membership of fifty-eight. The receipts of the Association amounted to $60.95, disbursements $63.30, bills due $30.00, making a deficit of $32.35. The deficit is so large owing to the expense of stationery and preliminary matters of organization. Dues are being well paid up.

A discussion of the financial condition of the Association brought out the fact that the annual dues for 1911 would certainly wipe out the deficit and leave the treasury in good condition. Thru the immediate payment of dues on this same evening the matter was almost cleared up at once.

A discussion of ways and means for the publication of annual proceedings was entered into at this time. The Secretary announced that Dr. E. P. Felt, Editor cf the Journal of Economic Entomology, had offered the services of that Journal.

Motion made and seconded that the Association accept with thanks the offer of Doctor Felt and instructing the Secretary to correspond with him relative to printing the proceedings in one issue of the Journal. Motion carried unanimously.

Motion carried to proceed with program for the evening.

8:00 p.m. Symposium on the Scope of Economic Entomology as practised on the Pacific Coast from the viewpoint of:

a. The Horticultural Commissioner, Hon. H. P. Stabler, Yuba City.

b. The Insecticide Manufacturer, Mr. R. R. Rogers, San Francisco.

c. The Sanitarian, Prof. W. B. Herms, University of California. (Appears in this number of the Journal.)

d. The Educator, Prof. C. W. Woodworth, University of California.

Motion made by Mr. H. P. Stabler and seconded by Mr. L. J. Nickels that a copy of Professor Herms' paper on "Economic Entomology from the Viewpoint of the Sanitarian" be forwarded to the San Francisco papers for publication. Motion carried.

Saturday, 9.00 a.m., April 1, 1911

Motion made and carried that the regular order of business be set aside and that the President appoint a nominating committee to report immediately after the morning's program.

The President appointed the following members to constitute the nominating committee, viz., Professor R. W. Doane and Mr. A. L. Rutherford.

Reading of papers proceeded as follows:

8. "Some Coccid parasites in California." Professor H. J. Quayle, University of California. (See Bull. 222, 223 and 226, University of California Experiment Station.)

9. "The Quantity of Spray required." Professor C. W. Woodworth, University of California.

10. "Chalcids which feed at Punctures made by the Ovipositor." Professor S. B. Doten, University of Nevada. (See Technical Bull. No. 78, Agr. Exp. Station, University of Nevada.)

11. "The Distribution of Ecto-parasites." Professor V. L. Kellogg, Leland Stanford University. (Abstract appears in this issue of the Journal.)

12. "Anti-Malaria Campaigns in California,—methods and results." (To be published together with other material in book form, "Malaria, cause and control.").

The nominating committee reported the following nominations:

President,—Professor C. W. Woodworth, Berkeley, California
State Vice-Presidents,—
Arizona, —— ——, Phoenix
British Columbia, Hon. Th. Cunningham, Vancouver
California, Professor R. W. Doane, Palo Alto
Colorado, Professor C. P. Gillette, Fort Collins
Idaho, Professor L. F. Henderson, Moscow
Montana, Professor R. A. Cooley, Bozeman
Nevada, Professor S. B. Doten, Reno
New Mexico, Professor Fabian Garcia, Agricultural College
Oregon, Professor A. B. Cordley, Corvallis
Utah, Professor E. D. Ball, Logan
Washington, Professor A. L. Melander, Pullman
Wyoming, Professor Aven Nelson, Laramie
Executive Committee,—
Mr. R. R. Rogers, San Francisco
Mr. H. P. Stabler, Yuba City
Mr. L. H. Day, Hollister
Mr. G. H. Jackson, Monrovia
Secretary-Treasurer,—W. B. Herms, Berkeley, California

The secretary was instructed to cast a ballot for the election of these officers.

After a discussion of the time and place of the next meeting, the matter was left in the hands of the Secretary and adjournment took place.

Third Annual Meeting of the Pacific Slope Association of Economic Entomologists

The Third Annual Meeting of the Pacific Slope Association of Economic Entomologists took place at Stanford Univeristy, California, April 5th and 6th, 1912, in affiliation with the Pacific Association of Scientific Societies. The Entomologists had their headquarters in Room 432, Zoölogy Building.

Friday Morning, April 5th, 1912

11.00 to 12.00 Business Meeting. The Society was called to order by the President, Professor C. W. Woodworth. The minutes of the last Annual Meeting were read and approved. On motion the President appointed the following committees:

Auditing committee comprised of Professor R. W. Doane, Mr. G. A. Coleman and Mr. D. L. Crawford. Nominating committee consisting of Professor H. J. Quayle, Mr. J. C. Bridwell, Mr. E. O. Essig.

After announcements by the Secretary the Association adjourned to meet at 1.30 p.m.

Friday afternoon, April 5th, 1912

Motion carried that we proceed to carry out the program as printed.

The President called upon Professor Doane to occupy the chair. The chairman called for the first paper on the program "The Insecticide Industries in California" by Professor Woodworth. After reading his paper the President again resumed the chair.

The following papers were read and discussed:—

1. "The Insecticide Industries in California." Professor C. W. Woodworth. (Appears in this issue of the Journal.)
2. "Studies of the Petroleum Fly (Psilopa petrolei Coq.) in California." Mr. D. L. Crawford, Leland Stanford University. Published in full in Pomona Journ. Ent. Vol. IV, No. 2, pp. 687–97.)
3. "Diabrotica virgifera Lec. as a Corn Root worm." Professor C. P. Gillette, University of Colorado (Read by Professor W. B. Herms). (Appears in this number of the Journal.)
4. "A new Genus of Coccidæ destroying the Sugar Pine." Mr. George A. Coleman, University of California.
5. "Photographing Insects with demonstration of apparatus in the photographic room of the Entomological laboratory." Professor R. W. Doane, Leland Stanford University.

Friday Evening, April 5, 1912

At six-thirty the members of the Association present met at the Hotel Palo Alto for dinner together with the Biological Society of the Pacific Coast. After dinner an informal round table was indulged in, during which informal, chiefly reminiscent, talks were given by Doctor A. J. Cook, Professors Woodworth, Doane, Herms, Doctor McCracken, Mr. Bridwell and others.

The dinner and round table were voted a success and the secretary's plan to make this affair a regular part of the program for the future was approved.

Saturday morning, April 6, 1912

Meeting called to order by the President. The paper on "Hippodamia convergens and the Canteloupe aphis in the Imperial Valley" was called for. This paper was omitted yesterday owing to the absence of Mr. Bridwell.

After the presentation of the above paper the regular program was resumed, viz.:

7. "New Laboratory Apparatus." Professor C. W. Woodworth, University of California.
8. "The Chemistry of phenolic insecticides." Mr. G. P. Gray, University of California.
9. "Entomological Field Notes." Mr. J. C. Bridwell, University of California.

Owing to the advanced hour the meeting adjourned for luncheon to meet at 1.30 p. m. for the completion of the program and other business.

Saturday afternoon, April 6, 1912

Motion made and carried that the completion of the program be deferred until after the transaction of business.

A brief verbal report was made by the President, Professor C. W. Woodworth.

The Secretary-Treasurer reported a membership of 63, an increase of five during the year. The finances of the association were reported very much improved, the deficit of $32.35 having been wiped out with a balance of $7.15 in the Treasury.

The Auditing committee reported the accounts of the Secretary-Treasurer in good order and entries correct.

The report of the Nominating committee was read and the secretary was instructed to cast a ballot for the following officers:

President,—Professor R. W. Doane, Palo Alto
State Vice-Presidents,—
Arizona,—— ——
British Columbia, Hon. Th. Cunningham, Vancouver
California, —— ——
Colorado, Professor C. P. Gillette, Fort Collins, Moscow
Idaho, Professor L. F. Henderson
Montana, Professor R. A. Cooley, Bozeman
Nevada, Professor S. B. Doten, Reno
New Mexico, Professor Fabian Garcia, Agricultural College
Oregon, Professor A. B. Cordley, Corvallis
Utah, Professor E. D. Ball, Logan
Washington, Professor A. L. Melander, Pullman
Wyoming, Professor Aven Nelson, Laramie
Executive Committee,—
Mr. E. E. Luther, Watsonville
Mr. H. P. Stabler, Yuba City
Mr. J. C. Bridwell, Berkeley
Mr. G. H. Jackson, Monrovia
Secretary-Treasurer,—W. B. Herms, Berkeley

Motion made and carried that the Secretary be instructed to correspond with the Editor of the Journal of Economic Entomology relative to securing space in that Journal for the publication of the annual proceedings of this Association.

Motion made by President Doane and seconded by Mr. Morrill that the secretary be instructed to do all in his power to secure an international congress of entomologists for San Francisco for 1915, and that he correspond with Professor Vernon L. Kellogg, now in Europe, to that effect. Motion unanimously carried.

Motion made and carried that the Association extend a vote of thanks to the local committee on arrangements for efficient and kindly services rendered.

The remaining numbers on the program were then taken up, viz.:

10. "Malaria Investigations,—Epidemiology and Prophylaxis." Professor W. B. Herms, University of California. (To be published in Book form together with other material, "Malaria, cause and control.")

11. "Cleonus canescens Lec. as a Fruit Tree Pest." Professor C. P. Gillette, University of Colorado (Read by Professor W. B. Herms). (Appears in this issue of the Journal.)

12. "Demonstration of Breeding Methods in Heredity Experiments in progress at Stanford University." (Room 447 Zoölogy Building). Doctor Isabel McCracken, Leland Stanford University.

The visitors were taken to a room where Dr. McCracken was carrying on breeding experiments with the silk worms.
certain laws of heredity.

Adjournment then followed.

W. B. HERMS, *Secretary-Treasurer.*

SOME INSECT PESTS OF THE CALIFORNIA LIVE OAKS

By R. W. Doane, *Stanford University*

(As this is a preliminary report on the study of the Oak pests, only an abstract of the paper is given here.)

During the past year the oaks in the Santa Clara Valley have been having a particularly serious time. The live oaks especially have suffered from the attacks of leaf-miners. In addition to the leaf-miners, the twig-girdlers have been doing a great deal of damage and the carpenter worms, which heretofore have been found only occasionally in old weakened trees, have this year developed into very important pests, killing some trees and very seriously injuring many more.

The Oak Tree Moth. The first serious outbreak of *Phryganidia* in the Santa Clara Valley occurred in the fall of 1894 and the spring of 1895 when, entirely without warning, the larvae appeared in astounding numbers and completely stripped all of the oak trees in the vicinity of Stanford University, appearing in less number at the same time in other parts of the valley.

Few parasites were noted in the first fall brood of the larvae; the following over-wintering brood were found to be rather badly parasitized; and the larvae and pupa of the next fall brood, the third of the outbreak, were so badly parasitized that but few reached the adult condition and the parasites than remained in control a number of years.

During the spring and summer of 1908 nearly all the trees in the vicinity of the University were again defoliated. In June 935 larvae and pupa were collected from a mass on an oak tree; 228 of these were parasitized by *Pimpla behrendsii* Cresson, 704 were killed by a bacterial disease and three adults issued. In October of the same year 1170 were collected in the same locality; 83 per cent were parasitized, 6 per cent were killed by a bacterial disease, 4 per cent reached the adult condition and 7 per cent died from undetermined causes.

The larvae attacked by the bacterial disease showed to a remarkable degree the tendency to mass together.

Tussock Moth. Instances almost as remarkable might be cited to show how the tussock moth is controlled by its parasites, principally the Tachina flies, although the small hymenopterous parasites and the Dermestes beetles also do important work.

The last serious outbreak of the tussock moth larvæ occurred in the spring of 1907.

Leaf-Miners. We have at least three species of leaf-miners infesting the live oak. One has been called the "white blotch oak leaf-miner" on account of the characteristic white blotch on the upper side of the leaf. The larvae work only in the upper layer of cells, making a rather large irregular blotch in which they finally pupate after spinning a flat, loosely constructed web. Like other members of this genus, *Lithocolletes,* the larvae undergo an interesting change during development. The leaves of the white oak and the blue oak are attacked by the same species and sometimes seriously affected.

One of the other leaf-miners makes a long serpentine burrow which gradually grows wider as the larva increases in size. When it is full grown it drops to the ground and spins a small, rather closely woven brownish cocoon.

The other species, *Bucculatrix,* makes a dense brown blotch and a short serpentine mine which is distinctly visible on both sides of the leaf.

Part of the larval stage is spent as a miner and part as a surface feeder. The moult takes place under a circular white silken web on the under surface of the leaf. We have not yet determined the length of the different larval stages, but the typical ribbed *Bucculatrix* cocoons are made in May and June, the adults issuing a little later. The leaf-folders that simply fold over the edge of the leaf and the leaf-tiers that fasten two leaves together for protection while feeding, are often abundant enough to seriously affect the appearance of the tree, especially in May when the new growth comes.

Twig Girdler. During the last three years the California oak twig girdler (probably a species of Agrilus) has been increasing to an alarming extent. A few years ago the work of this insect was rarely noticed on the trees but now the beauty of many of our noblest trees is sadly marred. The larva evidently enters close to the tip of the twig in the tender new growth. At first it works in the center of the twig but as soon as it reaches the harder wood it works just beneath the bark in the cambium and sap wood. As soon as it enters the cambium it begins working down the twig in a spiral, thus effectively girdling and killing it.

As the larvae enter the twigs early in summer and work all winter until about June, they often kill quite large twigs. When scores of these pests are at work on a tree, the whole tree soon looks brown and ragged and presents a very unpleasing sight.

The Carpenter Worm. Early last fall our attention was called to certain oak trees that were dying. An examination showed that the trees were badly riddled by the carpenter worm. The greater part of the cambium was destroyed and the larval burrows were everywhere throughout the wood. Later we found that scores of other trees were badly infested, mostly with young larvae. Their presence was indicated by the exudations from the tree and the castings of the larvae. The young borers work mostly in the cambium and sapwood, sometimes making rather long winding chambers but more often eating out a large irregular shaped cell and loosening large pieces of the bark. After they have attained considerable size they bore deeper into the wood.

As some of the trees in Palo Alto were killed and others were seriously threatened, some of the students in our forestry class coöperated with the city of Palo Alto and all of the badly infested trees that stood in the streets were treated. The entrance to the burrow when stopped up was opened with a knife or chisel and a small pipette full of carbon bisulphid was introduced into the burrow and the entrance closed by being plastered over with mud. This killed all the larvae.

The Oak Tree Cerococcus. The underside of the large limbs and smaller branches of many of the live oaks is covered over with a slimy mould. For a long time this was supposed to be only a mould growing on the tree but it was found that its presence there was due to the fact that a peculiar scale insect, *Cerococcus ehrhorni*, was there secreting a honey dew in which this fungus grows. When these insects are present in such numbers as they frequently are, they must considerably impair the vitality of the tree.

If the oak tree finally succumbs to the attacks of some or all of these pests, it is immediately attacked by an army of other insects that live on the dying or dead wood. The Scolytidae come first, then the Buprestidae, Cerambycidae, and other wood borers, so unless the wood is protected it is soon destroyed.

Fungus Disease. A peculiar disease has been doing very serious damage to the live oaks in the Santa Clara Valley during the past fall and winter. On many of the trees a small patch of leaves would begin to turn brown, this area would rapidly spread, sometimes covering one side of the tree, rarely spreading over the whole tree. Seen from a short distance, these patches looked exactly like a fire had been burning under the tree and had leaped up and burned the leaves. Many trees lost most of their leaves in this way but as soon as the old leaves were off, new ones appeared and the trees seem to be recovering from the attack.

Dr. Meineche, who recently examined trees affected in this way, believes the disease to be due to a fungus working in the leaves and probably in the branches.

FRUCTIFICATION OF THE FIG BY BLASTOPHAGA[1]

By G. P. Rixford, *U. S. Department of Agriculture, Bureau of Plant Industry*

The subject of this paper is both botanical and entomological and to make it clear, it is necessary to mention some of the botanical characteristics of the fig.

Botanists are now generally agreed in the acceptance of the ideas of Linneus and others that the caprifig is the staminate form and the Smyrna and all the common figs in cultivation the pistilate form of a dioecious species. Hegardt reached this conclusion as early as 1844 and this view is now generally accepted.

The fruit of the fig tree is not a fruit in the sense in which we regard the apple, peach, etc., but is what is known to botanists as a receptacle, upon the inner surface of which are arranged hundreds of unisexual flowers. At the apex of the receptacle is an opening which in the young fruit is closed by a number of scales or imbricated bracts. The blossoms of the fig tree are therefore never seen except by opening the fig. The flowers thus being effectually cut off from the outer world, there is no way by which the pollen from the male flowers can reach the female flowers, except by the assistance of some outside agency. In this case the medium of conveyance is the female *Blastophaga grossorum*.

Crops of the Fig Tree. All the female fig trees, both of the Smyrna class, the fruit of which never matures without pollination, and the other large class which does not require pollination, have two well defined crops. The first pushes from the old wood and is the first to appear in spring, ripening in July and August and in the south of Europe are called Brebas, *figues fleurs* or *figues d'éte*. The next, which is the main crop, called in France *figues d'automne*, spring from the axils of the leaves of the new wood and ripen in summer and fall.

The crops of the male or capri tree are two well defined and a third which is in doubt by some authorities. To these for convenience the Neapolitan names, mamme, profichi and mammoni have been applied. The first or mamme crop forms in late summer on the wood of the current season and the Blastophaga from the preceeding mammoni oviposits in them when they have reached the size of filberts. By December these are the size of small walnuts and change but little during winter. The insect hibernates in them in the larval condition and will endure a temperature of 20 degrees without injury. As

[1] Read at the meeting of the Pacific Association of Scientific Societies held at Berkeley March 31, 1911.

the weather becomes warm in spring, the wasps develop rapidly and in April are ready to issue. At this time the spring or profichi crop on the same or other capri trees are in a receptive condition. This crop grows in clusters on the old wood at the extreme ends of the branches and, unlike the mamme which is nearly spherical is much larger and usually has a pronounced neck. It is produced in enormous numbers—many times greater than any other crop—a wise provision of nature as it is the one which is most abundantly supplied with pollen and also the one which is exclusively used to pollinate the main Smyrna fig crop.

The third or summer crop of the capri tree, known as mammoni, unlike the others, pushes from the axils of the leaves on the new wood and matures from September to the middle of November. The only purpose of this crop seems to be to carry the Blastophaga through the late summer and fall months and to produce seed. Dr. L. O. Howard, Chief of the Bureau of Entomology of the U. S. Department of Agriculture, has doubts as to the existence of three distinct crops of caprifigs and with good reason, for at times and in some climates belated mammoni hibernate with the mamme. The chief difference between the two is that the former contains a well defined cluster of staminate flowers, while in the mamme no male flowers have been observed. These hibernating figs are so similar in form and general appearance that without cutting them open it is difficult to tell them apart. They can be found on some capri trees at the present time. Last Saturday the writer in company with Prof. Harper of the University of California found considerable numbers of them on a tree at Niles. When their habits are better known they may prove to be an important source of pollen for the early crops of Smyrna and other breba figs, which for want of pollen often fail to develop. The Blastophaga from these oviposit in the winter crop and thus the cycle of the yearly life of the insect is completed.

The Fig Flowers. Count Solms-Laubach and Dr. Meyer, the German botanists, Olivier the Frenchman and Casparina, Gallesio and Pontedera, the Italians and later Dr. Gustav Eisen, author of the leading treatise on the fig in the English language, are all agreed that there are four kinds of flowers in the fig. It may seem presumptuous to take exceptions to this array of distinguished authorities, but it is nevertheless a fact, easily demonstratable with the abundant material now accessible in California, that there are but two kinds of fig flowers, namely pistillate and staminate. These authors enumerate the four kinds as the male and female of the caprifig, the regular female flower of the Smyrna fig and lastly the female flowers of the Adriatic class, which some of them contend have imperfect stigmas and cannot be pollinated and therefore call them mule flowers. Pontedera and Gallesio call such flowers *fico mula* and *fico semi-mula*, the latter a few of which are susceptible of pollination and the former not at all. This idea has become so fixed in the minds of some horticulturists that they are calling this class of figs "mule figs," a positive misnomer and entirely unwarranted by the facts.

The staminate flowers of the caprifig are arranged in a zone or cluster at the upper part of the fig, just within the eye. The remainder of the receptacle is filled with gall flowers which are nothing more than female flowers, the pistils of which are modified for the purposes of the female Blastophaga. The styles of these flowers are short and thick compared to those of the Smyrna and other female figs and are provided with a duct down which the female wasp pushes her ovipositor into the ovary where she deposits the egg. These styles are surmounted usually by forked stigmas, the surfaces of which are provided with the usual cells or glands and the viscous coating to which the pollen grains adhere. With sufficient magnifying power the pollen tubes can be seen pushing their way from the surface down through the cellular tissue into the ovary. The gall flowers of all caprifigs are alike except for slight variations in the shape of the stigmas.

We now come to the regular female flower of the Smyrna fig, upon the character of which all are agreed. The style is long and slim—two or three times longer than the style of the caprifig and this is the reason that it is unsuited for the purpose of the insect. It is divided at the summit usually into two stigmas and they appear to be identical with those of the Adriatic class to which belong all those figs which reach an edible condition without pollination. The stigmas of the latter, the books say, are mostly malformed and cannot be fertilized.

To show how erroneous is this conclusion it may be mentioned that during the spring of 1909 the writer by applying the Blastophaga to the so called "mule figs" in more than forty cases found that in every instance heavy fertile seeds were produced and in as large proportion as in the Smyrna fig. From these seeds thousands of plants were grown at the U. S. Introduction Garden at Chico. It is believed that such plants will be the means of producing some interesting varieties. The breeder does not have to wait long for results for most of the seedlings bear fruit at the age of two and three years.

A striking instance of the fertilization of common figs occurred last year at Loomis, Placer county, where a fruit grower had grafted a portion of an Adriatic tree with Smyrna scions. The Smyrna branches set quantities of figs and wishing to secure a crop the owner hung caprifigs in them containing Blastophaga ready to issue. Some of the wasps entered the Adriatic figs on the ungrafted part of the tree. The writer secured three mature Adriatic figs which showed by their larger size had been entered by the wasps. These three figs contained by actual count 4800 heavy, fertile seeds, or an average of 1600 for each fig—certainly a good crop for a "mule fig" which according to some writers will not breed.

In this way fertile seeds can be secured from all kinds of our cultivated figs and the breeder has complete control of such crosses and can with considerable confidence expect to perpetuate desirable hereditary characteristics in his seedling trees. It is found, however, from experience that about one-half of such seedlings are staminate trees. The process is exceedingly simple. A twig is selected with a number of figs from three-eighths to three-quarters of an inch in diameter, which is the receptive size in most varieties. Drop a caprifig with Blastophaga ready to issue into a paper bag and tie it tightly over the twig and the insect will do the rest. At the end of two or three weeks remove the paper bag and replace with one of mosquito netting for protection against birds and to prevent the ripe dried fig from falling to the ground.

Caprifig Seeds. The mammoni crop of the capri tree is the only one which has been observed to produce seeds and then only in small numbers. The obvious reason is that it is pollinated by the Blastophaga of the preceding profichi crop. The profichi itself yields no seed, because the mamme figs preceding it have no pollen, although the pistils are provided with receptive stigmas.

Solms-Laubach found 20 seeds in 40 mammoni figs and reached the conclusion that not more than one flower in 2000 was a perfect female flower, all the others being gall flowers, incapable of fertilization. The writer has found as many as 75 fertile seeds in one fig and from a large number of mammoni seeds secured last summer, young plants are now being grown at Chico. From careful observations the writer has been forced to the conclusion that all gall flowers are perfect female flowers and susceptible of pollination and that most of them are pollinated, but if the Blastophaga deposits an egg in the ovary, the resulting larva, would prevent the formation of the ovule and if formed would be eaten or otherwise destroyed. The seeds therefore found in the mammoni figs are from those flowers in which the insect failed to oviposit.

There seems to be some connection, not yet well understood, between the seed and the secretion of sugar and coloring matter. The pedicels and floral envelopes of the seeds in mammoni fig are succulent, sweet and generally of a pink color, while all parts of the gall flowers containing Blastophaga are white and quite dry, the difference in appearance being so great that the seeds can be readily picked out with a pair of forceps from the mass of galls by their juiciness and color.

As further evidence that all the flowers in the mammoni fig are perfect female flowers, some of the persistent styles were taken from fertile seeds and others from galls containing fully developed Blastophaga in the same fig and placed side by side under the microscope and were found to be identical in cellular structure and in every other respect. The writer is therefore satisfied that the stigmas of the caprifigs are equally as susceptible to pollination as are those of the female figs, and in fact are so pollinated but fail to produce more than a few seeds for the reason given.

When the Blastophaga enters the caprifig its stamens are in an undeveloped condition and will not be ready to shed their pollen until about two months later, that is at the time when the next generation of wasps is ready to issue. It is therefore impossible for a fig to pollinate itself. Here then is a striking instance of one of nature's methods of preventing self fecundation.

Life of the Blastophaga. The beneficent insect upon which depends absolutely the whole Smyrna fig industry was sent over to the United States from Northern Africa in 1899 by Mr. Walter T. Swingle of the Bureau of Plant Industry of the U. S. Department of Agriculture. He succeeded where others had often failed by confining his efforts to the winter generation and by the ingenious device of wrapping each caprifig in tinfoil to prevent evaporation. Mr. Swingle is entitled to full credit for his successful efforts, notwithstanding the fact that the Blastophaga was already here, having been accidentally introduced with fig trees from the South of Europe about 1865, but not known to orchardists until about three years ago, having been as far as known confined to an isolated tree ten miles west of Modesto.

In April in the warm valleys of California, the wasp which hibernated in the larval form during the previous few months reaches maturity. The male leaves the gall first. He moves about the interior of the fig and finding a gall containing a female, gnaws a hole through the cortex at the base of the style and inserting his long, slim, abdominal projection, fertilizes the female while still in the gall. The female enlarges the opening and sometimes makes another, usually at the base of the style, probably because it is the point of least resistance. In from 22 to 48 hours she comes out, reaching the open air through the cluster of male flowers, the anthers of which at this time have burst and are shedding large quantities of pollen. She is frequently so loaded that she is unable to fly until she divests herself of much of it in the same way that the common house fly cleans itself. After being relieved of part of the load she flies to the nearest fig and if found to her liking, immediately seeks the opening at the apex. At this time the figs are hard and from a quarter to three-quarters of an inch in diameter and the eye is closed by the overlapping scales. With her powerful mandibles she sometimes is obliged to cut away a portion of one of them to effect an entrance, but usually she is able to push her head in and after a struggle of sometimes five minutes or more pushes her body down the zigzag way to the interior of the fig, leaving her wings behind.

While one wasp is probably sufficient to fertilize a fig, where they are very abundant as at the Maslin orchard at Loomis, it is not unusual to find a dozen or fifteen in one small fig and as many more in a struggling mass trying to get in, often the cluster of wings radiating from the eye like the plumes of a feather duster. If the caprifig from which the wasp has issued has been hung in a Smyrna tree she enters a Smyrna fig and then finds she made a mistake, as the flowers are of such shape that she cannot oviposit in them, and after wandering about in a vain effort to dispose of her eggs, in this way doing her useful work of fertilizing the female flowers, in most cases crawls out. When the weather is warm, say 90 to 100 degrees, the insects are very active and come out of the caprifig with a rush. The writer has seen 40 come out in one minute. The issue takes place almost entirely in the forenoon, except a cold windy morning is succeeded by hot sun in the early afternoon, then a considerable number come out. The movement depends much upon the weather. During cool windy mornings very few issue, but if the next morning is warm, calm and sunny a great rush occurs. The wasps continue to issue from a single fig for a week or ten days and from various trees for two to three weeks. After the females have left the fig most of the males soon follow and being wingless drop to the ground like the females from the Smyrna figs.

Every Smyrna fig not entered by the Blastophaga dries up and falls from the trees. The same is true of the caprifig. In a few days the caprified fig undergoes a remarkable change. It begins to increase rapidly in size, becomes smooth by a lessened prominence of the ribs and losing its pea green color, assumes a decidedly pruinose tinge, this being true also of the caprifig.

There are still obscure problems to be solved in connection with the fructification of the fig and it would be gratifying if some of our skilled cytologists could be interested. One such problem is to determine why the first crop of certain figs reach an edible condition without caprification, while the next one never matures without it. One of these varieties is the white San Pedro and another is the Gentile, the first crop of the latter, however, does not entirely fail without pollination, but the crop is much increased by the application of the Blastophaga.

Outlook for the Fig Industry. The outlook for the Smyrna fig industry in California is extremely promising, due principally to favorable climatic conditions, and is rapidly spreading to all parts of the great interior valley. The climate is not at all inferior to that of the Smyrna district of Asia Minor, where the bulk of the finest figs of the world are now produced. The valley of the Meander, the seat of the great Smyrna fig industry, has a much moister climate and in some respects is inferior to that of portions of California. The rain fall is three or four times greater than that of the central San Joaquin valley, where in this state the industry has at present its greatest development. The rain however falls mostly from November to April with occasional showers and dew in summer, making irrigation unnecessary. One drawback in that country is that once in three or four years a frost occurs which is severe enough to destroy the caprifigs, when the growers are obliged to draw supplies from the frost free islands of the Mediterranean.

The ideal climate for Smyrna fig culture is one in which the winters are mild enough to permit the Blastophaga to live through without injury and freedom from early fall rains. The Smyrna figs ripen and dry on the tree in September, October and November and then fall to the ground, only the large figs require further exposure to the sun. Dry weather at this period is therefore indispensible. As these conditions prevail nowhere else in the United States, except in California and a part of Southern Arizona, these would seem to be the regions in which the industry will have its greatest development.

ECONOMIC ENTOMOLOGY FROM THE VIEW POINT OF THE SANITARIAN

(Abstract)

By W. B. HERMS, *University of California*

Entomology as a specific science was not known to our grandfathers, and the economic application as related to horticulture in the control of plant diseases is a development of this generation, while the application of entomology in the control of human and animal diseases, in public hygiene and sanitation, is the development of the last very few years. The new science of Medical Entomology is perhaps barely five years old and we, here on the Pacific Coast, have had a large share in its systematic development. The unique position geographically which California in particular occupies with reference to the entire world, provides an opportunity for observation and experiment not found elsewhere, and the climatic conditions afford a favorable basis for control when the life history and habits of the responsible disease vehicle are known. The following quotation from the letter of a prominent eastern physician indicates the tenor of a number of letters received from interested observers, viz., "It looks very much as if the Pacific States are destined to lead the nation, yes, the world, in this extremely important and direfully neglected work." Perhaps no state in the nation needs to protect itself more against the introduction of disease than does California because it is the goal of many thousands of health seekers and other visitors, but this it can do more easily and more successfully than any other state, on account of its natural resources conducive to health and vigor. The greatest menace of course is that of the parasitic tropical and semi-tropical diseases which are insect borne, owing to the fact that these diseases can thrive here almost without exception if once introduced.

The economic entomologist if also equipped as a sanitarian and parasitologist, has a greater opportunity by far to stay the advance of such diseases as malaria, yellow fever, bubonic plague and the like, than has the sanitarian without the entomological and parasitological training. Manifestly the person who is familiar with the habits of the Anopheles mosquito in addition to knowledge of malaria and the causative micro-organism, has a far greater advantage in controlling the disease. The same holds true for yellow fever, and bubonic plague as distributed by fleas, etc. As the successful economic entomologist is not merely a student of systematic entomology and morphology, he must indeed be proficient in chemistry and mechanics, so the Medical Entomologist must cover also a broader field and include in addition to the above, the greater portion of the field of Parasitology in a restricted sense, i.e., must be familiar with the habits of the pathogenic organisms carried, the manner in which insects become infected and in turn how these infect other animals and man.

With the scope of our subject pretty well defined it might be contended that this is not a branch of economic entomology at all, and indeed, the sanitarian may find little sympathy at the hands of the usual type of entomologist, perhaps because the mere matter of human life and happiness is involved,—that this field does not concern itself with the tree and its fruit, and the vine and its product. However that may be, and I do not ask for less attention to the horticultural side of economic entomology, but I do plead for more positive attention to the sanitary and hygienic phase of the subject. Surely where a preventable disease is concerned such as malaria, a good economic case can also be made. Business is far more keenly affected by malaria and mosquitos than we may at first thought suspect. There is perhaps no other disease that quite so successfully undermines a man's efficiency, his vigor, and good spirits. Victims of malaria whether employed in the orchard or vineyard, or in the wheat field, or at dredging or in construction, are only giving half in return for their wages. The value of real estate is greatly affected. Situations otherwise ideal for permanent house sites or summer homes are made practically uninhabitable by the presence of this disease. Malaria is always a great drawback to colonization,—great areas offering the most fertile soil and best of climate, affording otherwise the best of health conditions, are made of little value because of this disease, an infection which can be controlled almost absolutely and at a small relative cost. The malaria crusades under the writer's direction during the past year gave protection at the rate of 40 cents a day per square mile, with a reduction of malaria in the first season by approximately 45 per cent.

Once the real estate booster and colonizer gets the right view point things will change. The writer had to feel much opposition at first from certain classes of people who feared that publicity would do the town an injury. The attitude is changing rapidly so that now many who were once opposed, feel that it is a good advertisement to make known that the town of so-and-so is actively engaged in fighting malaria. And certainly it is, for everybody had already been well informed of the fact that this disease was prevalent there, notwithstanding all statements to the contrary.

The time will unquestionably come, indeed is already here, when the sanitary officers of a community will be required to have a knowledge of insect control, as far as disease carriers such as mosquitos, flies and fleas are concerned.

DISTRIBUTION OF ECTO-PARASITES

(Abstract of paper presented by Professor V. L. Kellogg)

In this paper Professor Kellogg called attention to some of the interesting problems in connection with both the geographic and particularly the host distribution of the various insect ecto-parasites of birds and mammals. Specific illustrations of these problems were drawn from the conditions presented by the Mallophaga, a group to which the speaker has given special attention for many years.

One of the most striking problems in this connection is that of the presence on two or more hosts of absolutely distinct geographic range, of a common Mallophagan species. For example, there are many species of Mallophaga which are common to European and American birds of different although usually related species and genera. Some of these cases can be explained by a circumpolar range and hence possible contact of the hosts, but in most this explanation is unavailable. Indeed in most of these cases the host individuals of the distinct American and European species are absolutely restricted to their Old World and New World habitats and never by any chance come into contact with each other. But there is no question of the identity of Mallophagan species found on these hosts. The speaker's solution for this problem is that the parasite species of the different but related host species has persisted unchanged from the common ancestor of the two or more host kinds.

The speaker pointed out that these problems of distribution of the ecto-parasites, which always have been of large biologic interest and importance, are now assuming, in the light of the discovery of the disease-disseminating possibilities of the parasites, a new interest.

THE INSECTICIDE INDUSTRIES IN CALIFORNIA

By C. W. Woodworth

California stands foremost among the states in the use of insecticides. Our annual bill for these materials amounts to somewhere in the neighborhood of a quarter of a million dollars. More than half of this money is sent out of the state but we possess a large and growing insecticide industry which is reaching out for other markets and it is likely that in the near future California will be exporting more insecticides than are being imported. Indeed, I confidently expect to see California take a leading place in the manufacture of insecticides.

In this paper I do not propose to discuss either the technical or the commercial aspects of this industry, interesting as these phases of the subject might be, but rather the relation this industry bears to economic entomologists. I am not sure we all appreciate the tremendous influence the manufacturers and dealers of insecticides are exerting. They are in touch with a hundred growers where an Experiment Station Entomologist reaches one. They have the last word when they furnish the goods just as they are about to be applied. Their advice will go far to confirm or to counteract our recommendations.

The quality and uniformity of the insecticides are factors of highest import and they are dependent solely on the care and honesty of the manufacturer or dealer.

The appreciation of the need of close co-operation is responsible for one of the distinctive features of this association. While the

American Association of Economic Entomologists is almost strictly an organization of investigators, the Pacific Slope Association numbers among its charter members and specifically recognizes in its constitution, the manufacturers of insecticides.

One of the most important results of this affiliation has been the enactment of the California Insecticide Law, a measure demanded by our leading manufacturers as well as by the fruit growers and which takes advanced ground regarding the guarantee of the quality of the goods offered for sale in this State. This law is sure to have a large influence upon the legislation of other states, and if our prediction of the dominance of California insecticide industries is well founded, it wil! have a direct and positive influence upon the economic entomology of the Pacific Coast.

The distinctive feature of the California Law is the requirement of the statement on the label of the composition of the insecticide. The manufacturer or dealer must guarantee, and the law requires under severe penalties, that he honestly guarantees, the composition of the insecticide he offers for sale.

The attitude of entomologists all over the country towards secret preparations has been one of suspicion and distrust and the influence of the dealers in such goods have in consequence been antagonistic, often in the extreme.

Entomologists have very generally held that secrecy is prima facia evidence of fraud. Many cases have been investigated and rarely have manufacturers of these preparations given full money value for the material sold. The California law strikes at the root of the evil and has decreed that hereafter there shall be no secret preparations offered for sale in this state.

The enactment of this law has driven out of the market the preparation known as I X L compound, which has been sold to growers in every part of the state and in very large quantities for more than a score of years,—a material fraudulent not because it was without insecticidal value but because every means was used to give an exaggerated estimate of its value, so that it was sold for far more than it was worth and was applied at a strength at which it could serve no useful purpose. This preparation was advertised as being at the same time patented and secret. As soon as the law required an honest statement of its contents, it ceased to be offered to the public.

The number of preparations of an entirely fraudulent character on the California market is not large. There are several hundred manufacturers of insecticides, large and small, in California and very few preparations have been withdrawn from sale since the law went into effect, though in many cases the composition has been changed fundimentally when the statement of composition was required. The chief benefit of the requirement of the statement of composition in the proprietary preparations is that the dealer can no longer safely make extravagant and therefore fraudulent claims of the efficiency of the preparation he is offering for sale. Many of the smaller manufacturers have urged that they were being compelled to divulge a valuable trade secret to their competitors but in no case, after the necessary formula was in my hands, did there appear any substance in any of the compounds as having insecticidal value which was not already a matter of common knowledge, and the secret, if there was any, lay in the per cent used of the different ingredients,—whether, for instance, A used 5 per cent of snuff in his flea powder.

The only real basis for objection lay in the fear that B could not sell his perfumed pink gasolene for ten times as much as he could charge for the ingredients, or that C could not sell vinegar and water for head lice at twenty-five cents an ounce.

Such sales border so close to downright frauds that arguments of this character appeal very strongly neither to entomologists nor to consumers, and if one has built up a trade for crude carbolic acid at several times its value by calling it "Lousene" or any other fanciful name, it has been accomplished by leading the purchaser to think that he is getting something better than carbolic acid when he buys the can with the picture label.

All manufactuers must now sell their insecticides for what they really are and a long step has been taken towards making the entomologist and dealer harmonize their recommendations.

The knowledge of the practical value of cyanide for orchard fumigation dates from a bulletin issued by the California Experiment Station.

Cyanide constitutes the largest single item of expense for insecticides in this state. None of it is made in California, and practically all of it comes from the firm of Roessler and Hasslacher and Company of New York. This material has varied very greatly in composition during the years fumigation has been practiced in California, and is at present of a higher grade and more uniform composition than in the earlier days. The acid used in generating the gas is all manufactured in California and is as large in quantity though cheaper in price than the cyanide. There are two large plants manufacturing the acid, one the American Agricultural Chemical Company near Los Angeles making the acid from crude sulfur, which is peculiar among crude chemicals by being almost chemically pure. The other, The Mountain Copper Company, with a plant near Martinez, that make the acid as a by-product, but produces, nevertheless a very high grade of acid.

There has been much complaint in years past as to the quality of the cyanide and more particularly regarding the acid, doubtless sometimes with justice but more often the trouble has not been with the chemicals used.

Next to the cyanide, the arsenicals take the most prominent place among insecticides. Outside of California the arsenicals easily hold first place. The United States insecticide law set definite standards for Paris Green and lead arsenate and did not mention by name any other insecticides.

Until within the last five years all the arsenicals used in California came from the East. Now the California Spray Chemical Company manufactures lead arsenate and zinc arsenite and supplies the major part, not only of the California market, but very largely also the Northwest.

The organization of this company came about because of the need of a specially insoluble grade of arsenate of lead, such as none of the Eastern manufacturers would supply, and which they are now only beginning to compete with. In most regions the danger to foliage is not so great as in the Pajaro Valley and therefore does not require this degree of insolubility.

All of the larger Eastern manufacturers of arsenicals still sell their goods in this state, probably in as large quantities as they did before the organization of the California Spray Chemical Company, since there has been a very great increase in the consumption of arsenicals following the Codlin Moth investigation conducted by the University in the Pajaro Valley.

Lime sulfur as a spray mixture originated more than a quarter of a century ago in California and was used in this state in large quantity for many years before its use spread to other states. For a long time it was the largest item of Insecticide work in this state and even yet may be more important than the use of the arsenicals. It is very difficult to obtain a reliable estimate of the amount used since it is still very largely a home made preparation. The lime used is all of local manufacture and the sulfur imported, largely from Japan.

Both of these materials are used quite extensively for other than insecticide purposes and but for this reason it would be very easy to get an estimate of the amount used in making this spray.

The commercial production of lime sulfur originated not in California but in the East and was introduced into California through the business enterprise of the California Rex Spray Company erecting an extensive factory at Benecia. Subsequently the California Spray Chemical Company began to manufacture this spraying material also, first for the strictly local trade, but now extending their market even into other states.

Through the efforts of these companies the use of the home made preparations have been largely replaced by the more uniform commercial product with very satisfactory results.

The competition of these two companies has resulted in a cheapening of the price and their rivalry has kept up or even increased the density, all to the benefit of the consumer.

Distillates of California petroleum have played a rather important role in the insecticide operations in this state. The refineries have from time to time, sold special spraying oils, but most of the spraying has been done with ordinary commercial grades of kerosene, or the cruder stove distillate, sometimes with the lighter grades of crude oil just as it comes from the ground.

In the past there have been many who have manufactured emulsions from distillates, chiefly for local trade. The only firm now making a commercial emulsion and the only one who has manufactured it for sale over the state generally is the Bean Spray Pump Company of San José, under their trade name "Buggo."

The R. R. Rogers Chemical Company of San Francisco were the first to put out, and, I believe now the only firm, manufacturing a true miscible oil which they sold under the name of "Spra-mulsion."

The use of power spraying outfits producing a mechanical mixture of a very satisfactory quality has prevented the large use of these emulsified oils, and the smaller users have not become sufficiently acquainted with the convenience and satisfactory character of these commercial products. Undoubtedly the future will see a greatly increased use.

Tobacco is coming to be a more important insecticide in California but the local source of supply is very limited. All of the commercial nicotine preparations are imported from the East. Forty per cent nicotine sulphate, sold by the Kentucky Tobacco Corporation, has become the standard, particularly since the insecticide law has gone into effect and the dealers are learning that the ordinary nicotine solutions are very unreliable in composition, possibly due to the decomposition of the alkaloid.

The high nicotine content of California tobaccos, which stand in the way of the commercial growing of this crop in the state, should indicate that there was a field for the growing of tobacco for this special purpose, though at present the Eastern nicotine is a by-product.

Nicotine sulphate is used largely both for tree spraying and as a dip for animals.

Most of the animal dips are made from crude carbolic acid and the same material has considerable use as a tree spray. When prepared and sold as a dip, the regulations of the U. S. Bureau of Animal Industry have operated to secure a fairly reliable standard but it has only been since the insecticide law went into effect that dealers have known what per cent of cresylic acid was present, and this has varied from 5–40 per cent.

Under these circumstances it is not at all surprising that experimenters have generally considered this material too unreliable to recommend nor that the results last year in the Santa Clara Valley were so irregular.

There are quite a number of local manufacturers; (I will not attempt to name them) compounding carbolic insecticides. The crude material and a good proportion of the preparations are shipped from the East. Entomologists have neglected very largely this cheap and efficient insecticide, leaving it to compounders of proprietary dog soaps, dips, sprays and lice killers, both liquid and powders, to exploit its use.

There is an important and very largely neglected field for the economic entomologist in the study of the remedies to be used on our domestic animals and in what are known as household remedies. By far the larger number of the California manufacturers of insecticides are compounding these preparations. Many of them admit that they have no practical knowledge of the relative efficiency of their compounds, that they are ready and anxious to make any change that experiment may indicate advisable in their formulae. Clearly here is an open field for our efforts of no small magnitude, since the aggregate sales of these preparations is much larger than generally appreciated.

We have already made some progress in the study of flea powders, of which scores of preparations are on the market showing a very great variation in efficiency. Most of these powders are compounded in the state.

Insect powder of the very highest quality is grown and manufactured by the Buhach Producing and Manufacturing Company of Stockton,—all the other insect powders and compounded flea powders are imported, or made up from imported ingredients.

To this class of household insecticides belong the many preparations for lice on human beings which are so much less prevalent than a generation or so ago, due to the almost universal and immediate application of remedies,—for bed bugs, which, though nowhere as prevalent in California as elsewhere, are accountable for a large sale of remedies,—for cockroaches, which are coming to be very annoying about San Francisco,—for houseflies, which are almost omnipresent,—lotions for mosquito and flea bites,—remedies for clothes moths and finally and by no means the least, the ant poisons, which have appeared in great variety, especially since the spread of the Argentine Ant to so many parts of the state.

The great desideratum is the improvement and standardization of the great host of what may be called the minor insecticides. Those that are used in the spraying of orchard trees have been reduced to a good degree of uniformity, due to the work of the economic entomologists and the use of these preparations correspondingly enlarged as the users appreciated more fully their reliability.

The California insecticide law will go far to standardize the other insecticides by giving publicity to their composition, provided that we contribute our share in the study of their relative efficiency.

THE PETROLEUM FLY IN CALIFORNIA

By D. L. Crawford, *Stanford University, California*

(Printed in Pomona Journ. Ent., Vol. IV, No. 2, May, 1912, pp. 687–97.)

DIABROTICA VIRGIFERA LEC. AS A CORN ROOT-WORM

By C. P. Gillette

Diabrotica virgifera Le Conte; Trans. American Entomological Society, Volume II, page 59;

Diabrotica filicornis Horn: Trans. American Entomological Society, Volume XX, page 94.

The last week in July, 1909, a neighbor told me that his sweet corn was being killed by a little grub boring in the roots. A week later, I went to examine the corn and found the adult beetles of the above species abundant, resting on the leaves and stems of the corn and quickly taking wing when approached. The grubs had practically all left the roots but the injuries to the roots and crowns were everywhere present, very few plants escaping the attack. The owner said there were plenty of grubs in the roots during July. Figure 1 of the accompanying plate was drawn from a corn stalk taken by Mr. L. C. Bragg on July 12th of the following year and fairly represents the injury that the larvae do.

On July 2, 1910, I received a card from Mr. R. C. Aiken, of Loveland, Colorado, stating that fully one-third of his sweet corn was practically dead from the attacks of a small white worm in the roots. Mr.

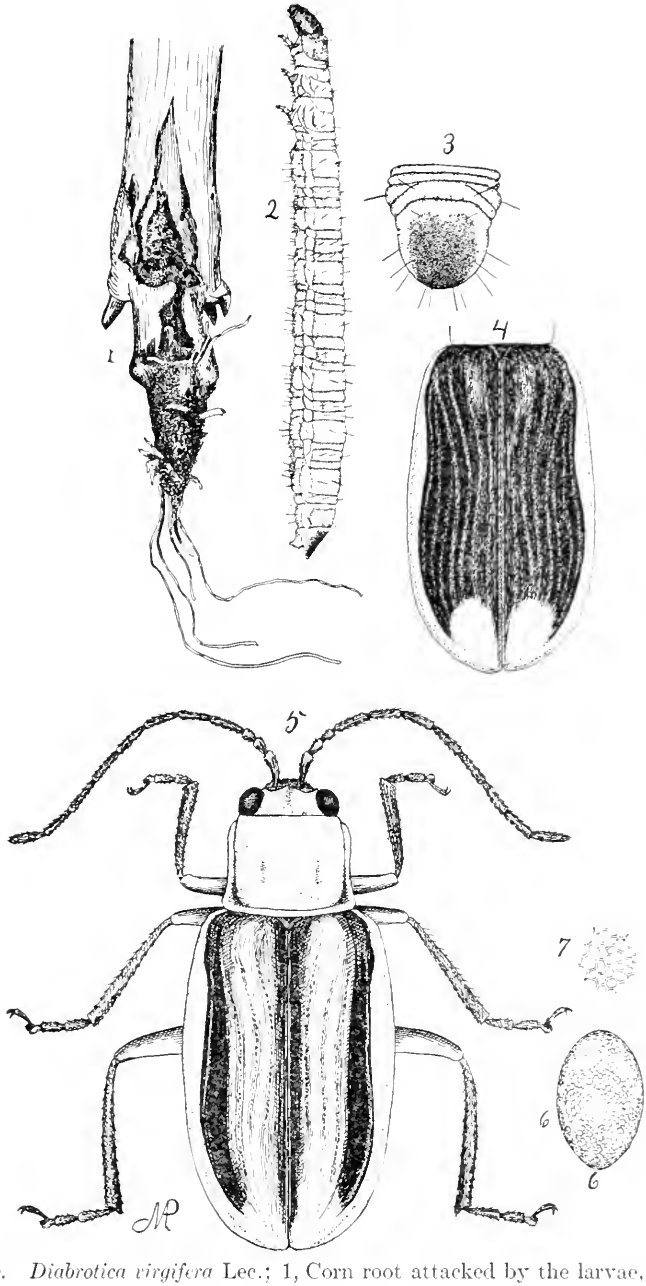


Plate 9. *Diabrotica virgifera* Lec.; 1, Corn root attacked by the larvae, $\frac{2}{3}$ natural size; 2, larva; 3, dorsal view of last segment of larva; 4, dorsal view of elytra of male; 5, female; 6, egg; 7, reticulation of egg shell. Figures 2, 4, and 5 are enlarged 10 diameters; figure 3, 16; figure 6, 30; and figure 7, 80 diameters. Original, M. A. Palmer, Delineator.

Bragg was sent to investigate the trouble and *D. virgifera* was found to be doing the damage. Mr. Bragg spent considerable time hunting for the injuries of the beetle during 1910 about Fort Collins and was able to report it fairly common on ground where corn had been grown for two or more years in succession and, in a few instances, the injuries were very severe. During 1911, the injuries seemed to be less, though the insect has been taken frequently about Fort Collins upon corn during the late part of the summer.

This insect occurs in two forms, one striped and closely resembling *D. vittata* as shown in Figure 5; the other with the wing covers black except for the narrow yellow margins and yellow tips, as shown in Figure 4. Specimens were sent to Professor Wickham, of the Iowa State University, who determined the striped form as *D. virgifera* Lec. and the dark form as *filicornis* Horn, and stated that *virgifera* is known from New Mexico, Arizona, and Sonora, while *filicornis* is known from New Mexico. I have not been able to find any references to either of these insects from other localities and the species was not represented in our collection here until taken in the patch of sweet corn mentioned above.

It did not seem possible to me that these two forms, with some intergrading in the color markings, could represent two species, as they occur in practically equal numbers together in all cases where we have observed them. Furthermore, the striped form had every appearance of being the female beetle and the black form, the male, and the two forms have frequently been taken *in copula*. Late in the summer, the striped form was found to be full of eggs, whereas ova never developed in the dark form, so I think the conclusion is safely drawn that *D. filicornis* Horn is the female of *D. virgifera* Lec. The antennal differences as given in the original descriptions seem to be constant for the two sexes.

Mr. Bragg followed the habits of this insect quite carefully in the field but was unable to find the eggs out of doors. Beetles brought into the laboratory, however, deposited eggs quite freely in test tubes. The eggs are pale yellow in color and measure about .65 mm. in length, .45 mm. in width, and are finely reticulated on the surface. See Figures 6 and 7. The larva is pale yellowish in color, 11 mm. in length when fully grown, and has a conspicuous black anal plate. See Figures 2 and 3. The length of the beetles varies little from 5 mm.

It seems certain from the observations that we have already made that the insect is single-brooded, and has practically the same life history as *D. longicornis*. This being the case, the very simple remedy will be, not to grow corn after corn where this insect has been at all common the preceding year.

CLEONUS CANESCENS LEC. AS A FRUIT TREE PEST

By C. P. Gillette

This insect has been reported to me on several occasions as a pest to young fruit trees on the western slope of the Rocky Mountain range in Colorado and Utah.

On June 30, 1908, Mr. O. B. Whipple, who at that time was Field Horticulturist for the Colorado Experiment Station, at Grand Junction, reported this insect to me as injurious to the foliage of young peach trees in an orchard near Grand Junction.

On July 10th of the same year, Mr. George P. Weldon, who at that time was acting as Field Entomologist on the western slope for the Colorado Experiment Station, reported the same insect to me as destructive to the buds and young leaves of newly set peach and apricot trees.

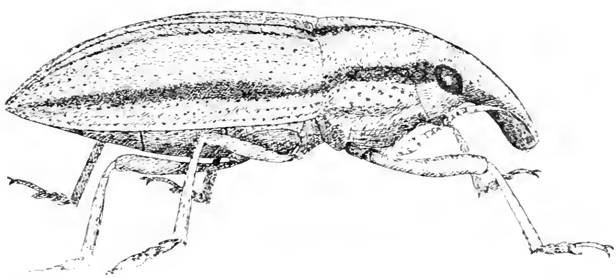


Figure 4. *Cleonus canescens* Lec.; Adult beetle enlarged 6 diameters. Original, M. A. Palmer, Delineator.

On June 20, 1910, Mr. Weldon took the same insect at West Lake, Utah, where he found it doing serious injury to the foliage of newly set apple trees. Mr. Weldon reported that the beetles were present in considerable numbers on every tree that he examined.

On June 27th, of the same year, Mr. E. P. Taylor, who was also acting as Field Entomologist on the western slope for the Colorado Station, sent me specimens of this beetle, which he reported as being destructive to the young leaves of newly set apple trees in the Grand Valley.

It is quite evident from these records that this beetle is a native and that it normally feeds upon the native food plants of the sections where it occasionally becomes injurious to the fruit trees. In every instance where the injury was reported, the trees were newly set on virgin soil.

ITONIDA INOPIS O. S.

By E. P. Felt, *Albany, N. Y.*

1862 **Osten Sacken, C. R.** Mon. Dipt. N. Amer. 1 : 196–97 (Cecidomyia).
1890 **Packard, A. S.** U. S. Entomol. Com. 5th Rep't., p. 800 (Diplosis).
1910 **Smith, J. B.** Ins. N. J. List, p. 732 (Cecidomyia).
1911 **Felt, E. P.** Econ. Ent. Journ. 4 : 465 (Cecidomyia).

Numerous resinous cocoons of this interesting gall midge were found on the needles of scrub pine, *Pinus rigida* at Karner, N. Y., May 22, 1912, adults soon commencing to issue therefrom and numerous parasites, *Polygnotus diplosidis* Ashm., being reared May 27 and 28. An examination of shoots bearing infested needles showed distinct swellings some 7 mm. long here and there, accompanied by more or less exudation of pitch. Some of these were contiguous and produced a nearly uniform enlargement extending for several inches on twigs of last year's growth. A few larvae were found within the swellings and numerous cocoons upon the needles, most of the midges having emerged by the 27th. The habits as outlined above and the characters of the cocoon and larva to be given below, agree with those given by Osten Sacken for a species observed on *Pinus virginiana* (*P. inops*), and as these two pines are closely allied there can be little doubt as to the identity of the insect. The midges, issuing the latter part of May or early in June, deposit their reddish orange eggs upon the needles and developing young growth, probably mostly on the latter under natural conditions. The maggots soon hatch and establish themselves in the tissues while the latter are still tender.

It is very probable that part of Packard's account of *Diplosis pinirigidae*[1] refers to this species, since we have failed to find any such resinous cocoons on needles of limbs bearing the characteristically deformed leaf clusters associated with this species. The female described in this account may be *I. inopis*, since the adult was reared from a cocoon at the proper time. It would be very easy to overlook the galls of *P. inopis*, especially if the infestation was sparse, and associate the cocoon, as Packard apparently did, with the deformed needles.

This species approaches the pitch midge, *Itonida resinicola* O. S. from which it is distinguished by its larger size, darker color and shorter antennal stems in the male. It is somewhat smaller than the western pitch midge, *I. resinicoloides* Wlms., a form easily recognized by structural characteristics. There is a difference in habit as well as color in the European *Itonida pini* DeG. The species of Itonida infesting

[1] 1890 U. S. Entomol. Com. 5th Rep't, p. 798–800.

pine resemble each other and may warrant segregation in a genus by themselves.

DESCRIPTION. *Gall.* Length 7 mm., a more or less distinct, subcortical swelling containing an irregularly oval chamber some 4 mm. long and 3 mm. in diameter. These swellings are frequently indicated by more or less exuding pitch.

Egg. Length 0.5 mm., narrowly oval, reddish orange.

Larva. Length 3 mm., reddish orange, moderately stout and with a series of subdorsal and lateral, conical, fleshy processes, the latter bearing moderately stout spines. On the posterior segment these processes seem to be fused and there appear to be a pair of submedian, lobelike processes, each bearing apically a heavy, chitinous, subconical structure supporting the spiracle, the latter being further protected by four short, stout, fingerlike processes. The head is small, tapering and remarkable because of the greatly produced, diverging processes at the latero-posterio angles; breastbone indistinct. The skin is coarsely shagreened.

Cocoon. Length 2.75 mm., diameter 1.5 mm., irregularly oval, whitish or yellowish white, becoming fuscous with the development of the insect and sometimes irregularly fluted; the anterior extremity is irregularly pointed, the insect escaping by forcing off a conical lid. The cocoons are attached by the side to the needles, to the developing shoots and occasionally to the twig.

Exuvium. Length 3 mm., the head and thorax and their appendages distinctly though variably fuscous, the abdomen semitransparent. The pupa, when escaping from the cocoon, emerges so as to expose only the fuscous portion of the exuvium. Antennae short, stout, hardly extending to the base of the abdomen, the wing covers to the third abdominal segment, the legs to the 6th and 7th abdominal segments.

Male. Length 2.25 mm. Antennae about as long as the body, sparsely haired, reddish brown; 14 segments, the fifth having the stems 1-2 and as long as their diameters, respectively. Distal enlargement nearly subcylindric, with a length 1-4 greater than its diameter, the circumfili moderately short, stout and with numerous loops. Terminal segment; distal enlargement produced, with a length 2 1-2 times its diameter, a constriction near the middle and an irregular, stout process apically. Palpi; first and second segments short, stout, irregular, the third with a length four times its diameter, moderately stout, the fourth 1-4 longer than the third, slightly dilated. Mesonotum dark brown, the submedian lines short, silver haired. Scutellum reddish brown, postscutellum dark brown. Abdomen dark reddish brown, the genitalia with a reddish cast. Wings hyaline, costa reddish brown. Halteres reddish brown, yellowish basally. Coxae reddish brown, the legs mostly a pale straw, the tarsi slightly darker. Claws moderately stout, slightly curved, simple, the pulvilli longer than the claws. Genitalia; basal clasp segment stout; terminal clasp segment short, swollen basally; dorsal plate short, very broadly and triangularly emarginate; ventral plate moderately long, broad and triangularly emarginate; style short, stout, broadly rounded.

Female. Length 3 mm. Antennae extending to the third abdominal segment, sparsely haired, reddish brown; 14 segments. The fifth having the stem 1-4 the length of the cylindric basal enlargement, which latter has a length 2 1-2 times its diameter. Circumfili moderately high, stout; terminal segment slightly produced, with a length thrice its diameter, with an irregular, broad knob apically. Abdomen reddish brown, the ovipositor about half the length of the body, fuscous yellowish, the terminal lobes lanceolate, with a length over four times the width, sparsely haired; legs mostly reddish brown, otherwise nearly as in the male. Cecid a2284.

PACIFIC COAST INSPECTORS ASSOCIATION

The meeting of the Pacific Coast Inspectors Association was called to order by Mr. M. L. Dean, Horticulturist of State of Montana.

By vote Mr. M. L. Dean was made President of the Association; Mr. J. Edward Taylor, State Horticultural Inspector for Utah, Vice-President, and Mr. J. U. McPherson, Horticulturist for Idaho, Secretary and Treasurer; with J. P. O'Gara of Medford, Oregon, F. A. Huntley of Tacoma, Washington, Dr. A. J. Cook of Sacramento, California, and Prof. C. P. Gillette of Fort Collins, Colorado, as members of the Executive Committee.

Chairman, Mr. M. L. Dean, authorized the Secretary to draft the Constitution and By-Laws of the Association, subject to the acceptance at the next meeting, which place and time is to be set by the President of the Association, and at which time the matter of fees to maintain the organization will be brought up.

The organization will, also, include in its membership all persons who are interested or engaged in the horticultural inspection work, either actively or in an advisory capacity.

Being no further business, the meeting adjourned subject to the call of the President.

Salt Lake City, Utah,
June 4, 1912.

Constitution and By-Laws

Article I. This organization shall be known as the Pacific Coast Inspectors Association.

Article II. The object of this Association shall be to promote and foster the horticultural interests and inspection work of the Western States:—Montana, Utah, Colorado, Idaho, Washington, California, Oregon, Wyoming, New Mexico, Nevada, Arizona, Texas, and British Columbia.

Article III. Any person, who is employed in inspection work, either actively, ex officio, or in an advisory capacity, can become a regular member of this Association upon the signing of the Constitution and the paying of annual dues.

Any person, who is connected with the inspection work in other states of the Union, may become associate members upon invitation of the Executive Committee. Associate members shall have the privilege of the Association, except holding office and voting; and they shall not be required to pay annual dues.

Article IV. The officers of the Association shall consist of a President, Vice-President, and Secretary-Treasurer; and Executive Committee made up of the aforesaid officers and four more to be elected; and an Advisory Committee to consist of the chief inspection officer of each state represented in the Association. They shall be elected by a ballot at each annual meeting. Their services shall begin at the close of the session at which they are elected, and continue for one year. The President can hold office during only two consecutive years.

Article V. The Association shall hold at least one meeting annually, at such a time and place as the Executive Committee designate. Special meetings may be called by the Executive Committee when the interests of the Association shall require it.

Article VI. The President, with the consent of the Executive Committee, shall appoint such committees as seem advisable for the best interest of the Association.

Article VII. The Constitution may be amended or changed at any regular meeting in the following manner:

1.–All proposed amendments must be filed with the Secretary at the opening of the annual meeting.

2.–No amendment can be acted upon by the Association unless read by the President at first session of annual meeting.

3.–The By-Laws of this Association may be amended by a majority vote of the regular members in attendance.

Article VIII. The annual dues of the members of this Association shall be fixed by the Executive Committee subject to change at any regular meeting. The dues of the ensuing year shall be $1.00.

DUTCH INSPECTION SERVICE

We have at hand a recent communication from Dr. J. Ritzema Bos of the Phytopathological Service of Holland, calling attention to minor changes in the certificates from the form published in the February issue of the JOURNAL, pages 85–86.

The modifications in the certificate are mostly in a transposition of the data relating to destination and contents. The copy certificate is modified to contain a specific provision against infestation by the brown-tail moth, and provision is also made for numbering and the Service stamp..

Dr. Bos, in his communication, states that every consignment from Holland must be provided with a certificate, both stamped and numbered, adding that the Dutch Inspection Service must not be held responsible for shipments not accompanied by these certificates. He would also esteem it a favor if parties receiving from Holland nursery stock, which had not been inspected, would notify him in regard to the same.

GIPSY MOTH

A small colony, apparently of about three years' standing, and practically confined to a city block, was discovered recently at Geneva, N. Y. No expense is being spared and an early extermination of this out-lying colony may be expected. Similar infestations may develop elsewhere, and the probability of such occurrences emphasizes the need of careful inspection.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

AUGUST, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The economic entomologist certainly deserves all the credit he receives, since altogether too frequently enthusiasts in this branch of natural science are called upon to serve at a rediculously low compensation, considering the requirements of the position. Personal notes, records of achievements and summaries of the life work of our associates are valuable stimuli to professional workers and frequently give the layman a glimpse of conditions as they exist. We print in this issue a series of memorial resolutions, feeling that the party richly deserves all of the honor conveyed or implied thereby, and yet we are of the opinion that in most cases an obituary notice with its summary of the life work, is of more interest to readers and will prove of greater historical value.

The economic entomologist is not primarily a systematist, yet he is occasionally compelled by exigencies to undertake taxonomic work and not infrequently encounters perplexing questions in nomenclature. The Entomological Code, recently compiled by Messrs. Banks and Caudell, promises to be of much service in affording a basis at least, for the settlement of troublesome problems. It is extremely unlikely, as the authors point out, that all the provisions will be satisfactory to any worker, yet it is an important step toward unifying procedure, and we trust that all entomologists will interpret the provisions of the Code in a comprehensive manner and with due regard to the welfare of Science as a whole. The authors, in undertaking this task, mostly thankless we fear, have laid their fellow workers under a burden of debt, an obligation which will become more evident with the progress of time.

This issue, following the example of some popular magazines, might be denominated our western number, since it contains the Proceedings of the Pacific Slope Association of Economic Entomologists with its valuable contributions from entomologists in that section of the country. All such matter is gladly published. It is not our intention to issue a local Journal, whether we speak of sections, nations or even hemispheres. We take this opportunity of assuring all economic entomologists in all parts of the world that articles covering any phase of economic entomology are most heartily welcome. Several efforts have been made to secure papers from entomologists not resident in the United States and for the most part with comparatively little success. Our collaborators in Africa, Asia and Australia, to mention only a few regions, must have much worthy of publication and frequently of general interest. An international scientific Journal can be successful only through the co-operation of all and we bespeak once more the assistance of scientists stationed in distant sections of the globe.

Memorial

CLARENCE E. HOOD

WHEREAS, It has pleased God to take unto himself our beloved friend and coworker CLARENCE E. HOOD; and

WHEREAS, Our dear friend by his earnest endeavors and never ceasing efforts had already reached a prominent position in his chosen field and that the scientific investigation he was so ably carrying on will suffer greatly by his sudden and untimely death; and

WHEREAS, His lovable character and ever ready desire to help others had won for him an esteemed place in the hearts of his fellow workers; be it

Resolved, That we, his fellow entomological workers of Porto Rico will ever hold dear the remembrance of one whose friendship was held in such high esteem; be it further

Resolved, That we extend to the family of the deceased our sincere and heartfelt sympathy and be it further

Resolved, That a copy of these resolutions be sent to his family and one published in The Journal of Economic Entomology.

W. V. TOWER,
D. L. VAN DINE,
C. W. HOOKER,
R. I. SMITH,
THOS. H. JONES,
S. S. CROSSMAN.

June 26, 1912.

WHEREAS, The Board of Commissioners of Agriculture of Porto Rico has lost by death its esteemed friend CLARENCE E. HOOD; and

WHEREAS, He made a trip into Mexico in the interest of this Board, thereby placing himself in the midst of great danger, but was spared to return from the trip unharmed; and

WHEREAS, Clarence E. Hood by his love for his work and his faithful and active nature, was one of the most promising of the younger Entomologists; and

WHEREAS, His manly and lovable character had placed him high in the affections of the Board; therefore be it

Resolved, That in the death of Clarence E. Hood the Board has suffered a great loss; be it further

Resolved, That the Board wishes to especially show their appreciation and admiration for a man who put away fear, for the best results, when his work took him into danger; be it further

Resolved, That the project which he was so well prepared for, will be retarded by his sad and untimely end; be it further

Resolved, That the Secretary be instructed to send a copy of these resolutions, with an expression of their most sincere sympathy to his family; and be it further

Resolved, That a copy of these resolutions be published in the Journal of Economic Entomology.

W. V. TOWER,
Entomologist and Secretary for the Board.

June 26, 1912.

Reviews

The Plum Curculio, by A. L. QUAINTANCE and E. L. JENNE, U. S. Department of Agriculture, Bureau of Entomology, Bulletin 103, p. 1–250, 20 plates and 33 figures. 1912.

Our Federal Bureau of Entomology is to be congratulated upon having issued another comprehensive and well illustrated monograph upon an important pest. The careful study of the biology of such an insect in various representative sections of the country is invaluable because of the light thrown on methods of control. This type of work is peculiarly appropriate to a Federal agency.

This is both a full account and an important contribution to our knowledge of the plum curculio. The original description is reproduced, followed by a detailed history of the insect and a discussion of its distribution, food plants, life history, etc., the work closing with an exhaustive bibliography. Reference to the map shows that this common species is confined to the eastern and central United States and to the eastern and central part of southern Canada. The annual loss is estimated by the authors at $8,500,000. There are detailed records of oviposition, showing that ¾ of all the eggs are laid within six weeks, the egg period lasting six or seven days. The larvae emerge from the fruit mostly at the end of the third week from oviposition, the insects remaining in the soil three to six weeks, most of them only four or five. This is particularly valuable since it is based on extensive studies in several localities.

The discussion of remedial measures includes a historical account of earlier methods followed by a consideration of the relative value of collecting, spraying and cultivation for the destruction of pupae. The authors hold that the older method of jarring is giving way to the more modern spraying with poisons, supplemented possibly by cultivation for the destruction of pupae. Experiments show that the latter results in the average destruction of about 33% of the insects. It is worthy of note that the one spraying for the codling moth just after the blossoms fall is a very effective treatment for the control of the curculio. The authors state that thorough spraying greatly reduces the pest in all cases, though the degree of benefit varies widely. They find that with an abundance of insects and a small crop, thorough spraying will not produce a satisfactory amount of sound fruit. Clean culture and the planting of orchards some distance from woodlands or other natural shelters is of material benefit. There is also a valuable chapter upon spraying peaches with arsenicals. The authors are to be congratulated upon having prepared a standard work.

Papers on Insects Affecting Stored Products, by F. H. Chittenden, U. S. Department of Agriculture, Bureau of Entomology, Bulletin 95, Parts 2 and 3, pages 19–52. 1911.

These two parts give general biologic and systematic accounts of four of the less known grain pests, namely, the broad-nosed grain weevil, *Caulophilus latinasus* Say, the long-headed flour beetle, *Latheticus oryzae* Waterh., the lesser grain borer, *Rhizopertha dominica* Fabr., and the larger grain borer, *Dinoderus truncatus* Horn. The first named, the author regards as a permanently established enemy of dried cereal and other food products in the United States; the second is a recent introduction thus far known only in Texas, while the two remaining, though of considerable importance in tropical climates, are seldom injurious in colder countries. The author considers that we may adopt as a general standard, 2 lbs. of carbon bisulfid to 1,000 cubic feet of space, the temperature being between 65° and 75° F. and continuing the fumigation for 48 hours or more or until the odor of the gas has become entirely dissipated. The species discussed are well illustrated.

A Manual of Philippine Silk Culture, by C. S. Banks, Department of the Interior, Bureau of Science, Manila, pages 53, plates 20. 1911.

This comprehensive, almost monographic work gives a historical account of silk culture in the Philippine Islands, a summary discussion of the silk worm, *Bombyx mori* and of the eri or castor silk worm, *Attacus ricini*, together with a brief mention of several wild silk worms. The growing of the mulberry, the selection of cocoons, the shipment of eggs and the elaboration and culture of silk also receive attention. The value of the latter is greatly increased by two plates giving the plans of a house for growing silk worms and also diagrams showing the construction of a hand silk-reeling machine. There are admirable illustrations of the various silk worms in their different stages. The work is practical and should be of great service in establishing a profitable industry in our Island possessions.

Current Notes

Conducted by the Associate Editor

Dr. L. O. Howard left Washington about July 1st for a brief European trip.

Mr. Shigern Kuwayama, author of papers on the Psyllidae of Japan, died Feb. 17th, 1912.

Mr. Henry B. Weiss, has been appointed acting State Entomologist of New Jersey.

Mr. H. C. Eagerton, has been appointed extension assistant in entomology, at Clemson College and Station, S. C.

Mr. R. W. C. Shelford, known for his work in entomology, formerly connected with the Oxford Museum, died on June 22nd, aged thirty-nine years.

Dr. Nettie M. Stevens, associate in Experimental Morphology at Bryn Mawr, and the author of a number of papers dealing with insect structures, died at Johns Hopkins Hospital, Baltimore, May 4th, 1912.

Mr. Nathan Banks, of the Bureau of Entomology, is in Europe for a few months, and will visit several museums for purposes of study.

Professor Herbert Osborn gave the principal address at the twenty-fifth anniversary meeting of the Iowa Academy of Science, held at Des Moines, April 26, 1912. This address was printed in *Science* of July 12.

William B. Herms, assistant in entomology, has recently been promoted to assistant professor of applied parasitology, University of California.

Dr. A. W. Morrill, State Entomologist of Arizona, spent his vacation in Massachusetts in July, and visited a number of entomological laboratories in the northeastern states before returning to his work in Arizona.

Professor R. H. Pettit, professor of Entomology in Michigan Agricultural College, visited the New England States the latter part of June to familiarize himself with the work there against the gypsy and brown tail moths. He also visited the Entomological department of the Massachusetts Agricultural College, at Amherst, and of the Connecticut Agricultural Experiment Station, at New Haven.

Colonel Wm. C. Gorgas, chief sanitary officer of the Panama Canal Zone, received the honorary degree of Doctor of Law, at Johns Hopkins University, June 11th.

An act has passed the Arizona legislature, and has been approved by the governor of the state, amending the Horticultural Law, which has been in operation for the past three years. The scope of the work has been enlarged and the Horticultural Commission will hereafter be known as the Arizona Commission of Agriculture and Horticulture.

The duties for the State Entomologist have been better defined and many other important changes made. An annual appropriation of $12,000.00 is provided, and in addition an emergency reserved fund of $1,500.00 is established, to be drawn upon only in the event of the discovery of the Alfalfa Weevil in the state.

Prof. C. F. Baker, we learn through the *Monthly Bulletin* of the California State Commission of Horticulture, has resigned as head of the Department of Biology of Pomona College to accept a similar position in the Philippine Islands.

Dr. E. A. Back has resigned as Entomologist of the Virginia Crop Pest Commission and the Virginia Agricultural Experiment Station to re-enter government service as Expert in the Bureau of Entomology. Dr. Back will have charge of the Bureau's investigations of the Mediterranean Fruit Fly in the Hawaiian Islands. His address is Honolulu, T. H.

The American Association of Nurserymen, at the recent Boston meeting, adopted the following resolution:

"RESOLVED—That the report of the Legislative Committee on matters of Federal Legislation be accepted and that their endorsement of House Bill #24119 be approved, and further, that the new Legislative Committee be instructed to co-operate with the United States Department of Agriculture in urging the speedy passage of the Bill referred to, or any other bill not materially changing the provisions thereof."

Mailed August 21, 1912.

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

WILL SELL FOR CASH a complete set of Illinois Geological Reports, or will exchange for technical entomological writings, those dealing with parasitic insects preferred.

J. E. Hallinen, Interlaken School,
Laporte, Ind.

WANTED—To correspond with those desiring to exchange life-history series of important insects for economic collections.

W. E. Hinds, Auburn, Ala.

WILL PAY CASH or exchange for parts 9 and 10, Vol. IV, Insect Life.

H. F. Wilson, Bureau of Entomology,
Washington, D. C.

WANTED—Bulletins Bureau of Entomology, new series, Nos. 2, 15, 21, and Technical series, Nos. 1, 4, 5, 6, 7. Will pay cash.

James F. Zimmer, Bureau of Entomology,
Washington, D. C.

WANTED—Exp. Sta. Record, Vol. 3 No. 4 and Vol. 4 No. 5; Trans. of the Am. Ent. Soc. Vols. 2 and 3; Proc. of Ent. Soc. of Philadelphia, Vol. 2; Ann. Repts. Ent. Soc. of Ontario Nos. 2, 3, 7, 8; Papilo, Vol. 2 Nos. 2, 3 and 7, Vol. 3 No. 1. Will pay cash or exchange.

R. W. HARNED,
Agricultural College, Miss.

I offer in exchange for rare lepidoptera or coleoptera from the U. S. of N. A. specimens of the introduced species of Mantis—Tenodera sinensis; also, specimens of the rare beetle—Polyphylla variolosa.

Philip Laurent, 31 East Mt. Airy Ave., Philadelphia, Penn.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4, 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS.
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

WANTED—Will pay cash for Buls. 7, 8, 11, Tech. Ser. Bur. Ent. U. S. Dept. Agr.

H. A. GOSSARD,
Wooster, Ohio.

BACK NUMBERS WANTED.

Will pay 60 cents for No. 2, Volume I, and 30 cents each for No. 1 and No. 6, Volume II, No. 6, Volume III, and No. 2, Volume IV, to complete sets. Address:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.
MELROSE HIGHLANDS, MASS.

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

A bi-monthly journal, published February to December, on the 15th of the month, devoted to the interests of Economic Entomology and publishing the official notices and proceedings of the American Association of Economic Entomologists. Address business communications to the Journal of Economic Entomology, Railroad Square, Concord, N. H.

TERMS OF SUBSCRIPTION. In the United States, Cuba, Mexico and Canada, two dollars annually in advance. To foreign countries, two dollars and fifty cents ($2.50) annually in advance. Single copies, fifty cents. To members of the American Association of Economic Entomologists, one dollar annually in advance. 50 cents extra postage to foreign countries.

MANUSCRIPT for publication should be sent to the Editor, E. Porter Felt, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. Burgess, Melrose Highlands, Mass.

Vol. 5 OCTOBER, 1912 No. 5

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Published by
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
Concord, N. H.

Entered as second-class matter Mar. 3, 1908, at the post-office at Concord, N. H.,
under Act of Congress of Mar. 3, 1879.

CONTENTS

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 5 OCTOBER, 1912 No. 5

THE TICK PROBLEM IN SOUTH AFRICA

By WILLIAM MOORE, *School of Agriculture, Potchefstroom*

One of the most important and interesting problems in Economic Entomology is the role played by ticks in the spread of certain diseases and how these ticks may be destroyed. There is probably no other country in the world where the tick problem assumes the proportion that it does in Africa. Most of the articles dealing with ticks which are available for the entomologist abroad do not consider the problem as it is presented to the entomologist and stock farmer in Africa. It is therefore—with the object of expressing the situation as it is in South Africa, that this paper is written.

Ticks and the Diseases Transmitted. In South Africa it is not one tick and one disease which must be dealt with, but a number of ticks producing a number of different diseases. *Boophilus decoloratus* Koch, the blue tick, carries Texas cattle fever (known in South Africa as redwater)—and *Spirochætosis,* the latter being a disease of cattle, horses and sheep. *Amblyomma hebræum* Koch, the Bont tick, transmits a disease of sheep, goats and cattle, known as heartwater. The organism causing the heartwater has not yet been observed, and it therefore differs from the other diseases transmitted by ticks, which are caused by Protozoa. *Hæmaphysalis leachi* Audouin, the dog tick, transmits the organism causing malignant jaundice, a rather fatal disease of dogs. *Rhipicephalus appendiculatus* Neumann, the brown tick, transmits East coast fever and gall-sickness of cattle, and may also transmit Texas cattle fever. *Rhipicephalus capensis* Koch, the Cape brown tick, transmits East coast fever. *Rhipicephalus simus* Koch, the black-pitted tick, and *Rhipicephalus evertsi* Neumann, the red tick, transmits East coast fever and gall-sickness, while *R. simus* may also transmit *Spirochætosis,* and *R. evertsi* is the carrier of biliary fever of horses.

Besides the ticks which are known to transmit diseases, there are many others which attack domesticated animals. Among these may be mentioned *Ixodes pilosus* Koch, which attacks sheep, goats, oxen, horses, etc., and is supposed to be the cause of a paralysis of sheep in Cape Colony; and *Hyalomma ægyptium* Linn., the Bont leg tick, the adult of which may be found on all domestic animals, and is thought by some to cause abscesses on the animals. Other ticks whose injury may only amount to tick worry, are *Ixodes rubicundus* Neumann, *R. oculatus* Neumann, *R. sanguineus* (Lat.), *R. lunulatus* Neumann, *R. duttoni* Neumann, *R. bursa* Canestrini & Fanzago, *R. nitens* Neumann, *Amblyomma variegatum* (Fabr.), and sometimes *A. marmoreum* Koch.

The Life History of Certain Species. With this formidable array of ticks and diseases that they transmit, it can readily be seen that their destruction is not so simple as the control of *B. annulatus* is in the Southern United States. The problem is made more difficult by the fact that the life history of the various ticks differs considerably and in some cases is such, that destruction is impossible or next to impossible. Due to the work of Doctor Theiler, C. P. Lounsbury and C. W. Howard, the life cycle of many of the common ticks has been worked out. *B. decoloratus* has a very simple life cycle. In about five days or more from the time the engorged female drops from the host, the eggs are laid. These hatch in from three to six weeks—or in winter a longer period is required. The larvæ may live for six or eight months without feeding. *B. decoloratus* seeks but one host in its life time, i. e. the moult from larva to nymph and from nymph to adult is performed without leaving the host animal. The period spent on the host is about three to four weeks. The eggs of *R. evertsi* hatch in about 30 days, and the larvæ can exist for seven months without feeding. *R. evertsi* differs from *B. decoloratus* in that two hosts are attacked in its life time. The moult from larva to nymph is performed upon the animal, but the engorged nymph drops from the animal and moults on the ground, seeking a second host for its adult existence. The time spent on the first host is about ten to fifteen days, but the adult tick may live for as much as a year, should it not find a suitable host. The adult tick remains on the host animal from six to ten days. The life cycle of *R. appendiculatus* is typical for *R. capensis*, *R. nitens*, and *R. simus* and is given for the group. The eggs are laid by the engorged female in about six or more days from the time she drops from the host animal. These hatch in from 28 days to several months, depending upon the temperature. The larva remains on the animal for about three to eight days, after which it too drops to the ground to moult—which is accomplished in about

21 days. The nymph attaches itself to a second host animal and remains for from two to seven days, when it drops off to moult to the adult. The second moult occupies about 18 days. The adult remains on the third host for a period of four to seven days. The larval tick can exist for seven months should it not find a host, the nymph six and one-half months, and the adult nine and one-half months. *A. hebræum* also has a life cycle much similar to *R. appendiculatus.* Three hosts are sought, the larva remains on the animal from four to 20 days, the nymph four to 20 days, and the adult 10 to 20 days.

H. ægyptium differs from the above species in that the larvæ attach themselves to various birds and hares. The larva moults to the nymph while on the bird, but the engorged nymph drops to the ground to moult to the adult. The adult attacks domesticated animals, being often very abundant upon oxen. *A. marmoreum* differs from *H. ægyptium* in that it is the larva or nymph which attacks oxen and goats, while the adult and also the nymph are very common upon tortoises.

"Trekking." Long before any relationship between ticks and disease had been discovered or even thought of, many of the Boers employed methods of ridding their flocks or herds of disease which were really based upon the distribution of the disease transmitting ticks. The High Veld is one of the farmers' favourite grazing sections of South Africa. The average altitude of the High Veld is between 4000 to 6000 feet. In the summer the land is covered with green grass, which makes very good grazing for cattle and sheep. Over this area the ticks which transmit diseases are limited or nearly limited to *B. decoloratus* and *R. evertsi.* The reason for this is that the group of brown ticks and the Bont tick cannot withstand the temperature. In the winter the grass dries up and the pasture becomes poor, so the stock farmers started the practice of "trekking" or traveling with their animals to the warm low veld or bush veld, where the grass was abundant. There their animals often took sick from some of the "tick diseases"—especially was this true with the approach of the hot weather. The Boers would then trek back to the higher country, and upon reaching a place where the ticks which caused the disease could no longer live, the disease would disappear.

Grass Burning. Grass burning is another early method which was and is even yet often employed to reduce the number of ticks. By burning off the dry grass, the new green grass comes up much sooner and will furnish grazing for cattle and sheep at a much earlier date. Some farmers noticed that after the grass had thus been burned off, the animals suffered far less from ticks. The practice of grass burning then came to be adopted against the ticks themselves. Burning off the grass, when the larvæ ticks are sitting on it waiting for a host animal, will greatly reduce the number of ticks, but of course fails to destroy the ticks or tick eggs which are in a protected position.

Starvation of Ticks. The starvation method of eradicating ticks —which has been so successful in the Southern United States, against *B. annulatus* has been tried in South Africa, but has not been so effective. If *B. decoloratus* was the only tick which was to be starved out, the method would prove successful in this country, providing all the host animals were kept off the land for a period of nine to ten months. The animals would all be moved into plot B and at the

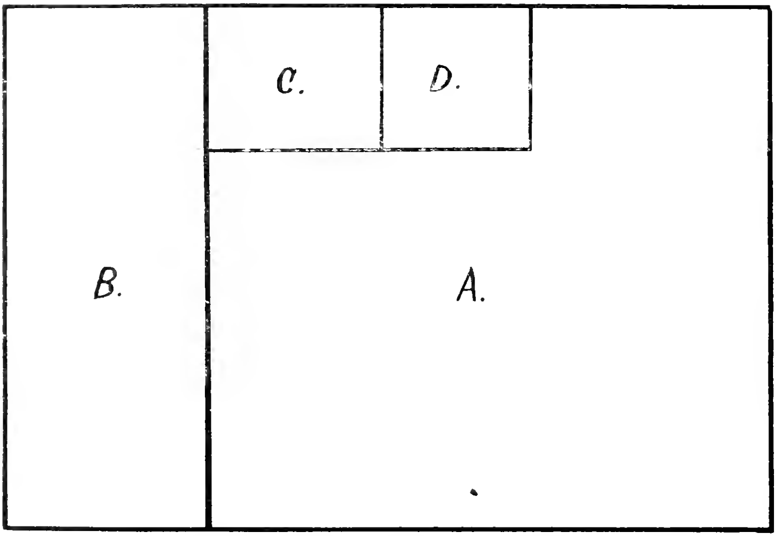


Fig. 6. Plan showing division of land for the starvation of ticks.

end of nine or ten months moved to plot C for a period of about five or six weeks, during which time all the ticks would have dropped from the animal, but they would not have time to lay their eggs, and the larvæ of the next generation to attach themselves to the animals. The stock could then be turned into A which would be tick-free, while B and C could be closed to cattle for ten months.

Generally the question is not the eradication of the blue tick, but also the eradication of the brown and red ticks, *Rhipicephalus* sps. and the Bont tick *A. hebræum*. In theory even these could be destroyed by placing all the animals in B and keeping them there for a period of fifteeen months. They could then be transferred to C where they could be kept for about six weeks and the blue tick would fall off, as stated above. From the facts given, however, it will be seen that within four weeks the larvæ and nymphæ which have dropped from the cattle when they were first moved into C will have moulted to the succeeding stages and be again found on the cattle.

Therefore it is advisable to move the cattle at the end of 18 days to a new plot D so that the ticks which have dropped off in C will not have had time to moult and again seek the host. In D the remainder of the ticks on the animals will drop off and in 18 days the animals tick-free could be turned into A. B, C, and D could be closed against cattle for 14 to 16 months and the farm thus freed of ticks. This method in theory would rid the farm of all the ticks which are known to transmit diseases to oxen, horses, sheep and goats.

In practice however the starvation of ticks is not so easy, due to the number of wild animals which will act as hosts to the ticks, thus carrying them over the starvation period.

The following table of the common ticks, which will attach themselves to some of the common wild animals, will show how easily the tick can be carried over the "starvation period":—

COMMON AFRICAN TICKS AND THEIR WILD HOSTS

Hosts	*A. hebræum*	*B. decoloratus*	*R. appendiculatus*	*R. capensis*	*R. evertsi*	*R. simus*
Lion	X	..	X	..	..	X
Wild Dog	X	..	..	..	..	X
Jackal	..	..		..	.	X
Reed Buck	..	..		..	X	..
Various Antelopes	X	..	X	..	X	..
Buffalo	X	..	X	..	.	..
Giraffe	X	..	.	..	X	..
Bush Pig	..	..		..	..	X
Cape Hare	..	..	X	..	X	.
Hedgehog	..	.	.	.	.	X
Ostrich	X	.	.	..		..

This table compiled from the work of C. W. Howard, shows that of those ticks which transmit disease but two species do not find a host on the wild animals. In an actual trial of the starvation method carried out by H. E. Laws in the East London district, the results obtained are very nearly what one would expect from the above. A portion of a farm was closed to all stock in May 1908. In February, 1911, ten oxen were driven to the gate of the enclosed farm, and after all the ticks which could be found were picked off, they were thoroughly sprayed with a mixture of kerosene and water containing 25 percent of kerosene. The oxen were then turned into the paddock and allowed to remain for three days. The animals were then carefully examined and all the ticks collected, numbering 340 in all. The results may be conveniently tabulated.

TICKS COLLECTED FROM TEN OXEN

	Males	Females	Nymphs	Total
A. hebræum	6	..	1	7
Ixodes pilosus	2	9	..	11
R. simus	73	176	1	250
R. evertsi	8	3	..	11
R. appendiculatus	27	15	2	44
R. capensis	5	8	..	13
Hæmaphysalis parmata (?)	...	4	..	4

From this experiment it will be seen that the blue tick can be starved, but it also shows that *R. capensis* seems to have some host among wild animals which has not been observed. Mr. Laws does not state what wild animals may have been running on this area other than hares and duiker (one of the antelopes)—both of which he mentions as being tick infested when shot.

Not all farmers have all the animals mentioned above, but hares and antelopes are very abundant. Many farms have hundreds or thousands of various antelopes which are not free to be shot even should the farmers so desire. With these conditions it does not seem likely that even the ticks which transmit diseases will be eradicated by the starvation method. *Hæmaphysalis leachi*, the tick which carries malignant jaundice, will probably never be eradicated, as dogs cannot be so readily handled as stock, while ticks such as *Hyalomma ægyptium* cannot be reduced to any great extent, as the birds will be constantly reinfesting the farm.

In favour of the starvation method, Dr. Theiler mentions that the freeing of an area from East coast fever is probably due to the starving out of the ticks. He does not mention that the ticks entirely disappeared, but that the area was freed from East coast fever by the removal of the stock for about 15 months. Inasmuch as the organism causing East coast fever does not remain in the blood of the recovered animal, and as the tick cannot transmit the disease after it has attached itself to an animal which does not have the disease, it would seem that the freeing of these areas from East coast fever was not the starvation of the ticks, but the freeing of the ticks of the organisms causing the disease.

Dipping. The usual and the most successful method employed in South Africa against ticks is dipping. A large trough is used through which the cattle are made to swim. A fenced passage which is divided several times by gates, leads up to the entrance of the dipping tank. By means of gates the number of animals approaching the dip can be regulated until only one passes into the dip at a time. A steep incline causes the animal to slip into the dipping fluid through which it swims to the other side, which is furnished with steps by which the animal can easily climb out.

There are a number of patent dipping fluids on the market, but the one found most useful is that recommended by Pitchford, which is

5 1-2 lbs. of soft soap.
2 gallons kerosene.
8 1-2 lbs. arsenite of soda.
400 gallons of water.

Even dipping has its disadvantages, if the farmer has many species of ticks which he is desirous of destroying. If only *B. decoloratus* is to be destroyed, dipping every three weeks will catch all the ticks, which attach themselves to the animal. *R. evertsi*—as is seen from the life cycle, only remains on the animal for a period of six or ten days as an adult. In order therefore to destroy all which may attach themselves—the dipping would have to be done every week. If the farmer also wishes to destroy the brown ticks, *Rhipicephalus* sps.—he would need to dip every three days to insure killing every tick which would attach itself to his animals. In order to make dipping every three days possible, the above formula has been modified to:

3 lbs. soft soap.
1 gal. kerosene.
4 lbs. arsenite of soda (20 percent arsenic).
400 gals. water.

Where wild animals are abundant on the farm, (they may far outnumber the stock animals)—the chances are that many ticks will be carried along upon them and never be destroyed by the dip. Heavy stocking the farm and frequent dipping however will greatly reduce the number of ticks. Where the farmer has his cattle grazing over one or two thousand acres, and must collect these and drive them through the dip every three days, it is found that it seriously interferes with any other farming operations in which he is engaged. It would seem, however, that, should dipping be done every week, although all the ticks which would attach themselves to the animal would not be killed, still by the law of chance, ticks which escaped the dip at one time would be caught at a later date providing the dipping was continued over a number of years.

Conclusion. From the above brief account of the work which has been done and is being done, in South Africa, it will be seen that—although the tick problem is a large one, much has been accomplished. It is now for the farmer to put into practice what has been learned of the ticks and the methods of their eradication. Many progressive farmers have built dipping tanks and are regularly dipping their cattle. There are still many who have not yet adopted good methods of ridding their farms of ticks, but it is to be hoped that soon, by a united effort, the farmers will at least reduce the number of species of ticks which annually cause them loss.

THE EGG LAYING HABITS OF ADOXUS VITIS IN FRANCE

By C. R. Crosby

In speaking of the egg laying habits of the California grape root-worm (*Adoxus obscurus vitis*) H. J. Quayle (Calif. Agr. Exp. Station, Bull. 195, p. 11, 1908) states, "The eggs of this beetle are laid usually in crevices beneath the layers of bark on the old wood. . . . The same insect in France, according to Mayet, lays in the neighborhood of thirty eggs either singly or in patches on the under side of the leaves. This number is probably simply an approximation. The fact, if it is a common occurrence, that they are laid on the under side of the leaves, is the most striking difference between the habits in California and in France." In a footnote Quayle cites, Mayet's *Insectes de la Vigne*, p. 308, as authority for this statement.

This is certainly a striking difference of habit and out of curiosity the writer consulted Mayet's work and found on page 308 a statement to that effect but also discovered that it did not refer to *Adoxus vitis* at all but to *Altica ampelophaga*. On page 326 Mayet describes the egg laying habits of Adoxus as follows: "Le nombre des œufs pondus est d'une trentaine environ; ils sont deposés, en captivité, dans les anfractuosités et les fentes du recipient où on élève l'insecte, les replis de papier, etc. Il est probable qu'à l'etat de liberté ils sont toujours placés sons les écorces, non loin du collet de la souche; c'est dans conditions—la M. Maurice Giard dit avoir observé plusieurs poutes." This agrees closely with the habits of the beetle in California as described in detail by Mr. Quayle.

LIME-SULPHUR WASH AN INEFFICIENT OVICIDE FOR CODLING MOTH

By V. I. Safro, *Oregon Agricultural College, Corvallis, Oregon*

Reports have occasionally been published showing a decrease in codling moth infestation following applications of a lime-sulphur wash. Until within the past few years a coating of lime-sulphur upon insect eggs has generally been considered fatal. Only recently have experiments shown a surprising lack of insecticidal power in spraying aphid and red spider eggs with lime-sulphur mixtures.

The Oregon Station, and doubtless other stations, has received letters from growers claiming a reduction in codling moth infestation due to applications of lime-sulphur. One grower even stated that summer applications alone of lime-sulphur had kept the crop practically free from codling moth.

This is a report of a short preliminary series of experiments conducted during the fall of 1911, in order to obtain data on the possible efficiency of lime-sulphur in killing the eggs of the codling moth. From an infested orchard, more than two hundred apples were collected upon which codling moth eggs had been deposited.[1] These were examined and only the apparently healthy eggs were used in the experiment.

Method of Facilitating Daily Observations. The small size of the eggs and their inconspicuous color rendered their necessarily frequent location and examination a rather slow process. A simple method was devised that resulted in but a minimum loss of time in locating eggs.

The side of the apple opposite the egg was cut to form a flat base. Each apple, then, rested on this base with the egg (where but one was present) on top. To still further facilitate location of the eggs and provide for the ready location of several eggs on one apple, an arrow was cut in the epidermis pointing to and but about one-fourth of an inch from the egg. The arrow, upon exposure to the air, turned brown and became quite prominent. It is interesting to note that the arrow was a very convenient place for the recently hatched larva to begin feeding. In fact, in almost every case, the young larva was found feeding in the arrow. Each apple was placed upon a slip of paper which bore the number of the apple and other data.

Conditions of the Experiment. The experiments were carried on

[1] Of the 221 apples collected, 198 had one egg each, 20 had two eggs each, one had three, and two had four eggs. In four cases the two eggs present on an apple were partly superimposed, indicating two successive eggs from the same moth.

in a laboratory, the infested apples being placed upon desks safe from the direct rays of the sun. The daily maximum temperature of the room during the tests ranged from 64° F. to 71° F. All eggs were examined at least once a day and the appearance recorded.[1] The maximum temperature outdoors ranged from 55° F. to 72° F.

On September 24th all eggs that had failed to hatch were examined to ascertain, if possible, the condition of the embryo at death. When the embryo appeared hard and dry it was recorded as "dried." When the contents of the egg were watery the egg was recorded as "crushed." This was undoubtedly the case in some instances but the term is used in the absence of a certain knowledge of the cause of death. Embryos apparently normal but in which the development ceased before hatching was complete were recorded as "dead." These terms are indefinite and signify nothing more than merely the appearance of the egg contents.

At first an attempt was made to spray the apples by means of an atomizer. This method was given up as a failure because the spray collected in drops covering only a small portion of the surface of the apple, in which case the egg was more frequently missed than hit. When the drops of spray were too large they would roll from the apple leaving a practically dry surface. The same would frequently occur upon shaking the fruit. This was the first indication in the experiment of the inefficiency of a lime-sulphur spray for killing codling moth eggs. The failure of a spray to cover the eggs deposited on the fruit is sufficient to exclude it as a codling moth ovicide regardless of its efficiency in the laboratory.

The method adopted was to place a drop of the spray material directly upon the egg. If, then, with such treatment the insecticide failed, then the results would be doubly conclusive.

The eggs were divided into four lots. One lot remained untreated as a check. A second lot received a treatment of a one-to-30 dilution of lime-sulphur testing 30° B.[2] A third lot received lime-sulphur

[1] The appearance of the well known "red ring" and "black spot"; when the larva was visible throught the chorion with a hand lens the appearance was recorded as "larva."

[2] The author frankly admits that this specification of the "strength" of lime-sulphur, so often encountered in the literature, signifies absolutely nothing. It is true that the dilution is certain and known and if a *chemically identical* lime-sulphur concentrates were diluted similarly then the *biological* results would, under similar conditions, be similar. But all 30° B. lime-sulphurs are by no means identical or even approximately so. Nor does it make matters any clearer to obtain an analysis showing the amount of total sulphur or total sulphid sulphur. Such data give no more definite idea of its efficiency as an insecticide (or, for that matter, as a fungicide) than a mere statement of its density. The reason for this uncertainty lies in the

one to 30 with arsenate of lead added at the rate of four pounds to 100 gallons of the diluted spray. The fourth lot was treated with a 5% solution of calcium polysulphides containing a slight amount of CaS_2O_3, furnished by Prof. H. V. Tartar, of the Oregon Experiment Station. The eggs were treated on the day collected.

Results with Unsprayed Apples. As a check, ninety-three eggs were left untreated in the laboratory. Of these, ninety hatched, one was accidentally crushed and two failed to hatch "due to natural causes."

Notes on the Appearance of the Developing Eggs. It was noted, in recording the appearance of the eggs, that of the twenty-six white eggs in the lot, only five showed a red ring before the appearance of the black spot. The eggs recorded as having a red ring showed all variations from the merest trace of red to a deep red circle, many showing but fractional rings. In one case (35 a) the egg hatched without the black spot becoming visible through the chorion. Additional data in the tables are included as records on development.

Lime-sulphur Wash (30° B.) 1–30. One hundred eggs were treated with a one-to-30 dilution of clear lime-sulphur testing 30° B. Of this number 85 hatched, one was accidentally killed and 14 failed to hatch due to other causes. This fourteen percent includes, undoubtedly, some "natural" and "accidental" mortality. Deducting these latter items—or even ignoring them—the lime-sulphur mortality amounts to very little indeed. Were every codling moth egg in an orchard hit

---

fact that a specific gravity determination of a lime-sulphur solution is really a reading of two (at least) solutions of unknown densities, present in unknown proportions, and of radically different degrees of chemical activity. These two solutions are the calcium polysulphides (CaS_4 and CaS_5) and the calcium thiosulphate (CaS_2O_3). Of these solutions the polysulphides are by far the most active, chemically, and undoubtedly the most important insecticidal ingredient in lime-sulphur.

The length and rapidity of boiling and cooling the spray are important factors causing the variation in proportion of calcium thiosulphate to the calcium polysulphides, the proportion of polysulphides increasing with the length of boiling and the thiosulphates increasing with the rapidity of cooling. The knowledge of the resulting density of the solution gives no definite idea of its chemical nature. Of the two solutions, the one lower in density may be much more active due to the larger amount of polysulphides present in proportion to the thiosulphate. For the same reason a dilution of one concentrate may be fully as effective as a "stronger" dilution of another. The bearing of this problem on the occurrence of spray injury to the foliage is discussed by the author in a forthcoming publication.

The nearest approach, at present, to a logical determination of the "strength" of lime-sulphur is a statement of the amounts present of calcium polysulphide and calcium thiosulphate. The author used a 5% solution of calcium polysulphide as a more certain test in addition to "a one-to-30 dilution of lime-sulphur testing 30° B."

UNTREATED EGGS, DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.			
16 a	9	white	10	black spot	11	larva	12	3
40 a	9	white	10	black spot			12	3
49 a	10	white	11	black spot			13	3
60 a	10	white	11	black spot	12	larva	13	3
62 a	10	white	11	black spot	12	larva	13	3
52 a	10	white	12	black spot			14	4
7 a	9	white	12	black spot	13	larva	14	5
33 a	9	white	12	black spot	13	larva	14	5
59 a	10	white	14	black spot			16	6
44 a	10	white	16	black spot			18	8
1 a	9	white	16	black spot	17	larva	18	9
3 a	9	white	10	red ring	17	black spot	18	9
6 a	9	white	16	black spot			18	9
9 a	9	white	17	black spot			18	9
41 a	9	white	10	black spot	17	larva	18	9
68 a	10	white	11	red ring	18	black spot	19	9
2 a	9	white	17	black spot	18	larva	19	10
14 a	9	white	17	black spot	18	larva	19	10
21 a	9	white	14	red ring	18	black spot	19	10
22 a	9	white	17	black spot	18	larva	19	10
56 a	10	white	18	black spot	19	larva	20	10
73 a	10	white	12	red ring	19	black spot	20	10
81 a	10	white	11	red ring	18	black spot	20	10
82 a	10	white	19	black spot			20	10
79 a	10	red ring	11	black spot			12	2
15 a	9	red ring	10	black spot	11	larva	12	3
19 a	9	red ring	10	black spot			12	3
23 a	9	red ring	11	black spot			12	3
24 a	9	red ring	10	black spot			12	3
29 a	9	red ring	10	black spot			12	3
35 a	9	red ring	11	black spot			12	3
35 a	9	red ring					12	3
46 a	10	red ring	11	larva			13	3
51 a	10	red ring	11	black spot	12	larva	13	3
54 a	10	red ring	11	black spot			13	3
58 a	10	red ring	11	black spot	12	larva	13	3
66 a	10	red ring	11	black spot	12	larva	13	3
69 a	10	red ring	12	larva			13	3
71 a	10	red ring	11	black spot			13	3

UNTREATED EGGS, DETAIL TABLE—*Continued*

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
4 a	9	red ring	11	black spot				13	4
13 a	9	red ring	11	black spot				13	4
41 a	9	red ring	12	black spot				13	4
55 a	10	red ring	13	black spot				14	4
64 a	10	red ring	12	black spot				14	4
67 a	10	red ring	13	black spot				14	4
74 a	10	red ring	12	larva				14	4
80 a	10	red ring	12	black spot				14	4
5 a	9	red ring	12	black spot				14	5
12 a	9	red ring	12	black spot	13	larva		14	5
31 a	9	red ring	12	black spot	13	larva		14	5
34 a	9	red ring	12	black spot	13	larva		14	5
36 a	9	red ring	12	black spot				14	5
38 a	9	red ring	13	black spot				14	5
42 a	9	red ring	12	black spot				14	5
17 a	9	red ring	14	larva				15	6
18 a	9	red ring	10	black spot	11	larva		15	6
20 a	9	red ring	13	black spot	14	larva		15	6
26 a	9	red ring	13	black spot	14	larva		15	6
27 a	9	red ring	14	larva				15	6
43 a	10	red ring	14	black spot				16	6
61 a	10	red ring	14	black spot				16	6
76 a	10	red ring	14	black spot	15	larva		16	6
77 a	10	red ring	16	black spot				17	7
24 a	9	red ring	15	black spot				17	8
39 a	9	red ring	15	black spot				17	8
48 a	10	red ring	17	black spot				18	8
50 a	10	red ring	16	black spot				18	8
11 a	9	red ring	17	black spot				18	9
37 a	9	red ring	16	black spot				18	9
47 a	10	red ring	17	black spot				19	9
65 a	10	red ring	17	larva				19	9
75 a	10	red ring	18	black spot				19	9
78 a	10	red ring	18	black spot				19	9
4 a	9	red ring	14	larva			crushed	24	
5 a	9	black spot						10	1
5 a	9	black spot						10	1
25 a	9	black spot						10	1
28 a	9	black spot						10	1
30 a	9	black spot						10	1
32 a	9	black spot						10	1
44 a	10	black spot						11	1
45 a	10	black spot						11	1
53 a	10	black spot						11	1
63 a	10	black spot						11	1
70 a	10	black spot						11	1
72 a	10	black spot						11	1
74 a	10	black spot						11	1
83 a	10	black spot						11	1
10 a	9	black spot						12	3
57 a	10	black spot					crushed	11	
65 a	10	black spot	12	larva			dried	17	

LIME-SULPHUR WASH (30° B.) 1-30, DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.			
63 b	10	white	11	black spot			12	2
67 b	10	white	11	larva			13	3
71 b	10	white	12	black spot			13	3
38 b	9	white	12	larva			13	4
66 b	10	white	13	black spot			14	4
51 b	10	white	14	black spot	15	larva	16	6
15 b	9	white	16	black spot			17	8
24 b	9	white					17	8
58 b	10	white	16	black spot			18	8
9 b	9	white	10	red ring	17	larva	18	9
43 b	9	white	16	black spot			18	9
50 b	10	white	16	black spot			19	9
68 b	10	white	16	black spot	18	larva	19	9
7 b	9	white	18	larva			19	10
21 b	9	white	17	black spot			19	10
25 b	9	white	14	red ring	17	black spot	19	10
28 b	9	white	17	black spot			19	10
30 b	9	white	17	black spot			19	10
54 b	10	white	19	black spot			20	10
71 b	10	white	18	black spot			20	10
72 b	10	white	19	black spot			21	11
71 b	10	red ring	12	black spot			12	2
72 b	10	red ring	11	black spot			12	2
78 b	10	red ring	11	black spot			12	2
5 b	9	red ring	10	black spot			12	3
11 b	9	red ring	11	black spot			12	3
16 b	9	red ring	10	black spot			12	3
18 b	9	red ring	10	black spot	11	larva	12	3
20 b	9	red ring	10	black spot	11	larva	12	3
32 b	9	red ring	10	black spot			12	3
48 b	10	red ring	11	black spot	12	larva	13	3
49 b	10	red ring	11	black spot	12	larva	13	3
53 b	10	red ring	11	black spot			13	3
55 b	10	red ring	11	black spot	12	larva	13	3
56 b	10	red ring	11	black spot	12	larva	13	3
57 b	10	red ring	12	black spot			13	3
71 b	10	red ring	12	black spot			13	3
75 b	10	red ring	11	black spot			13	3
81 b	10	red ring	12	black spot			13	3
84 b	10	red ring	11	black spot	12	larva	13	3
1 b	9	red ring	11	black spot	12	larva	13	4
3 b	9	red ring	10	black spot	12	larva	13	4
12 b	9	red ring	12	black spot			13	4
19 b	9	red ring	11	black spot	12	larva	13	4
29 b	9	red ring	11	black spot	12	larva	13	4

LIME-SULPHUR WASH (30° B.) 1-30, DETAIL TABLE—*Continued*

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
30 b	9	red ring	11	black spot	12	larva		13	4
45 b	10	red ring	10	black spot	12	larva		13	4
47 b	10	red ring	11	black spot	12	larva		14	4
65 b	10	red ring	13	black spot				14	4
69 b	10	red ring	13	black spot				14	4
79 b	10	red ring	13	black spot				14	4
87 b	10	red ring	12	larva				14	4
4 b	9	red ring	12	black spot	13	larva		14	5
26 b	9	red ring	11	black spot	12	larva		14	5
31 b	9	red ring	12	black spot				14	5
42 b	9	red ring	12	black spot				14	5
82 b	10	red ring	13	black spot	14	larva		15	5
2 b	9	red ring	13	black spot	14	larva		15	6
6 b	9	red ring	13	black spot	14	larva		15	6
46 b	10	red ring	14	black spot	15	larva		16	6
74 b	10	red ring	14	black spot				16	6
10 b	9	red ring	13	black spot	14	larva		16	7
14 b	9	red ring	13	black spot	14	larva		16	7
41 b	9	red ring	13	black spot				16	7
70 b	10	red ring	11	black spot	14	larva		17	7
76 b	10	red ring	13	black spot				17	7
83 b	10	red ring	14	black spot	16	larva		17	7
34 b	9	red ring	16	black spot				17	8
76 b	10	red ring	13	black spot				18	8
86 b	10	red ring	16	black spot				18	8
17 b	9	red ring	16	black spot	17	larva		18	9
27 b	9	red ring	15	black spot				18	9
62 b	10	red ring	16	black spot				19	9
61 b	10	red ring	18	larva				20	10
8 b	9	red ring					dried	10	
20 b	9	red ring	11	black spot	12	larva	dried	24	
22 b	9	red ring					dried	17	
47 b	10	red ring	12	black spot	13	larva	dried	24	
52 b	10	red ring	12	black spot			dried	24	
65 b	10	red ring	16	black spot			dead	24	
76 b	10	red ring	16	black spot			dead	24	
77 b	10	red ring	14	black spot			dried	24	
36 b	9	black spot						10	1
44 b	9	black spot						10	1
63 b	10	black spot						11	1
76 b	10	black spot						11	1
77 b	10	black spot						11	1

LIME-SULPHUR WASH (30° B.) 1-30, DETAIL TABLE—*Continued*

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
33 b	9	black spot						11	2
39 b	9	black spot						11	2
40 b	9	black spot						11	2
40 b	9	black spot	11	larva				14	5
23 b	9	black spot					dried	24	
35 b	9	black spot	11	larva			crushed	24	
37 b	9	black spot	11	larva			crushed	24	
59 b	10	black spot	11	larva			dried	24	
60 b	10	black spot					dried	24	
85 b	10	black spot	10	larva			dried	24	
80 b	10	larva					dried	24	

and covered by the spray (which is impossible practically) the largest percent mortality according to these results would be about 14 percent. In view of the fact that a foliage spray must be used when spraying for codling moth eggs, a one-to-30 dilution of a clear lime-sulphur solution is about as "strong" as would ordinarily be used. This preliminary experiment demonstrates to our satisfaction the ineffectiveness of lime-sulphur as a codling moth ovicide.

Notes on Development. In this lot, of twenty-one white eggs only two showed the red ring before the appearance of the black spot. Almost all eggs with a red ring when collected showed the black spot before hatching.

All the white eggs hatched. Of the sixty-three eggs with whole or fractional red rings when collected, eight, about 13 percent, failed to hatch. Of fifteen eggs showing the black spots when collected, six, 66 2-3 percent, failed to hatch. These records seem to indicate that the eggs are killed later on in their development—at a period when the embryo requires the most oxygen. Of the fifteen dead eggs the fully developed embryo, recorded as "larva," was visible through the chorion in eight. The embryo may have been as fully developed in the other eggs but on account of the residue of the spray or the opacity of the chorion could not be seen.

Lime-sulphur Wash (30° B.) 1–30 and Lead Arsenate 4–100. Would the addition of the usual strength (4 pounds in 100 gallons) of lead arsenate be effective in preventing the eggs from hatching? To obtain data on this question a third lot of twenty-three eggs were treated.

Of these, sixteen hatched, the larvæ all surviving. Taking for granted that the seven failing to hatch were killed by the treatment still the survival amounted to about 70 percent, indicating the futility of spraying with lime-sulphur and lead arsenate to prevent hatching of the eggs.

LIME-SULPHUR WASH (30° B.) 1-30 AND LEAD ARSENATE 4-100, DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		S pt.				
5 d	11	white	20	black spot				21	10
12 d	11	white	20	black spot				21	10
1 d	11	red ring						19	8
6 d	11	red ring	19	black spot				20	9
11 d	11	red ring	19	black spot				20	9
18 d	11	red ring	18	black spot				20	9
2 d	11	red ring						21	10
7 d	11	red ring					dead	24	
15 d	11	red ring					dried	24	
22 d	11	red ring	15	black spot			crushed	24	
23 d	11	red ring	18	black spot			dead	24	
24 d	11	red ring	16	black spot			dead	24	
9 d	11	black spot						13	2
17 d	11	black spot						13	2
20 d	11	black spot						14	3
21 d	11	black spot	13	larva				14	3
10 d	11	black spot						15	4
16 d	11	black spot						15	4
3 d	11	black spot						16	5
19 d	11	black spot						19	8
8 d	11	black spot					crushed	24	
14 d	11	black spot					dead	24	
4 d	11	larva						14	3

Calcium Polysulphides (5 percent Solution). The lime-sulphur used in the previous experiments was undoubtedly, to some extent, the cause of the death of the embryo. In order to obtain some data on the possible effect of the stronger, more accurately known, solution twenty-eight eggs were treated with a 5 percent solution of calcium polysulphides. This strength is equivalent to a lime-sulphur dilution of about one to eight, more or less, depending upon many factors. Of the twenty-eight eggs treated, eight hatched. The twenty failing to hatch included probably some natural mortality. In all results

FIVE PER CENT CALCIUM POLYSULPHIDES, DETAIL TABLE

No. of apple	Collected		Subsequent appearance				Embryo	Hatched Sept.	No. days reared
	Sept.	Appearance	Sept.		Sept.				
23 c	11	white						21	10
7 c	11	white					crushed	24	
10 c	11	white	12	black spot			dead	24	
11 c	11	white					dead	24	
13 c	11	white					dead	24	
16 c	11	white					crushed	24	
17 c	11	white					dead	24	
26 c	11	white					crushed	24	
12 c	11	red ring						12	1
18 c	11	red ring	13	black spot				15	4
2 c	11	red ring	13	black spot	14	larva		16	5
20 c	11	red ring	12	black spot				16	5
28 c	11	red ring						17	6
30 c	11	red ring	15	black spot	16	larva		17	6
3 c	11	red ring	17	black spot	18	larva		19	8
5 c	11	red ring					crushed	24	
15 c	11	red ring					dead	24	
19 c	11	red ring					dead	24	
22 c	11	red ring	14	black spot			crushed	24	
24 c	11	red ring	16	black spot			dead	24	
25 c	11	red ring					dead	24	
27 c	11	red ring	18	black spot			dead	24	
1 c	11	black spot					dried	24	
4 c	11	black spot					crushed	24	
9 c	11	black spot					dead	24	
14 c	11	black spot	15	larva			dead	24	
6 c	11	larva					dried	24	
29 c	11	larva					dead	24	

of this kind it should be remembered that the number of eggs hatched is of much greater importance than the number failing to hatch. With these results, then, it is evident that lime-sulphur, even too strong for use on foliage and fruit is, at best, an uncertain ovicide, its effectiveness of doubtful value economically.

WOOLLY APHID MIGRATION FROM ELM TO MOUNTAIN ASH[1]

Schizoneura lanigera (*americana*)

By Edith M. Patch

In the vicinity of Orono, the woolly aphid of the apple, *Schizoneura lanigera*, was abundant during the late summer and autumn of 1911 upon water shoots of certain apple trees; and upon trunk and branches of native mountain ash, *Pyrus* (*Sorbus*) *americana*; cultivated ornamental species of mountain ash, *Pyrus sitchensis* and others; and native and cultivated species of hawthorn, *Cratægus*. Some of each of these trees were located with the view of studying the overwintering forms of this aphid, some of which, according to all published accounts, migrate up from the base of the tree in the spring to tender and susceptible places on the bark where they establish bark feeding colonies. No such occurrence, however, took place here the spring of 1912. The identical trees which were heavily infested with woolly aphid last fall were free from infestation this spring until late in June and then the infestation did not come from root aphids. Whether *lanigera* ever overwinters on the apple in this climate one season's observations are of course insufficient to ascertain. I had heretofore taken it for granted that it would do so and this point has not been previously investigated in this locality. Testimony as to this habit is desirable from other northern states and I shall plan to continue observations here for some years to come. It should be stated that these notes concern the trunk, branches and water shoots only; no roots being examined. If, however, root forms were present they and their progeny certainly remained buried this spring, as daily observations of selected trees were made. It seems not improbable that the hard packed condition of the clay soil in this immediate vicinity may be partly responsible for this circumstance. The fall migrants of this colony were mature and taking flight September 20–23.

---

[1] Papers from the Maine Agricultural Experiment Station: Entomology No. 59.

Through the kindness of several southern entomologists, elm leaf curl in considerable abundance with winged forms ready for migration was secured in May. These migrants as previously explained (Science, Vol. 36, pp. 30-31) were caged over apple seedlings greenhouse-grown for the purpose, the seeds having been planted in December 1911 and January 1912. A few very successful colonies of woolly aphids were thus established on apple seedlings by the progeny of the elm migrants, the earliest of which was one started by migrants received May 12 which is still flourishing, even in indoor conditions, at the time this paper goes to press.

Encouraged by the successful indoor tests,[1] outdoor tests under more favorable conditions were made when the winged forms appeared in this vicinity.

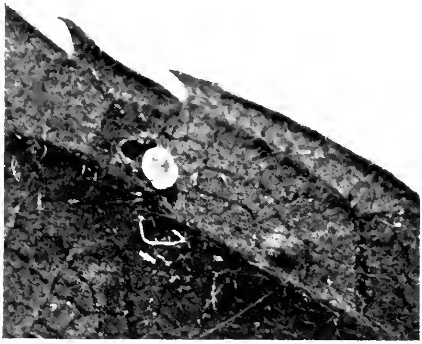
Water shoots had been allowed to grow about the base of a mountain ash, *Pyrus sp.* on the campus and up to June 21 this tree and the shoots were free from woolly colonies. As the migrants are much more docile about sundown than earlier in the day, I placed several hundred elm migrants at the base of the water shooots, about 7 p. m. on June 21. They moved about a little, most of them creeping to the ventral side of a leaf and remaining there; and during the night producing nymphs which sought the leaf axils of the water shoots so that by the afternoon of June 22 the tiny nymphs had already fed enough and secreted enough white wax to give the typical "woolly" appearance to the colonies. These and their progeny thrived on the mountain ash in a perfectly normal way for the woolly aphid of the apple.

Similar successful results were obtained by evening "plantings" of elm migrants upon uninfested water shoots of apple on June 24.

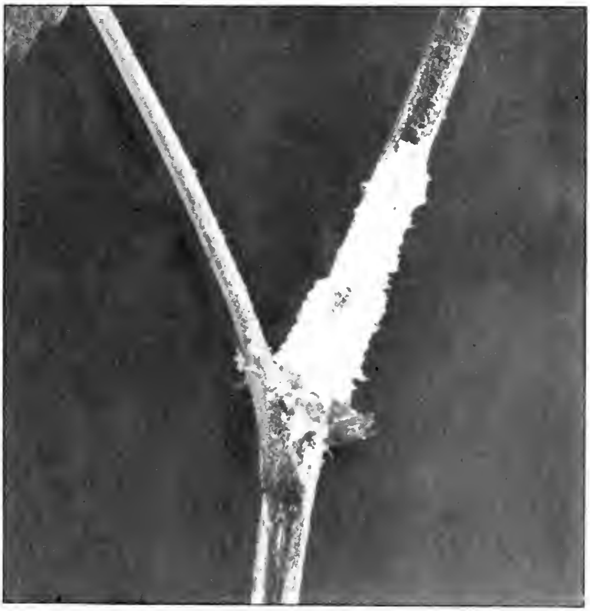
By this time the elm curl migrants were settling of their own accord on leaves of both mountain ash and apple and by June 28 colonies of

---

[1] A very high percent of the indoor attempts to establish colonies upon apple seedlings, both with the material from the south and with Maine collections were unsuccessful. The reasons for the failures I do not know. The seedlings were grown from seeds removed from apples on the Maine market and it is possible that many of these plants were varieties not susceptible to attack. Though healthy, the seedlings were rather a scrubby lot, having received no fertilizer on the theory that "neglected orchards suffer worst from attacks of woolly aphids." The later outdoor experiments showed that the most vigorously growing water shoots of apple and mountain ash (*Pyrus*) were most readily accepted, which would indicate that if the seedlings had been forced as they are in the nursery they might have been better bait. I think, too, that freshly moulted migrants are often too restless and instinctively impelled to flight and dispersal to take kindly to confinement. Whatever the trouble, I have often had cause to recall Riley's remark on this species,—"There is much greater difficulty in fully tracing the life-history of one of these small creatures than might be supposed. They languish in confinement and ill bear handling."



1. *Metellus rubi*, egg blister, one opened to show the egg and the one at the right intact.



2. Nymphs of the Woolly Aphid, *Schizoneura lanigera* (*americana*), on mountain ash, *Pyrus americana*,—the immediate progeny of migrants from elm leaf curl. Photographed at Orono, June 28, 1912.

nymphs of woolly aphid were easily found on both these summer hosts. That these were the progeny of the elm leaf migrants there was evidence enough. One native mountain ash, *Pyrus americana*, will serve for an illustration. The main trunk of this tree was dead nearly to the ground, but twelve vigorous shoots had grown up measuring about five feet each. On June 28 this mountain ash had about 150 woolly masses of nymphs grouped on the stem at the leaf axils. These nymphs ranged from very tiny ones to half grown insects, none being mature at that date. One such woolly mass contained 155 individuals of various sizes. (See plate 10, figure 2.) On the ventral surfaces of the leaves of this mountain ash were stationed many elm leaf migrants producing there their broods of nymphs which could be seen, with the hand lens, to be augmenting the woolly masses on the stem. Collections of these migrants thus stationed were made as follows:—July 2, 88 migrants; July 3, 211 migrants; July 5, 92 migrants; July 8, 54 migrants; July 9, 80 migrants; July 10, 33 migrants; July 11, 14 migrants; July 12, 3 migrants. Only living individuals were collected, dead ones being brushed off and discarded in the counts. Microscopic examination showed them to be identical with winged forms collected in elm leaf curls. Two large elm trees with leaves well stocked with this species stood about a rod distant.

Correlated with the appearance of the stem colonies of woolly aphides on mountain ash (*Pyrus* sp.) and water shoots of apple which were definitely ascertained to be the progeny of elm leaf migrants, were woolly bark feeding colonies on the trunks and branches of the elm, *Ulmus americana*. These were mostly about pruning wounds or protected under the bark, the latter colonies often not visible except on scaling back the bark. That these bark colonies on the elm are also the progeny of elm leaf migrants I have no doubt; but as the chief point of interest this year was centered in watching the elm leaf-apple situation no real attempt was made to get at the elm leaf-elm bark situation by catching the bark colonies in the process of making. This should not be especially difficult to do and is listed among the plans for 1913. In this connection it should be remembered that Riley's classic work on this species gives a continuous cycle for the elm in which he states of the *fourth generation* (progeny of the winged generation developing in the leaves): "They are, however, able to sustain themselves on the tender bark of twigs alone, and may be found nearly fully-grown, there exposed to view and enveloped in the white cottony matter, which brushes off at the slightest touch."

What influences the destination of the elm-leaf migrants and what determines their choice of the summer food plant for their progeny is not known. That they readily accept elm bark under some conditions

Riley's account testifies. That they migrate to water shoots of apple; to mountain ash (*Pyrus* species) and to hawthorns (*Cratægus* species), there producing progeny known as the woolly aphid of the apple, I have had definite and repeated proof.

The woolly colonies (mostly hidden under rough bark) are this season more abundant upon the elm than upon the apple in this vicinity, comparatively few of the apples being colonized, the mountain ash being here conspicuously a favorite summer host for *Schizoneura lanigera* (*americana*).

A bulletin of the Maine Agricultural Experiment Station (No. 203) now in press treats of certain phases of this problem not touched upon in the present paper.

An especial study of the antennal variation of this species is under way, it being purposed to tabulate at least 1000 antennæ, with camera lucida sketches of the more significant variations. The two extremes of the variable series show a difference wide enough to "separate *lanigera* from *americana* on good antennal characters." However, a large series renders a separation on this basis impossible. Although the discussion of this important point is postponed until the requisite data are tabulated, it may be of interest in this connection to state that a single collection of elm leaf migrants made at Orono show a range of from 19 to 32 annular sensoria on antennal joint III, 4 to 9 on IV, 2 to 10 on V, 0 to 2 on VI.

White Grubs (*Lachnosterna* species). These common pests were excessively abundant the past summer, at least in Albany, Columbia and Rensselaer counties, N. Y., they being so very numerous in many fields as to destroy practically all the grass roots so that large patches were badly pulled by the horse rake. Strawberry beds and corn were also seriously affected, especially when planted on sod. The greatest damage was confined to old seedings or meadows and usually to moister portions of the fields. These grubs were probably a little over a year old and may be those of *Lachnosterna fusca* Froh., since this was one of the species abundant in May and June 1911. In addition to these two, *L. grandis* Sm., *L. hirticula* Knoch and *L. hirsuta* Knoch were observed in abundance last year. Several species of June beetles were numerous last spring so that a continuance of the above noted depredations, probably on a more limited scale, may be expected in 1913.

E. P. Felt.

SCIARA SCIOPHILA LARVÆ CONGREGATING IN CHAINS

By J. S. Houser, *Department of Entomology, Ohio Agricultural Experiment Station, Wooster, Ohio*

About the middle of July of the present year there was reported to this department by Mr. C. R. Neillie, of the Cleveland City Department of Forestry, a serious outbreak of this insect, occurring on a lawn in Shaker Heights, Cleveland, Ohio. The writer was detailed to investigate the trouble and found that the insects had been present for two or three weeks. During this interval, on account of their repulsive appearance, they had been causing the inhabitants of the place a great deal of discomfort.

I was told by one member of the household as well as by the gardener, that the larvæ, especially in the early mornings, had exhibited a tendency common with some members of this family, to march in chains about the lawn, on the drives, along the foundation of the house and in similar places, but I was unfortunate in arriving just after the gardener had completed his customary morning rounds of pouring gasoline upon the insects and hence I did not see them in motion. The columns, however, were said to have varied in size from a half inch in width and two or three inches long, to those four inches in width and two or three feet long.

Something of the magnitude of the scourge may be gained from the fact that about a hundred gallons of gasoline had been used for killing the insects and that the putrid decaying masses of their bodies were to be seen in sheltered crannies everywhere, though in greater quantity along the walls of the house, at the bases of trees, along the sides of the walks, etc. On a number of places in the lawn, grass had been killed by the gasoline over areas of several square feet.

At the time of my visit the numbers of the larvæ were decreasing, but the flies were still abundant on the lawn and in the bordering woods. A collection was taken from both places, as was also one of larvæ and pupæ from the decaying mould of the woods. Within a short time adults emerged from the latter, and specimens of all three lots were sent to Dr. O. A. Johannsen, to whom I am indebted for the determination of the species. The insects developed not only in the woods, but in the lawn proper as well, for both larvæ and pupæ were found in the turf. As far as I was able to determine, the scourge was confined to the one lawn of about an acre and a half in extent.

"THE MINNESOTA FLY TRAP"

By F. L. Washburn, *Experiment Station, St. Anthony Park*

We have found the trap described herewith a valuable auxiliary in reducing the number of flies where these occur in large quantities.

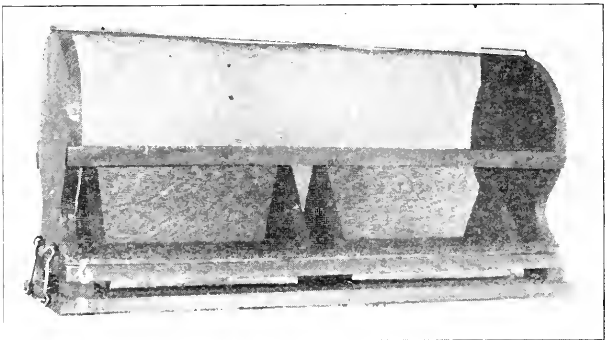


Fig. 7. General View of Trap

The trap is twenty-four inches long, twelve inches high and eight inches wide. It has been given a thorough test this summer with most satisfactory results. Whether the traps are rectangular or oval

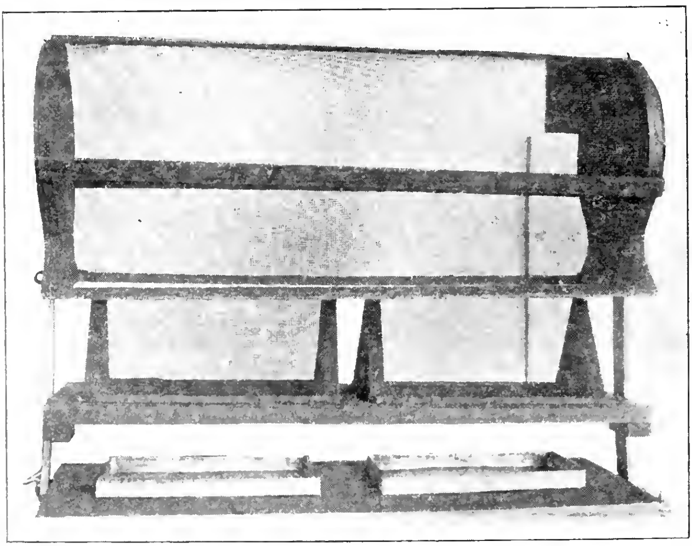


Fig. 8. The three parts of trap separated to show construction. The upright pieces at the ends are not a part of the trap.

seems to make no difference as regards their efficiency. The screen used is ordinary wire mosquito screen and that and the small amount of lumber required made each trap cost us 41c. for material. Made in large numbers the cost would be very much less. A skillful carpenter could easily construct this apparatus in two or three hours. The upper oval part (*c*) serves as a receptacle which the flies enter through the opening in the top of the middle portion (*b*) made of screen and shaped like the roof of a house. Under this is the base board (*a*), upon which rest two tin bait pans. The space between the baseboard and the middle portion is about one-half inch, and between this and the bait pans through which flies enter pans, about one-fourth of an inch.

The record made by one of these traps is in part as follows:

Rear of dining hall on campus, two days, 3000 flies
Dairy Barn, one day, 1700 flies.
Rear of dining hall, five days, 13,000 flies
Same place, three days, 6000 flies
Same place, one day, 4200 flies
On back porch of a dwelling not far from a stable where a few horses are kept, two days, 8700 flies
Same place, one day, 12,000 flies
Same place, one and a half days, 18,800 flies

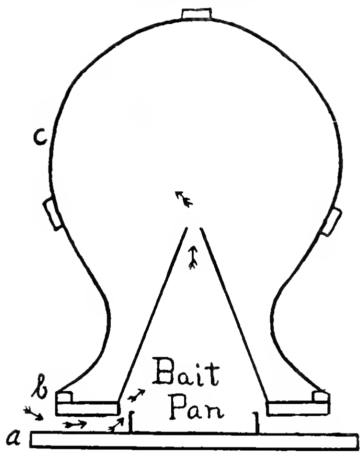


Fig. 9. Cross section of trap.

Bait: This is an extremely important factor in the use of this trap, and we find we have to qualify to a certain extent previous recommendations in this regard. Ordinarily, we believe that bread and milk, frequently renewed, is the best bait for this and other fly traps, but under certain conditions, this is not as attractive as it might be. For example: We loaned one of these traps to a dining hall association on the State Fair grounds this month to be used in the kitchen. It was found that waste, stale meat thrown into a box was more attractive to the flies than bread and milk in the trap. This was overcome by putting small pieces of the stale meat in the pans with the bread and milk and the receptacle of the trap was soon swarming with thousands of flies.

The flies, which gather in the upper part or receptacle, should be killed by immersing that part of the trap in hot water or pouring boiling water over it, or in any other way not injurious to the trap. The dead flies may be emptied out of the trap, the bait renewed and the trap reset.

We have been so pleased with the success of this contrivance that we have proposed for it the name which is used at the head of this article.

ARTHROCNODAX OCCIDENTALIS N. SP. (DIPT.)

By E. P. Felt, *Albany, N. Y.*

The small, yellowish species described below and easily separated from other American forms by the emarginate ventral plate, was reared July 15 and 30, 1912, by H. J. Quayle of the Division of Entomology, University of California, Berkeley, from larvæ preying on red spiders, Tetranychus species.

Male. Length 1 mm. Antennae a little longer than the body, thickly haired, pale straw, yellowish basally; 14 segments, the fifth having the stems with a length 2 1-2 and 3 1-2 times their diameters. Palpi; the first segment short, irregular, the second with a length over twice its width, the third 1-2 longer than the second, the fourth a little longer than the third, slender. Mesonotum fuscous yellowish. Scutellum and postscutellum yellowish. Abdomen pale yellowish, with a reddish orange spot basally. Halteres yellowish transparent. Wings hyaline. Legs mostly pale straw, the distal tarsal segments somewhat darker; claws slender, evenly curved, the pulvilli as long as the claws. Genitalia fuscous yellowish, both dorsal and ventral plates triangularly emarginate, each with the lobes sparsely setose apically. Type a 2328.

THE EGG OF THE BLACKBERRY LEAF-MINER

Metellus rubi Forbes (Scolioneura capitalis)

C. R. Crosby, *Ithaca, N. Y.*

Prof. C. O. Houghton has recently published an excellent account of the Blackberry Leaf-miner (Del. Agr. Exp. Sta. Bull. 87. 1910) but states that he has not observed the egg. The following note is presented to help fill this break in our knowledge of the life-history of the insect.

On August 25, 1908, the writer visited a large field of dewberries at Ripley, N. Y., which earlier in the season had been rather severely infested. The larvæ of the second brood were just beginning their mines. A careful examination of the under side of the leaves showed that the mines usually start near a prominent vein and that at their base a small round blister is present. These blisters are about .75 mm. in diameter, nearly round, low, green in color, and have a smooth surface. They are usually found close to a prominent vein and *two* are often placed close together. The egg itself is nearly white, smooth, flattened and lies between the two layers of the leaf. Plate 10, fig. 1 shows one of the blisters intact; the other has been opened and the egg partly removed. The blisters are rather inconspicuous but after one becomes used to looking for them can be easily detected without the aid of a lens.

According to the observations of Professor Houghton the eggs are probably inserted into the leaf from the upper side (Ent. News, XIX, p. 213. 1908)

Fall Army Worm (*Laphygma frugiperda* Sm. & Abb.). This insect was exceptionally abundant the latter part of September and early October in lawns and fields in the vicinity of New York city and on the eastern extremity of Long Island. There were several complaints of serious injury to lawns, the parties reporting the grass to be so seriously affected that they were fearful it would be destroyed. The caterpillars were reported very injurious to corn on Long Island. The larvæ, as is characteristic of this species, vary greatly in coloration. This outbreak is unusual for New York state or else, owing to the lateness of the season when the pest is usually abundant, is generally overlooked.

E. P. Felt.

APHID NOTES FROM CALIFORNIA

By W. M. Davidson,[1] *U. S. Bureau of Entomology, San José, Cal.*

The following paper reports several plant-lice not heretofore found in California, of which three species are new to science. A few sexual forms are also dealt with and illustrated.

Cerataphis lantaniae Boisd.

Taken in the spring of 1912 on ferns in the greenhouses of Stanford University, Cal., by Mr. H. Morrison.

Phyllaphis coweni Gillette.

Syn. *Cryptosiphum tahoense* Davidson (Jour. Econ. Ent. Dec. 1911).

I have not seen the types of *Phyllaphis coweni* but after comparing Gillette's description of this aphid (Can. Ent. xxxvii p. 125, 1905) with my description and specimens of *C. tahoense* I conclude that there is but one species.

Calaphis betulaecolens Fitch (Fig. 1, 2).

Alate male. Pale yellowish-green. Head, prothorax, thoracic lobes and two spots at the base of the wings black. Antennae reaching beyond cauda, yellow, apices of joints 3-6 and the filament dusky. Length of the joints as follows,—3, 4, 5, filament, 6, 1, 2. Legs yellow, femoral apices brown, base and apex of tibiae and the tarsi dusky. Wings large, stigma light gray with a large paler central area. Basal third of stigmatic vein obsolete. Second fork of third discoidal slightly nearer to the first fork than to apex of wing. Subcosta and discoidals stout, dark brown. Abdomen narrower than thorax, shorter than the head and thorax combined, greenish-yellow, with a dorso-median black transverse bar on all the segments except the last. Cornicles pale, almost as broad as long, situated on segment 7. Pale lateral tubercles occur on segments 2–6. Last segment dusky grey. Beak very short, reaching first coxae, stout and pale, the tip black. Under side of the thorax grey. Sensoria as follows:—III, 18–24: IV, 0:V, 1:VI, 1.

Measurements:	Body, length 2.05mm	Antennal joints I	.110
	" width 1.54mm	II	.078
	Wing expanse 7.70mm	III	.906
	Cornicles .08mm	IV	.633
		V	.550
		VI	.216
		fil.	.462

Oviparous female. Pale yellowish-green, caudal half of abdomen with a reddish tinge. Antennae reaching to cornicles or beyond, black, joints 1, 2, basal half of both 3 and 4 paler. Eyes red, Legs pale, base of tibiae and tarsi black. Cornicles longer than broad, the mouth flaring. Dorsum of body sometimes with indefinite dusky markings. Abdomen oval, the last three segments forming a conical addition.

---

[1]Published with the permission of the Chief of the Bureau of Entomology.

Measurements;	Body, length 3.13mm	Antennal joints	I	.142
	" width 1.37mm		II	.076
	Cornicles .16mm		III	.682
			IV	.491
			V	.417
			VI	.191
			fil.	.433

The sexual forms occur in November on cultivated Birch. Locality, Oakland, Cal.

Calaphis castaneae Buckton (Figs. 3, 4).

Alate male. General color lemon. Eyes dark red. Antennae reaching beyond the tip of the abdomen, dusky, joint 3 the longest and three times as long as the filament. Sensoria distributed as follows;—joint 3, 20; joint 4, 7; joint 5, 8; joint 6, 3–4. Thoracic lobes and scutellum brownish. Wings of medium size, stigmatic vein deeply curved, second fork of third discoidal slightly nearer to the wing apex than to the first fork. Stigma light brown, central portion lighter. Legs pale; tarsi, tibial apices and base of hind tibiae dusky. Abdomen narrower than the thorax, tapering gradually caudad, each segment with a median oval dusky area and dusky lateral spots. Cornicles dusky, almost twice as long as broad. Cauda globular, dusky, shorter than the cornicles. Beak pale, tip black, reaching midway between first and second coxae.

Measurements;	Body, length 1.33mm	Antennal joints	I	.064
	" width .50mm		II	.055
	Wing expanse 4.87mm		III	.621
	Cornicles .06mm		IV	.413
			V	.285
			VI	.120
			fil.	.194

Oviparous female. General color pale lemon yellow. Eyes dark red. Antennae not quite reaching to cornicles, pale, with the articulations and filament dusky; joint 3 longest, twice as long as the filament or as joint 5. Body oval, tapering posteriorly to the cornicles, beset with many long delicate spines. Abdominal segments 1–8 each with two oval, transverse dusky areas on the dorsum. Cornicles pale, twice as long as broad. Cauda bluntly rounded, short. Legs pale, tarsi and tibial apices dusky.

Measurements;	Body, length 2.11mm	Antennal joints	I	.071
	" width .95mm		II	.050
	Cornicles .12mm		III	.414
			IV	.247
			V	.190
			VI	.115
			fil.	.176

The sexual forms are found on Chestnut in early November. Locality, San José, Cal.

Euceraphis betulae Kalt. (Fig. 5.)

Oviparous female. Slightly woolly, body spindle-shaped, broadest at the third abdominal segment. Head and dorsum of the prothorax greyish-brown. Eyes red. Antennæ mostly dusky, reaching to the base of the cornicles, on small frontal tubercles, joint 3 the longest and in order after that 4, 5, 6, the filament, 1 and 2. Rest of thorax and abdomen greenish-yellow or yellowish-brown, meso- and metathorax and first five abdominal segments with lateral black spots and transverse rows of black or brown spots on the dorsum. Cornicles black, slightly longer than broad, their apices slightly enlarged. Cauda rounded, concolorous with the body, with a marginal fringe of hairs. Front of head bears four short hairs. Legs green with greyish tinge, tarsi and tibial apices black. Beak pale, reaching second coxae.

Measurements;	Body, length	3.50 mm	Antennal joints	I	.171
	" width	1.21 mm		II	.101
	Cornicles	.107mm		III	1.014
	Cauda	.087mm		IV	.700
				V	.585
				VI	.208
				fil.	.188

Male. Not taken.

The sexual female is abundant on cultivated Birch in November. Locality, Oakland, Cal.

Euceraphis flava sp. nov. (Figs. 6, 7).

Alate viviparous female. Pale yellow, covered with greyish-white woolly secretion. Antennae one-fifth longer than the body, mounted on frontal tubercles; joint 1 twice joint 2 in length and half as wide again; joint 3 much the longest, almost equaling 4 and 5 combined; joint 5 a little shorter than 4 and twice as long as 6; the filament four-sevenths as long as joint 6. First two joints encircled with a broken black ring at about half their lengths. Articulations of other joints black. Sensoria distributed as follows:—joint 3, 5–7, oval, transverse sensoria on its proximal fifth; joint 5, 1 apical sensorium; joint 6, 1 large apical sensorium and 3 smaller ones. Head and ocelli pale yellow. Eyes dark red. Prothorax pale with two parallel longitudinal dark stripes, one on either side of the dorso-median area. Thoracic lobes and scutellum pale brown, the latter with a black posterior border. Wings of medium size, stigma narrow, extended, pale grey; veins narrow, brown; sub-costa pale grey. Legs long, thin, pale yellow; tibiae dark brown at the base and apex; tarsi dark brown. Abdomen long and narrow, with three pairs of tubercles on its anterior half, one pair on each of the segments 2–4 inclusive. These tubercles are dark brown, wart-like, directed latero-caudad. Cornicles dark brown, as broad at the base as long, situated on a semicircular brownish area. Seventh segment with a pair of smaller dark lateral tubercles. Posterior margin of segment 8 with a brown cross-band. Cauda short, pale, globular. General color of the abdomen light yellow. Beak pale, tip brown, extending a little beyond the first coxae. Lower side of body pale yellow.

Measurements;	Body, length	3.33mm	Antennal joints	I	.128
	" width	1.18mm		II	.067
	Wing expanse	8.64mm		III	1.436
	Cornicles	.07mm		IV	.787
				V	.685
				VI	.358
				fil.	.206

Pupa of alate female. Pale yellow, with no woolly secretion. Antennal annulations and tarsi black. Rest of body pale yellow with the exception of abdominal black spots arranged as follows; two median dorsal and two lateral on segments 1–5 and 7, two median dorsal on segment 6 (on which occur the cornicles). These black spots are tuberculate and bear capitate hairs.

This species is not uncommon on the under side of the leaves of *Alnus rhombifolia* Nutt. I have never seen the apterous female nor the sexual forms. Habitat; Santa Clara Co., Cal. Spring and Summer.

Aphis cardui L.

Colonies on the young growth of several thistles throughout summer. Habitat; San José, Cal.

Aphis atriplicis L. (Figs. 8, 9).

Apterous male. Head, thoracic lobes and scutellum black. Prothorax brown. Eyes dark red. Anntenae black, reaching to the cornicles, third joint the longest, filament next, then fourth, fifth, sixth, first and second in order. Frontal tubercles small, black. Lateral tubercles absent. Legs brown, hind pair darker. Abdomen pale yellow, with 8 brown dorsal transverse bars, which are often broken up into spots. Cornicles short, black, incrassate, not half as long as the hind tarsi. Cauda black, tapering to a blunt apex, half as long again as the cornicles. Genital segment below cauda large, black, rounded. Coxae, under side of head and thorax and genital segment black. Rest of lower surface yellow. Beak transparent, its tip black, reaching second coxae. Sensoria on antennal III 18–21; IV 7–9; V 6–8; VI 3–5, small, placed irregularly on the much serrated antennae.

Measurements;	Body, length	1.08mm	Antennal joints	I	.057
	" width	.46mm		II	.050
	Cornicles	.078mm		III	.300
	Cauda	.086mm		IV	.151
				V	.185
				VI	.121
				fil.	.257

Oviparous female. Entirely pale greenish-yellow, with a thin white powdery covering. Eyes red. Antennae seven-jointed, about one-third the length of the body, pale greenish-yellow; the relative size of the joints as follows: joint III longest; the filament or seventh joint a little shorter with IV; V and VI sub-equal. Legs pale greenish-yellow, coxae brown. Cornicles pale brown, almost as long as the hind tarsi. Cauda shaped as in the male, pale brown, slightly exceeding the cornicles in length. Anal segment brown. Beak not quite reaching second coxae, its tip brown.

Measurements;	Body, length	1.57mm	Antennal joints	I	.064
	" width	.77mm		II	.043
	Cornicles	1.07mm		III	.179
	Cauda	1.30mm		IV	.086
				V	.093
				VI	.088
				fil.	.133

Apterous viviparous female. Pale green, slightly pulverulent. Body more than twice as long as wide. Antennae dusky, a little over one-third the body in length;

joint III the longest, filament next, then joint IV and V sub-equal, then VI, I and II. Legs entirely dusky brown. Cornicles green, slightly incrassate, small, barely exceeding the fore tarsi in length. Cauda slightly dusky, a little longer than the cornicles, widest at the base, tapering gently to a blunt apex. Eyes dark red. Beak dusky, very short, reaching midway between first and second coxae. Coxae very dark.

Measurements:	Body, length	1.82mm	Antennal joints	I	.083
	" width	.83mm		II	.057
	Cornicles	.147mm		III	.302
	Cauda	.226mm		IV	.131
				V	.127
				VI	.103
				fil.	.217

Occurs on the upper side of the leaves of *Chenopodium murale* L., the sexual forms appearing in August. Habitat; San José, Cal.

Aphis salicicola Thos.

Abundant on Willows throughout the summer. Preyed on by the larva of a *Leucopis* (Agromyzidae). Habitat; San José, Cal.

Aphis maidis Fitch.

Colonizing Corn (*Zea mays*). Habitat; San José, Cal.

Amphorophora latysiphon sp. nov. (Figs. 10–13.)

Alate viviparous female. General color dark olive green. Head, prothorax, thoracic lobes, scutellum, frontal tubercles, first two joints of the antennae, cornicles and cauda black. Legs yellowish-brown; distal half of the femora, distal third of the tibiae and the tarsi darker. Eyes dark crimson lake. Antennae on frontal tubercles, which bear hairs on their inner angles, half as long again as the body, armed with many hairs; third joint the longest, joints 4 and the filament sub-equal, joints 6 and 1 sub-equal, joint 5 a little shorter than joint 4. Sensoria distributed as follows;—joint 3, 13–17 on the exterior margin in an irregular row; joint 5, 1 apical; joint 6, 1 large and 3 small, all apical. General color of antennae yellowish-brown. Lateral tubercles small, bearing a hair. Wings of medium size, veins brown, stigma amber-colored, second fork of third discoidal close to the wing apex. Abdomen oval, yellowish-green or dark olive, with a large sub-quadrate black spot on the dorsum above the cornicles and a black cross-band on the segment below the cornicles and black lateral spots. Cornicles long, very much dilated for half their length. Cauda ensiform, about one-third the length of the cornicles. Under side of the body and beak olive green; tip of beak and sterna black. Beak reaches second coxae. Coxae dusky.

Measurements:	Body, length	2.54mm	Antennal joints	I	.149
	" width	1.17mm		II	.088
	Wing expanse	8.75mm		III	.977
	Cornicles	.67mm x .157mm		IV	.771
	Cauda	.19mm		V	.554
				VI	.163
				fil.	.733

Apterous viviparous female. General color of the body light olive green. Eyes dark red. Antennal articulations, prothorax, cauda, and a large quadrate spot on the dorsum of the abdomen dusky to black. Cornicles black. Antennae on large frontal tubercles, longer than the body with the relative size of the joints as in the winged form. Legs light olive, apical half of femora, tibial apices and tarsi dusky to black. Cornicles and cauda shaped as in the winged form. Beak pale, tip black, reaching to second coxae.

Measurements;–	Body, length	2.57mm	Antennal joints	I	.190
	" width	1.44mm		II	.097
	Cornicles	.73mm x .10mm		III	.887
	Cauda	.18mm		IV	.681
				V	.504
				VI	.151
				fil.	.700

Occurs sparingly on the Periwinkle (*Vinca major*) and *Convolvulus arvensis.* Habitat; San José and Courtland, Cal.

Phorodon carduinum Walker.

On the under side of the leaves of Artichoke, becoming a pest. Very susceptible in California to fungus diseases. Kindly determined by Mr. J. T. Monell. Habitat; San José, Oakland and Courtland, Cal.

Myzus varians sp. nov. (Figs. 14–19.)

Pupa of alate female (viviparous), dark form. Pale yellow, prothorax, anterior half of the abdomen, 7th abdominal segment purplish-red. Head pale yellow; ocelli prominent, light red. Eyes dark red. Antennae on large frontal tubercles, reaching to the base of the cornicles, pale yellow; articulations of joints 3–6 and the filament black. Filament the longest joint, then 3, 5, 4, 6, 1, 2 in this order. Legs pale yellow, tarsi black. Sutures of thoracic lobes reddish, wing pads pale with dusky tips. Abdomen broadest at the fourth segment, then tapering abruptly to the cauda. Cornicles about as long as antennal joints 4 and 5 together, narrowing from the base and curved, pale with the tip black. Cauda almost colorless, conical, as long as the hind tarsi. Beak pale, tip black, reaching the second coxae. Under side of the abdomen and thorax more or less reddish.

Measurements;–Body,	length	1.73mm
"	width	.72mm

Alate viviparous female, dark form. Pale greenish-blue, first three and last two abdominal segments tinged with crimson (fainter in some individuals). Rest of abdomen with a faint bluish tinge. Head and antennae black. Eyes dark red. Frontal tubercles prominent. Antennae exceeding the tip of the abdomen, base of third joint pale; relative sizes of the joints as in the pupa. Prothorax brownish-red. Thoracic lobes and scutellum deep brown. Wings large ; sub-costa and insertions reddish-grey; stigma long, narrow, grey; veins narrow, grey, second fork of the cubitus or third discodial slightly nearer to first fork than to the wing apex. Legs yellowish-red, apical half of femora, tarsi, and tibial apices black. Abdomen widest at segment three, with dusky transverse bands which sometimes coalesce to form a quadrilateral area on the dorsum, and with black lateral spots, and with a transverse dusky bar below the cornicles. Cornicles dusky, slightly curved, rather narrowed at the apex, not quite as long as antennal joint 3 and not quite reaching the tip of the cauda. Cauda black, conical, upturned, equalling the hind tarsi in length.

Under side of thorax black, of abdomen reddish. Beak pale, reaching midway between first and second coxae. Sensoria distributed as follows;—joint 3, 9–12 circular, in an irregular row; joint 5, 1 terminal; joint 6, 1 large and 3 small, terminal.

Measurements;—	Body, length,	2.28 mm	Antennal joints	I	.106
	" width	1.05 mm		II	.078
	Wing expanse	7.16 mm		III	.550
	Cornicles	.407 mm		IV	.334
				V	.365
				VI	.132
				fil.	.682

Alate viviparous female (Light form). Pea green. Antennae on prominent frontal tubercles, longer than the body, black with joints 1 and 2 green and joints 4 and 5 light brown. Eyes dark red. Head and prothorax light brown, rest of the body green. Abdomen wider than the thorax, widest at the fourth segment. Wings large; stigma greyish-yellow, narrow and long; insertions and sub-costa greenish-yellow; second fork of third discoidal about midway between first fork and the wing apex. Legs green, knees, tarsi and tibial apices black; tibiae yellowish. Cornicles green, slightly curved, six times the hind tarsi in length, shaped as in the dark form. Cauda short, dusky, conical. Beak green, tip brown, not quite reaching second coxae. In the single specimen that I have there are 9 sensoria on joint 3 of the left antenna and 10 on joint 3 of the right antenna. Joint 5 has 1 terminal sensorium and joint 6, 4 terminal sensoria. The antennae of this form differ from those of the dark form by having joint 4 longer than 5.

Measurements;–	Body, length	2.30mm	Antennal joints	I	.114
	" width	1.04mm		II	.080
	Wing expanse	7.13mm		III	.671
	Cornicles	.57mm		IV	.562
				V	.521
				VI	.153
				fil.	1.031

Apterous viviparous female. General color pea green. Filament and articulations of the antennal joints black. Mouth of the cornicles black. Eyes red. Tarsi grey. Antennae on very conspicuous toothed frontal tubercles, reaching to the base of the cornicles. Relative lengths of the antennal joints as in the green winged form. Legs slender, green; all tarsi grey. Cornicles green, curved, with tip black, five or six times the hind tarsi in length. Cauda green, conical, half as long again as the hind tarsi. Beak green, with a brown tip and extending to the second coxae.

Measurements;–	Body, length	1.96mm	Antennal joints	I	.124
	" width	1.51mm		II	.052
	Cornicles	.44mm		III	.383
				IV	.350
				V	.297
				VI	.132
				fil.	.604

Occurs on the under side of the leaves of wild Clematis (*Clematis ligusticifolia* Nutt.). The alate green forms are very rare while the dark forms apparently do not appear until November. No sexual forms were collected. Habitat; San José, Cal.

Amphorophora rubi Kalt.

Colonizes the terminal shoots of cultivated blackberry and loganberry and is also to be found on the wild thimble-berry (*Rubus nutkanus* Moc.). I am indebted to Mr. J. T. Monell for the determination of this species. Habitat; San José, Cal.

Macrosiphum chrysanthemi Oestl.

On the young shoots of a composite. Habitat; Courtland, Cal.

Macrosiphum granarium Kalt.

Occurs on various grasses in spring. Habitat; San José, Cal.

Macrosiphum solanifolii Ashm.

Occurs on wild lettuce. Habitat; San José, Cal. I am indebted to Miss E. Patch for the identification of this species.

Explanation of Plates 11, 12: 1, *Calaphis betulaecolens,* alate male; 2, *C. betulaecolens,* oviparous female; 3, *Calaphis castaneae,* alate male; 4, *C. castaneae,* oviparous female; 5, *Euceraphis betulae*, oviparous female; 6, *Euceraphis flava,* alate viviparous female; head and antenna; 7, *E. flava,* abdomen; 8, *Aphis atriplicis,* alate male; 9, antenna of same enlarged; 10, *Amphorophora latysiphon,* head; 11, antenna; 12, cornicle; 13, cauda; 14, *Myzus varians,* head of alate viviparous female, dark form; 15, antenna of same; 16, cornicle of same; 17, head of apterous viviparous female; 18, antenna of same; 19, cornicle of same. I am indebted for these figures to Miss E. Weber, formerly in the employ of the Bureau of Entomology.

Locust Leaf Miner (*Chalepus dorsalis* Thunb.). This common enemy of the black locust was excessively abundant on Long Island in 1911, the beetles, in association with the rosy hispa, *C. nervosa* Panz., skeletonizing the foliage of young locust trees over extended areas in the vicinity of Syosset. A recurrence of the attack was observed in August 1912, the injury being confined as previously, largely to the smaller trees and, the past season, being due almost entirely to work by *C. dorsalis*. The mines made by the grubs were of comparatively little importance where the feeding of the adults in August resulted in skeletonizing the foliage over large areas, the beetles being so numerous that 2, 4, 6 and even 8 were found on individual leaflets. It is evident that a thorough spraying, the latter part of July or early in August, with arsenate of lead would effectually control outbreaks of this character.

E. P. Felt.

Plate 11

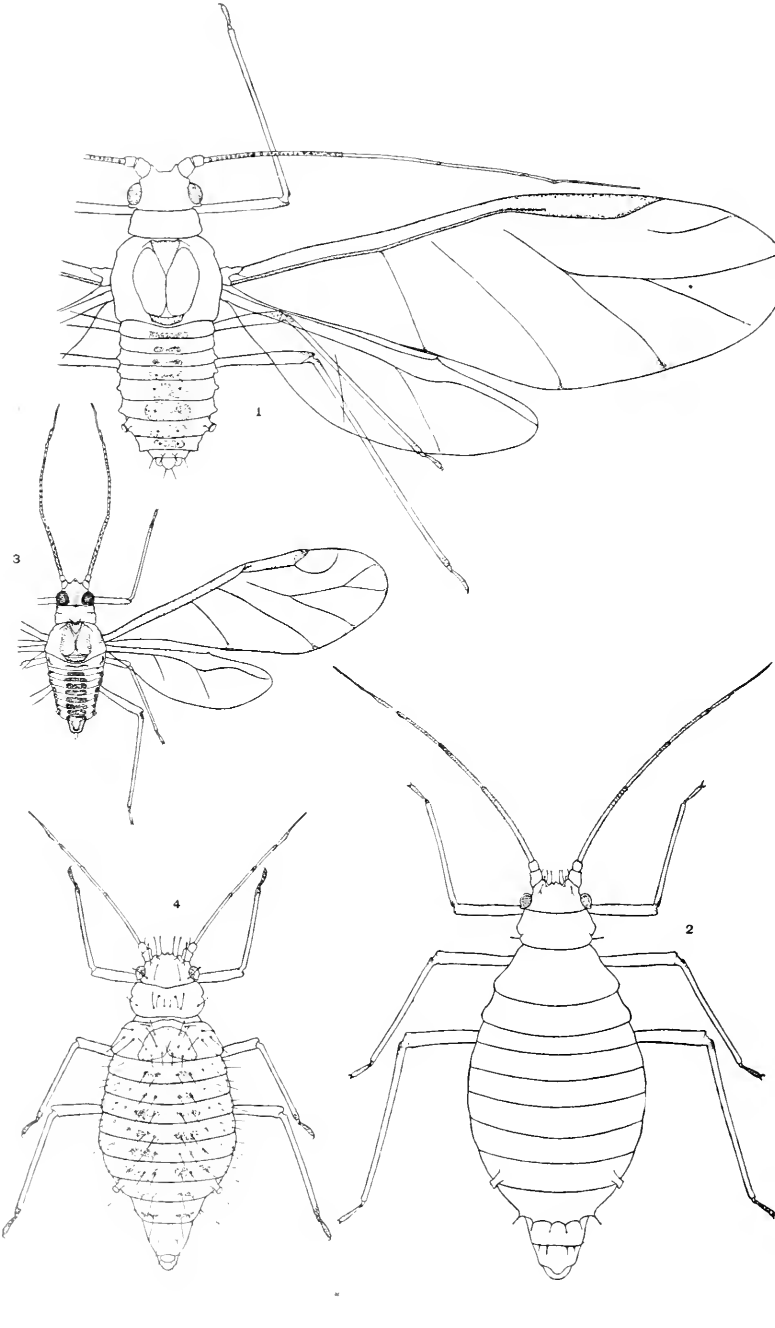
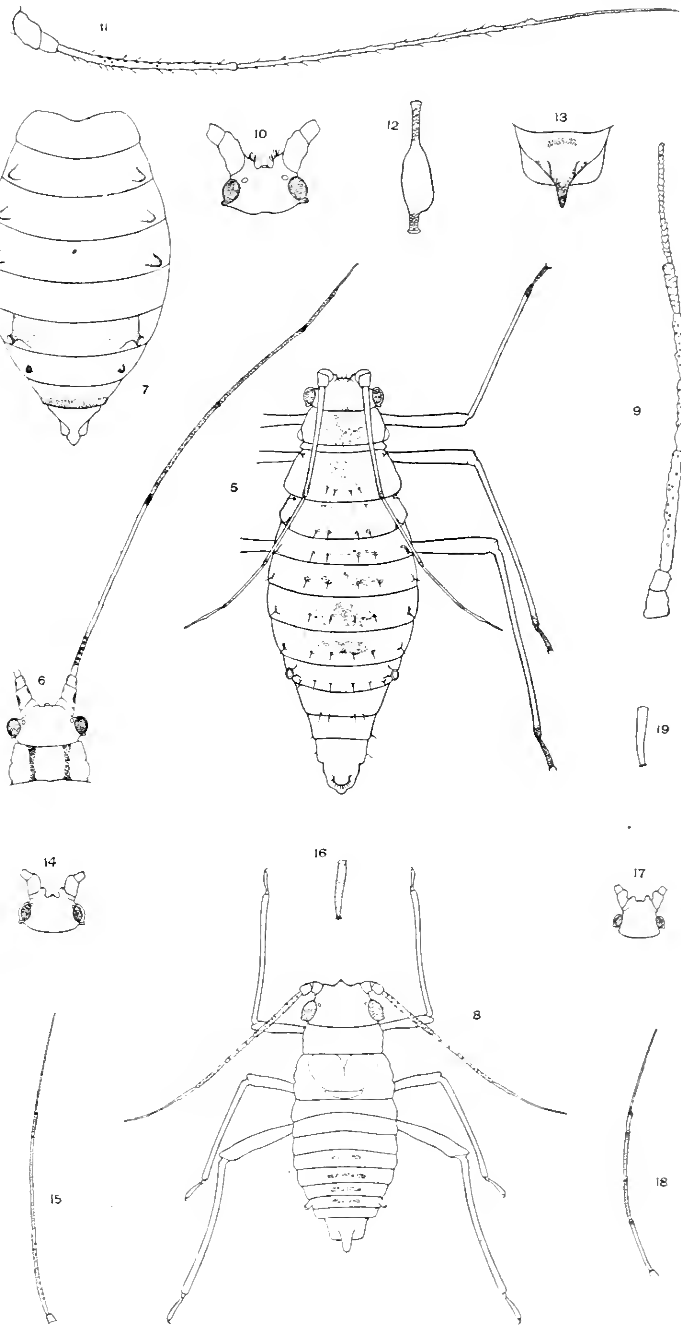


Plate 12



THE OCCURRENCE OF THE CITRUS RED SPIDER, TETRANYCHUS MYTILASPIDIS RILEY, ON STONE AND POMACEOUS FRUIT TREES IN OREGON

By H. E. Ewing, *Agricultural Experiment Station, Corvallis, Ore.*

In November of last year, while examining some leaves and twigs of apple trees at Corvallis for the common red spider of our eastern states and of Europe, *Tetranychus telarius* L., I came across another species which could easily be distinguished from *T. telarius* L. by the use of my hand lens. Upon examining specimens with the compound microscope in the laboratory, I was much surprised to find that this species was no other than *Tetranychus mytilaspidis* Riley, the well-known red spider of citrus trees in southern California. Since this initial observation several records have been made of this species in Oregon. The writer submits the following notes on its biology and economy under the influences of its new host plants and new climatic conditions.

In the autumn when the leaves of the deciduous fruit trees begin to brown, die, and fall, these mites change their summer habit of depositing eggs upon the leaves of the trees, and deposit nearly all of them on the twigs. After egg deposition the adults fall to the ground with the leaves and die. These eggs are always deposited singly, and may be placed very close together so that at times scores or even hundreds will be found almost touching one another. They are laid preferably at the bases of the last year's shoots or around the bases of the fruit spurs. Here they frequently become so numerous as to make these portions of the twig look quite red.

The eggs remain on the twigs over winter, and in Oregon suffer little from the hardships of moisture or low temperature, and are, at present, remarkably free from the attacks of predaceous enemies. During the month of April the eggs hatch, and the newly emerged, six-legged larvæ run about hunting for the opening leaf buds or the first tender leaf shoots where at once they begin to feed. By the seventh of May, at Corvallis, I found all instars present, as I did from this time on until the end of the season. These mites continue to feed and reproduce from the time of hatching in April until the end of the rainy season but with very little vitality. So few individuals are present at this time of the year that they are completely overlooked by fruit growers.

It is during July that the decrease in the humidity and the great increase in temperature causes these mites to reproduce and feed with great vigor. Now the adults become very active, and eggs are found scattered about all over the leaves. It is during this season that the species becomes very injurious to the trees by sapping the juices from the leaves and causing the latter to become pale or spotted and to curl up around the edges.

This species doubtless can be held in check by the use of summer sprays similar to those recommended for it in California; but, since the winter is passed only in the egg instar and these eggs are deposited in an exposed position, doubtless some dormant spray will be found that will be more satisfactory. I may add that lime-sulphur is not a satisfactory winter spray for the eggs of this mite. It will not kill the embryos in the eggs at all, but will, however, kill some, and at times perhaps 60 percent or 70 percent, of the larvæ after they have emerged.

The following records of the species in Oregon have been made and are here presented in tabular form:

RED SPIDER IN OREGON

Locality	Date	Host plant	Instars present	Situation and injury
Corvallis	Nov. 16	Apple	Chiefly adults and eggs	Adults on fallen leaves. Eggs on twigs
Salem	Dec. 19	Prune	Eggs	On twigs
Corvallis	Dec. 26	Apple	Eggs	On fallen leaves
Linn County	Feb. 11	Peach and prune	Eggs	At the bases of the last season's growth of twig
Eugene	Feb. 16	Apple	Eggs	On bases of twigs and spurs
Corvallis	Feb. 24	Apple	Eggs	At bases of spurs and on rough places on twigs
Corvallis	March 19	Prune	Eggs	On twigs. Thickest at bases of spurs
Salem	March 20	Prune	Eggs	Slight infestation on twigs
Salem	March 20	Apple	Eggs	Bad infestation of twigs
Estacada	March 30	Apple	Eggs	On rough bark of twigs and at bases of spurs
Corvallis	May 7	Apple	All instars	On the under side of young leaves
Corvallis	May 18	Apple	Adults and eggs	On leaves causing little injury
Corvallis	July 20	Apple	Adults and eggs chiefly	Causing slight injury to leaves
Corvallis	July 23	Prune	All instars	Very few individuals present; on some leaves; eggs numerous
McMinnville	July 25	Apple	All instars	No noticeable injury to leaves
Corvallis	Aug. 1	Apple	All instars	Injury slight
Corvallis	Aug. 17	Apple	All instars	Injury serious. Paling of leaves; also an upward cupping of edges of leaves

THE LIFE HISTORY AND HABITS OF CHEYLETUS SEMINIVORUS PACKARD

By H. E. Ewing, *Agricultural Experiment Station, Corvallis, Oregon*

Frequently found associated with some of our insect and mite pests is a little predaceous acarid, pale in appearance and less than a millimeter in length. This species was first described by Professor A. S. Packard in 1869. Since then it frequently has been observed by entomologists, usually in stored grain or grain products. The scientific name of this mite is *Cheyletus seminivorus* Packard. The specific name, *seminivorus,* means seed devouring; and doubtless was given to the species because it was believed that the acarid lived upon seeds. At any rate, it was first found in stored cabbage seed. The species, however, is not an enemy to seeds of any kind or to stored grains, for it is entirely carnivorous. When it is found among seeds or in stored grain it should be protected in every way, for it is there only to prey upon some other species, which is the real pest, whose destruction is to be desired.

During the last winter the writer came into possession of a sample of milled wheat which was infested with millions of Tyroglyphid mites. Associated with these Tyroglyphids were found at first only a few individuals of *Cheyletus seminivorus* Pack. Some of these were selected to be used in a series of experiments upon the life history and habits of this species. The following results were obtained.

Life History

Number of Eggs Laid and Rate of Deposition. Of the three females which I succeeded in getting to deposit eggs, one laid a total of 25 in a period of 6 days; another 22 in a period of 2 days; while the third laid only a single egg. The greatest number of eggs laid in one day by a single female was 11. The average rate of deposition per day for a single female was 5 1-3. All the females lived for several days after egg deposition had ceased. The eggs were laid near each other, but not in clusters; and the female remained by them for some time after deposition had ceased.

Length of Incubation Period. Of the 48 eggs laid in captivity 32 hatched. The minimum incubation period found for any one egg was 3 days, the maximum was 7 days. The average period of incubation for the 32 eggs was 4.31 days. These eggs were kept in cells at the ordinary laboratory temperature.

Description of Egg Instar. The egg is white, shiny, oblong-oval. It is about two thirds as broad as long. Generally the eggs are more convex on one side than on the other. During development the buds for the appendages may be seen through the egg-shell. Just before emergence the completely formed larva may easily be seen through the egg's shell. The egg-shell is a thin resistant membrane, which shrivels up after the hatching process. Measurements were made of 7 eggs which gave averages as follows: length, 0.130 mm.; breadth, 0.094 mm.

Percentage of Larvae Hatching from Eggs Deposited in Captivity. Of the eggs deposited in captivity 66 per cent. hatched. Those that did not hatch did not show developing embryos at any time, but soon began to shrivel and later to contract and dry up. I judged from this that they had not been fertilized.

Length of Larval Stadium. Of the 32 larvae which hatched from the eggs deposited I was able to get only 9 to live for any length of time. Yet out of these, 3 passed the larval instar into that of the first nymph. The minimum length of the larval stadium was 6 days, the maximum 9 days, the average 7.66 days.

Description of Larval Instar. Hyaline; in general appearance somewhat like the adult. None of the parts strongly chitinized. Beak very little chitinized. Palpal claw similar to that of the adult, but without the two tooth-like tubercles at its base. Inner serrula of palpal papilla about four-fifths as long as the outer and without teeth, being simply a large, curved bristle; outer serrula much stouter than inner, number of teeth 6 or 7. Antepenultimate segment as broad as long; femur of palpus but little swollen. Abdomen scarcely as large as cephalothorax. Three pairs of legs present. Measurements were made of three individuals which gave the following averages: length, 0.192mm.; breadth, 0.096mm.

The larva may at once be distinguished from the nymphs and adult by having only three pairs of legs instead of four as is found in the latter stages.

Length of First Nymphal Stadium. Two of the three nymphs passed this stadium successfully and became second nymphs. The length of the first nymphal stadium was in one instance 4 days, in the other 5 days. The other first nymph was killed in order to make a permanent mounted specimen of this instar.

Description of First Nymphal Instar. In general appearances this nymph is similar to the adult, but lacks certain structures while other structures which are found in the adult, in the first nymph have different proportions. Body and appendages, except the beak fleshy, soft, hyaline; tip of beak somewhat chitinized. Beak apparently shorter in proportion to the body than in the adult. Palpal claw as in the adult except the two tubercles at its inner side at the base are wanting. Outer serrula of palpal papilla with only 6 or 7 teeth; inner serrula without teeth, being simply a large, stout, curved, tactile seta; curved tactile seta of papilla as in adult. Antepenultimate segment and femur of palpus as in adult. Anterior pair of legs, relatively, much shorter in the first nymph than in the adult; tactile bristles of tarsus as long as the segment itself. Last pair of legs extending beyond the tip of the abdomen by one half their length. Total length of body, including the beak, 0.32mm.; width, 0.16mm.

Length of Second Nymphal Stadium. Of the two second nymphs obtained, one transformed in five days into the adult; the other, strange to say, lived in its cell for 32 days without transformation. At the end of this time it accidentally escaped. During this period it frequently became quiescent but at no time did it undergo transformation.

Description of Second Nymphal Instar. Very similar to the adult; beak and palpi showing more chitinization than in the first nymph. Beak and palpi very similar to that of the adult. Palpi stout, extending beyond the tip of the beak by about two fifths their length. Outer serrula of palpal papilla relatively larger compared to the palpal claw than it is in the adult, with 12 teeth; inner serrula with teeth, wherein it differs from that of the first nymph; number of teeth less than that of the adult, being only 9 or 10; curved tactile seta as in adult. Anterior pair of legs shorter than the body exclusive of the beak; tarsus considerably longer than the tibia as is true of the adult. Second pair of legs two thirds as long as the first pair; fourth pair of legs extending beyond the tip of the abdomen by one half their length. Total length of the body, including the beak, 48mm.; width, 0.26mm.

Length of Adult Stadium. The single adult obtained lived for 13 days and then died a natural death. This period corresponds very well with the length of time some of the adults lived which were not reared from eggs deposited in captivity.

Description of Adult. A very light yellow, almost flesh color; palpi and beak darker than the body and legs. Beak as long as the rest of the cephalothorax, more strongly chitinized at its tip than at its base and bearing not far from its tip a single pair of hairs or setae which extend one half their length beyond the beak. Palpi very stout, extending beyond the tip of the beak by two fifths their length. Last segment of palpus ending in a stout, curved, simple claw which extends beyond the tip of the outer serrula of palpal papilla by about one fourth its length. Two spurs or tubercles of about equal size are situated on the inner margin of the segment at the base of the palpal claw. Palpal papilla, or thumb, short, stout, as broad as long and bearing two serrulae and a large, curved, tactile seta; outer serrula much larger than the inner and almost as long as the palpal claw, with from 12 to 15 teeth, which increase in length as you pass from the base to the tip; inner serrula slightly over one half as long as the outer, with from 14 to 16 teeth, which are longest from the middle of the organ and become shorter as you pass toward the tip or base; curved tactile seta longer than the outer serrula and situated between and slightly below the two serrulae. Antepenultimate segment almost as broad as long; with but two setae which, however, are prominent; one is a large, curved, tactile seta situated on the inner margin of the segment next to the papilla, it is longer than the palpal claw; the other seta is situated on the ventral side of the segment. Femur of palpus one and a half times as long as broad; inner margin concave, outer margin convex. On the upper surface of the femur of the palpus is situated, a very long, simple or slightly pectinated bristle which is slightly longer than the segment itself. No other bristles on the upper surface of this segment. Cephalothorax broader than long excluding the beak. Eyes absent. Anterior pair of legs slightly longer than the body excluding the beak; tactile hairs on the tarsus sub-equal, and slightly shorter than the tarsus itself; tarsus longer than the tibia. Posterior pair of legs extending for almost one half their length beyond the tip of the abdomen. Total length of body excluding the beak, 0.58 mm.; width, .025mm.

Habits

The Molting Process. I was unable to observe the actual process of molting, but an examination of the cast skins showed that they had been split transversely at or near the scapular groove. This rupture was sometimes complete, and the two parts of the old skin when cast remained separated from each other some distance. The process evidently is the same for all stages. In some instances the posterior part of the cast skin showed a lateral rupture passing backward from the transverse one.

Nature of Food. This species is entirely carnivorous in its diet, and much prefers to catch its prey. Young individuals prefer to live upon the eggs of other mites if they can obtain them, and individuals of all stages will suck the juices of freshly killed creatures if they are unable to catch live ones.

Method of Approach and Attack upon Prey. These predaceous mites are extremely cautious about attacking creatures even smaller than themselves. I have watched the process several times upon the stage of the microscope. An individual will first approach its suspected prey slowly and touch it with the long tactile hairs on its front legs. Then it will retreat. Again it will repeat the process from another direction and again retreat. Now the hind legs will be presented to the victim and again a retreat will be made. When several of these actions have been performed and apparently if the Cheyletus has decided that it has prey and not a dangerous enemy, it rushes upon the latter and seizes it at the nearest point of attack by means of its powerful palpi, inserts the beak, and begins to suck the juices.

The Feeding Process. The victims do not stop movement when seized by this mite, as is claimed to be true by some writers for species of Cheyletus; in fact, frequently they are not killed at all. If the Cheyletus has been fasting it will seize its victim and suck it dry. I observed one under such conditions, and it took just 13 minutes for the feeding process.

After the beak is inserted one can see the strong pharyngeal muscles contract and relax very rapidly, while the stomach and abdomen gradually become distended with the blood sucked from the victim.

Number of Victims Killed. The adult individuals of *Cheyletus seminivorus* will frequently attack and kill many of their victims and suck but little of the blood. When they are very hungry they suck their victims dry, but if plenty of food is at hand they do not suck them dry. A single female in captivity killed 17 out of 20 Tyroglyphid mites in a day. Hence it will be seen that even in the adult stage alone, a great number of victims will be killed under favorable conditions, perhaps scores or even hundreds, by a single Cheyletid.

The Value of the Predaceous Habit as a Check upon the Ravages of Certain Pernicious Mites

Several entomologists have noticed the value of this species and others of the same genus in holding in check mite enemies of stored grain. Just how effective it is may be learned from the following: When the writer received the sample of milled wheat infested with millions of cheese mites (*Tyroglyphus* sp.) a careful examination of the same revealed but a few individuals of *Cheyletus seminivorus* Pack. Among the myriads of Tyroglyphids which swarmed in the ground grain scarcely any dead ones could be found. A short time after then I examined the same sample and found that out of 100 Tyroglyphids counted, 95 were dead and shriveled, 1 was dead but not shriveled, and only 4 were alive and active. Now the Cheyletids were common and everywhere busy seizing the Tyroglyphids and sucking their juices. Thus in a short period of only a few days this predaceous species had multiplied and destroyed about 95 per cent of the pernicious Tyroglyphids.

FEDERAL QUARANTINE NOTICES

Mediterranean Fruit Fly (*Ceratitis capitata* Wied.) Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine against the following fruits grown or shipped from the territory of Hawaii: Alligator pears, Carambolas, Chinese ink berry, Chinese orange, Chinese plums, Coffee berries, Damson plum, Eugenias, Figs, Grapes, Grapefruit, Green peppers, Guavas, Kamani seeds, Kumquats, Limes, Loquats, Mangos, Mock orange, Mountain apple, Natal or Kaffir plum, Oranges, Papaya, Peaches, Persimmons, Prickly pears, Rose apple, Star apple, String beans, and Tomatoes.

Potato Wart (*Chrysophlytis endobiotica* Schib.) Quarantine has likewise been declared against potato wart, potato canker, black scab etc. and the importation of potatoes forbidden from the following countries: Newfoundland, the islands of St. Pierre and Miquelon; Great Britain, including England, Scotland, Wales and Ireland; Germany; and Austria-Hungary.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—EDS.

The recent enactment of a National Plant Quarantine Act is a great stride in applied or economic entomology and one which should have been taken years ago. The Federal Government is now charged with functions which could not be exercised by the various States and all may look for a much greater protection from injurious insects. Co-operation between National and State agencies should result in a maximum efficiency at a minimum expenditure. Some were afraid such a law might prove a serious hindrance to certain phases of the nursery business. There is no denying that the welfare of all should take precedence over the prosperity of a few. Nevertheless, the administration of this law will doubtless go far to prove the groundless character of these fears and show how the enactment can be interpreted in such a catholic spirit as to command the respect of all.

The campaign against the house or typhoid fly has been in progress for about a decade. The press has displayed a commendable interest, many dailies and weeklies publishing brief timely warnings or directions for controlling the fly. We have at least two volumes on this insect, a moving picture film, some local anti-fly ordinances, accompanied here and there by vigorous campaigns—and flies. This is no implication that conditions have not bettered in some localities. It is simply an invitation to pause and see what has been accomplished. The educational campaign has been a necessary prelude to activity and here and there, but only locally, have we seen an approach to a systematic attempt to control this familiar pest. Is it not time that the more progressive sentiment of many communities, not excluding States, was crystallized into ordinances and laws along the lines such as those suggested by the Indiana State Board of Health for city and villages? Most intelligent people accept in a placid manner, the statements respecting the dangerous character of the fly, but in comparatively few instances does this result in action. Furthermore, it is difficult to secure desirable activity so long as neighbors do not or can not be compelled to assist in an undertaking which must depend in large measure for success upon general adoption. Here is where ordinances and laws are useful. Entomologists and others interested in bettering sanitary conditions might well turn their attention to this phase of the problem, since even the possibility of coercion proves a powerful stimulant to many who would otherwise be indifferent.

Reviews

Elementary Entomology, by E. DWIGHT SANDERSON and C. F. JACKSON, pages 372, figures 496. 1912.

The volume under consideration may be characterized as an excellent, profusely illustrated elementary entomology, admirably adapted to the needs of those interested or likely to become interested in the elementary or economic phases of the Science.

With less than 400 pages and nearly 500 text illustrations, the need of condensation is evident. Some 35 pages are devoted to a discussion of the external and internal anatomy, 22 pages illustrate growth and transformations, while over half the volume, about 200 pages, outline briefly the salient characteristics of the more important groups and incidentally notice many injurious forms. Scattered throughout the work there is much biological information, the value of the latter being greatly enhanced by the numerous figures of early stages in connection with those of the adult insect.

The laboratory work provides for the anatomical study and comparison of several typical forms and for biological work with aphids, the cabbage butterfly and the fruit fly. The keys to the orders and the more important families make it possible for students using this volume to become well acquainted with the entire group.

The authors have been successful in producing an admirable volume, small in size and moderate in price, which will appeal strongly to all having charge of elementary students in entomology. The paper is excellent, the printing clear, the figures distinct and the general appearance of the work most attractive.

The Wheat-Head Army-Worm as a Timothy Pest, by R. L. WEBSTER, Iowa Agricultural Experiment Station, Bulletin 122, pages 323–348. 1911.

The author gives an excellent comprehensive account of a timothy pest, *Meliana abilinea*. The discussion of control measures immediately following the characterization of the injury is a commendable feature in popular bulletins. The author advises clean culture, fall plowing and early fall pasturing. There is an excellent bibliography, a full life history and concise descriptions of the various larval stages. The excellent paper brings out the illustrations in a very satisfactory manner.

White pine blister rust (*Peridermium strobi* Kleb.) Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine against the following pines and their horticultural varieties, viz.: White pine (*Pinus strobus*), western white pine (*Pinus monticola*), sugar pine (*Pinus lambertiana*) and the stone or cembrian pine (*Pinus cembra*) originating in the following countries: Great Britain, France, Belgium, Holland, Denmark, Norway, Sweden, Russia, Germany, Austria, Switzerland and Italy.

Current Notes

Conducted by the Associate Editor

Professor S. W. Williston will make a paleontological expedition to South Africa this fall.

Mr. C. S. Brimley of Raleigh, N. C., has been elected president of the North Carolina Academy of Science.

Dr. J. S. Ward has been appointed inspector of Apiaries for the State of Tennessee, with headquarters at Nashville.

Mr. W. J. Price is now acting State Entomologist of Virginia, in place of Dr. E. A. Back who has resigned, to take up work in the Bureau of Entomology.

Mr. B. H. Walden, Assistant in Entomology at the Connecticut Agricultural Experiment Station, spent his vacation in Western Ontario, Can.

According to the report of G. M. Bentley, State Entomologist of Tennessee, there are 365 nurseries in Tennessee, with an annual income of $3,000,000.

Chas. T. Greene, Philadelphia, Pa., is now assistant in the Division of Forest Insect Investigations of the Bureau of Entomology. His specialty is Diptera.

Professor John Craig, professor of Horticulture in Cornell University and Editor of the National Nurserymen, died August 12th, at Siasconsett, Mass., aged 48 years.

According to *Science* a valuable collection of British Lepidoptera made by the late John A. Finzi, has been presented by his widow and daughter, to the Zoological Museum at University College, London.

Professor F. W. Rane was appointed by Governor Foss of Massachusetts, a delegate to the Second International Congress of Entomology at Oxford, England, held last August.

H. Maxwell Lefroy, Entomologist to the Government of India, located at Calcutta, has been appointed Professor of Entomology at the Imperial College of Science and Technology, South Kensington, London.

When Professor A. J. Cook became Commissioner of Horticulture in California a serial publication called "The Monthly Bulletin" was started. The ninth number has just been issued, making altogether 707 pages of interesting and valuable matter.

Mr. Howard Evarts Weed, a member of this association, formerly Entomologist at the Mississippi Agricultural Experiment Station, and now a landscape architect in Chicago, is the author of a book entitled "Modern Park Cemeteries," published by R. J. Haight & Co., Chicago.

Mr. F. W. L. Sladen F. E. S., formerly of Ripple Court Apiary near Dover, England, has been appointed assistant in Apiculture at the Experimental Farms, Ottawa, Can. Mr. Sladen is a practical beekeeper as well as a student of entomology and his work will be under the Dominion Entomologist, Dr. C. Gordon Hewitt.

Dr. W. J. Holland, Director of the Carnegie Museum, Pittsburgh, Pa., Author of "The Butterfly Book" and "The Moth Book" sailed August 20th, for Buenos Aires to install in the National Museum at La Plata, a replica of *Diplodocus carnegiei*, presented by Mr. Carnegie.

Mr. W. S. Fisher, for sometime assistant in the Division of Economic Zoology, Harrisburg, Pa., has recently accepted a position under Dr. A. D. Hopkins, in the Division of Forest Insect Investigations, Bureau of Entomology. Mr. Fisher specializes in the order Coleoptera, and for a time he will be stationed at Charter Oak, Pa., but during the winter will be located at Washington.

Professor T. J. Headlee of the Kansas Agricultural College has been appointed Entomologist of the Agricultural Experiment Station, State Entomologist of New Jersey, and Professor of Entomology at Rutger's College, New Brunswick, N. J., as successor to the late Dr. John B. Smith. Professor Headlee planned to take up his new work about October 1st.

According to *Science* Dr. Henry Fox, professor of biology at Ursinus College, has resigned to accept a position as assistant in the Bureau of Entomology. For the present his headquarters will be at the Experiment Station, Lafayette, Ind.

Rev. Geo. W. Taylor, a collector and writer in entomology, especially Lepidoptera, died at his home near Nanaimo, B. C., August 22. Mr. Taylor was Curator of the Canadian Marine Biological Station at Departure Bay.

It is reported in *Science* that a collection of foreign Lepidoptera containing about 150,000 specimens, included in 68 cabinets and worth over $200,000 has been received at the British Museum as a bequest from the late Mr. H. T. Adams of Enfield.

According to the Monthly Bulletin of the California State Commission of Horticulture, the services of Dr. F. Silvestri of Portici, Italy, have been procured for a period of twelve months, by the Board of Agriculture and Forestry of Hawaii, for the purpose of introducing into the Hawaiian Islands, parasites of the Mediterranean Fruit Fly, *Ceratitis capitata*, and the local Cotton Boll Worm, *Gelechia gossypiella*. Dr. Silvestri will obtain a leave of absence from his present work, and at an early date will visit the tropical portion of West Africa for this purpose. A series of Entomological Stations for receiving and distributing parasitic material will soon be established.

Mr. C. H. T. Townsend removed with his family in June, 1912, from Piura to Lima, Peru, where he becomes chief of the Estacion de Entomologia now being established with headquarters at the capital. The work at Piura will constitute a branch of the station. Mr. E. W. Rust, who has charge of the work in Piura under Mr. Townsend, was unharmed by the severe earthquake which visited that region on the morning of July 24, 1912. The collections, books, notes and important equipment escaped the earthquake, having been transferred to Lima. The Piura office quarters were badly damaged and a transfer is being made to a new temporary site. The equipment left in Piura suffered only nominal damage. Mr. Townsend's correspondents will please note his change of address to Estacion de Entomologia, Lima, Peru.

The following have been appointed members of the Federal Horticultural Board to have charge of the administration of the Plant Quarantine Act: Dr. C. L. Marlatt, Assistant Chief, Bureau of Entomology (Chairman); Dr. W. A. Orton, Plant Pathologist (Vice-Chairman), Peter Bisset, of the Bureau of Plant Industry; A. F. Burgess of the Bureau of Entomology and George B. Sudworth of the Forest Service.

Mailed October 15, 1912.

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

WILL SELL FOR CASH a complete set of Illinois Geological Reports, or will exchange for technical entomological writings, those dealing with parasitic insects preferred.

J. E. Hallinen, Interlaken School,
Laporte, Ind.

WANTED—To correspond with those desiring to exchange life-history series of important insects for economic collections.

W. E. Hinds, Auburn, Ala.

WILL PAY CASH or exchange for parts 9 and 10, Vol. IV, Insect Life.

H. F. Wilson, Bureau of Entomology,
Washington, D. C.

WANTED—Bulletins Bureau of Entomology, new series, Nos. 2, 15, 21, and Technical series, Nos. 1, 4, 5, 6, 7. Will pay cash.

James F. Zimmer, Bureau of Entomology,
Washington, D. C.

WANTED—Exp. Sta. Record, Vol. 3 No. 4 and Vol. 4 No. 5; Trans. of the Am. Ent. Soc. Vols. 2 and 3; Proc. of Ent. Soc. of Philadelphia, Vol. 2; Ann. Repts. Ent. Soc. of Ontario Nos. 2, 3, 7, 8; Papilo, Vol. 2 Nos. 2, 3 and 7, Vol. 3 No. 1. Will pay cash or exchange.

R. W. HARNED,
Agricultural College, Miss.

I offer in exchange for rare lepidoptera or coleoptera from the U. S. of N. A. specimens of the introduced species of Mantis—Tenodera sinensis; also, specimens of the rare beetle—Polyphylla variolosa.

Philip Laurent, 31 East Mt. Airy Ave., Philadelphia, Penn.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS,
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

WANTED—Will pay cash for Buls. 7, 8, 11, Tech. Ser. Bur. Ent. U. S. Dept. Agr.

H. A. GOSSARD,
Wooster, Ohio.

BACK NUMBERS WANTED.

Will pay 60 cents for No. 2, Volume I, and 30 cents each for No. 1 and No. 6, Volume II, No. 6, Volume III, and No. 2, Volume IV, to complete sets. Address:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS,
MELROSE HIGHLANDS, MASS.

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

A bi-monthly journal, published February to December, on the 15th of the month, devoted to the interests of Economic Entomology and publishing the official notices and proceedings of the American Association of Economic Entomologists. Address business communications to the JOURNAL OF ECONOMIC ENTOMOLOGY, Railroad Square, Concord, N. H.

TERMS OF SUBSCRIPTION. In the United States, Cuba, Mexico and Canada, two dollars annually in advance. To foreign countries, two dollars and fifty cents ($2.50) annually in advance. Single copies, fifty cents. To members of the American Association of Economic Entomologists, one dollar annually in advance. 50 cents extra postage to foreign countries.

MANUSCRIPT for publication should be sent to the Editor, E. PORTER FELT, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. BRITTON, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. BURGESS, Melrose Highlands, Mass.

Vol. 5 DECEMBER, 1912 No. 6

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Published by
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
Concord, N. H.

Entered as second-class matter Mar. 3, 1908, at the post-office at Concord, N. H., under Act of Congress of Mar. 3, 1879.

CONTENTS

TWENTY-FIFTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Cleveland, Ohio, January 1–3, 1913

The twenty-fifth annual meeting of the American Association of Economic Entomologists will be held in Cleveland, Ohio, January 1–3, 1913, in the Normal School Building, which is located between Euclid Avenue and East 107th and 115th Streets, four miles east of the center of the city.

The opening session will be called to order at 1 p. m., Wednesday, January 1, when the address of the President of the Association will be delivered. The meeting will be continued Thursday, in the morning and afternoon, and the final session will be held at 10 a. m., Friday, January 3.

Other Meetings

The American Association for the Advancement of Science, and its affiliated societies will hold meetings throughout the week. The Entomological Society of America will meet on Tuesday, December 31, and on Wednesday morning. The public lecture before that Society will be delivered Wednesday evening by Dr. P. P. Calvert of Philadelphia, Pa. The American Association of Official Horticultural Inspectors will meet Thursday evening at 8 p. m., when the Presidential address will be given. The meeting will be continued to Friday afternoon and evening.

Hotel Headquarters

The hotel headquarters for this Association have been secured at Hotel Euclid, which is located at Euclid Avenue, 14th and Huron Streets, in the central part of the city. Rates ranging from $1.50 per day and up for single rooms have been secured on the European plan. Members are urged to make hotel reservations as soon as possible as the number of rooms available at the lower rate are limited.

Railroad Rates

The following information concerning railroad rates has been furnished by Dr. L. O. Howard, permanent secretary of the American Association for the Advancement of Science:

Cleveland is in the territory of the Central Passenger Association. Legislative acts having reduced fares in this territory to the two cents a mile basis, the Central Passenger Association cannot make a further reduction by authorizing the certificate plan of fare-and-three-fifths for the round trip. This means that the certificate plan does not apply for this meeting. It is suggested that advantage be taken of such excursion fares as may be in effect at the time of the meeting. Members should, therefore, consult their local ticket agents regarding routes and rates. Parlor and sleeping car accommodations should be reserved in advance.

From the States of California, Nevada, Oregon, Washington, and west of, and including, Mission Junction, B. C.; also from what are known as Kootenay common points, namely, Nelson, Rossland, Sandon, Kaslo and Grand Forks, B. C., the Transcontinental Passenger Association has on sale daily Nine-Months Tourist fares, approximating two cents per mile in each direction, or about one fare and one third for the round trip. The nine-months fares apply to the eastern gateways of the Transcontinental territory which are:—

Atchison, Kansas.
Chicago, Illinois.
Colorado Springs, Colorado.
Council Bluffs, Iowa.
Denver, Colorado.
Fort Worth, Texas.
Houston, Texas.
Kansas City, Missouri.
Leavenworth, Kansas.
Memphis, Tennessee.
Mineola, Texas.
Minneapolis, Minnesota.
New Orleans, Louisiana.
Omaha, Nebraska.
Pueblo, Colorado.
St. Joseph, Missouri.
St. Louis, Missouri.
St. Paul, Minnesota.

Station agents will cheerfully advise delegates as to the eastern points to which it will be most advantageous for them to purchase nine-months tickets in rebuying through to Cleveland.

Proportionately higher fares are made to principal Atlantic seaboard points and to interior points such as New York, N. Y.; Baltimore, Md.; Philadelphia, Pa.; Washington, D. C.; Boston, Mass.; Montreal, Que.; Albany, N. Y.; Pittsburgh, Pa.; Buffalo, N. Y.; Detroit, Mich.; Toronto, Ont.; Cincinnati, Ohio.; Indianapolis, Ind.; Atlanta, Ga., etc

The nine-months fares do not apply to intermediate or interior points, but only to what are known as the eastern gateways of the Association, such as those named, including also Colorado Common Points. Should it happen that delegates apply at a station on the Pacific Coast from which the nine-months fare is not in effect, which may be the case at very small, unimportant stations, the agent will cheerfully ascertain and advise them the nearest point to his station from which such fare does apply.

Official Buttons

The official button of the Association will be supplied to all members whose dues are paid, including dues for the year 1913. These will be furnished at the meeting on application to the Secretary.

Exhibits

Several members have signified their intention to place on exhibition specimens of insects or breeding apparatus of various kinds. In addition to this the Ohio Agricultural Experiment Station will make an extensive exhibit of injurious insects in their various stages. This exhibit is used at agricultural fairs and will be of wide educational and practical interest to members and visitors.

Program

Wednesday, January 1, 1.30 p. m

Report of the Secretary.

Report of the executive committee, by President Hunter.

Report of the employment bureau for entomologists, by F. L. Washburn, St. Anthony, Park Minn.

Report of the committee on nomenclature, by Herbert Osborn, chairman, Columbus, Ohio.

Report of the committee on testing proprietary insecticides, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation with agricultural organizations, by F. M. Webster, chairman, Washington, D. C.

Report of the committee on legislation, by E. D. Sanderson, chairman, Morgantown, W. Va.

Report of the committee on affiliation of the Horticultural Inspectors with the American Association of Economic Entomologists, by T. B. Symons, chairman, College Park, Md.

Report of the committee on entomological investigations, by T. J. Headlee, chairman, New Brunswick, N. J.

Appointment of committees.

Miscellaneous business.

Action on proposed amendment to the constitution.

Strike out the first sentence in Article II, Section 1. In the following sentence after the word "entomologists" add "horticultural or apiary inspectors," so that the sentence will read as follows: "All economic entomologists, horticultural, or apiary inspectors employed by the federal or state governments . . . may become members." In Article III, Section 1, omit the last sentence, which provides for the appointment of the membership committee by the President of the Association.

New business.

Annual address of the President, W. D. Hunter, Dallas, Texas.

Reading of Papers

"Further Data on Heat as a Means of Controlling Mill Insects," by George A. Dean, Lawrence, Kans. (10 minutes.)

The temperature required, amount of radiation necessary, and results of heating several large mills.

"Notes on the Rice Water-Weevil, *Lissorhoptrus simplex* Say., and its Control," by Wilmon Newell, College Station, Texas. (15 minutes.)

An account of the writer's observations on this insect in the rice belt of Louisiana during 1909. Notes on feeding habits of adults and larvæ, host plants, longevity, probable number of generations annually, etc. The clue to successful control of the pest by proper manipulation of the irrigating water is pointed out. Use of arsenical poisons for destroying the adults before oviposition is suggested.

"Some Experiments with Roëntgen Rays upon the Cigarette Beetle, *Lasioderma serricorne*," by A. C. Morgan and G. A. Runner, Clarksville, Tenn. (15 minutes.)

"*Schizoneura ulmi* (*fodiens*) distinguished from *Schizoneura lanigera* (*americana*)," by Edith M. Patch, Orono, Maine. (5 minutes.)

Distinctive specific characters are presented for these two aphides both of which curl the leaves of elm; and evidence is cited to show that both species are present in America as well as in Europe.

Adjournment.

Program

Thursday, January 2, 10 a. m.

Discussion of the Presidential Address

Reading of Papers

"New Destructive Insects in New York," by P. J. Parrott, Geneva, N. Y. (12 minutes.)

Brief account of the importance and distribution of a number of species new to the State of New York.

"The Introduction, Methods of Control, and Spread of the Mediterranean Fruit Fly in the Hawaiian Islands, and the Danger of Introducing this Pest into the United States," by Henry H. Severin, Madison, Wis. Lantern. (30 minutes.)

How the Mediterranean Fruit Fly was Introduced into the Hawaiian Islands; the results of experiments in trapping the pest with crude petroleum products, vegetable and animal oils, "Spray and Spraying" and Clean culture; the distribution of the pest in the Hawaiian Islands within two years and the power of flight of two thousand marked male fruit flies; and the danger of introducing the pest into the U. S.

"Organization for Effective Work," by F. W. Rane, Boston, Mass., (10 minutes.)

"A City's attempt to Trap Brown-Tail Moths," by C. H. Hadley, Jr., Durham, N. H. (5 minutes.)

The varying captures at arc light traps. Proportion of males and females.

"Results of Experiments in Controlling the Gipsy Moth by removing its favorite food plants," by A. F. Burgess and D. M. Rogers, Boston, Mass. (15 minutes.)

"Preliminary Review of the Parasites of *Coccus hesperidum* in California," by P. H. Timberlake, Whittier, Cal. (15 minutes.)

A short account of the habits and interrelationship of the different parasites and of their efficiency.

"Some external parasites of domestic fowls," by G. W. Herrick, Ithaca, N. Y. (10 minutes.)

"Some Natural Enemies of Red Spiders," by H. J. Quayle, Berkeley, Cal. (15 minutes.)

An account of the biology and capacity for feeding of representatives of five different Insect Orders.

Adjournment.

Program

Thursday, January 2, 1.30 p. m.

Reading of Papers

"Economic Entomology at the Second International Congress of Entomology," by L. O. Howard, Washington, D. C. (10 minutes.)

"Mosquito Control Work in Connecticut in 1912," by W. E. Britton, New Haven, Conn. Lantern. (10 minutes.)

Brief resumé of educational work, campaigns for raising funds, area drained. Cost of draining and oiling to abolish breeding places.

"Notes on little known habits of the spotted fever tick," by R. A. Cooley, Bozeman, Mont. (12 minutes.)

Attitude assumed while waiting for a host; reaction to passing shadows; sensitiveness to animal breath; avoidance of sunlight.

"Additional Notes on the biology of the Rocky Mountain Spotted fever tick, (*Dermacentor venustus* Banks)," by F. C. Bishopp and W. V. King, Dallas, Texas. (10 minutes.)

Notes on the life history, seasonal history and habits which have been made mainly, since the publication of Bulletin No. 85 of the Montana Experiment Station and Bulletin No. 105 of the Bureau of Entomology, are brought together.

"Pellagra and the Sand-fly II," by S. J. Hunter, Lawrence, Kans. (15 minutes.)

"The Transmission of Infantile Paralysis by *Stomoxys calcitrans*, a résumé of Observations by Brues & Sheppard and Experimental Work by Rosenau & Brues and Anderson & Frost," by C. T. Brues, Forest Hills, Mass. (20 minutes.)

"The Stable Fly, *Stomoxys calcitrans* L., its Bionomics and Life history," by C. Gordon Hewitt, Ottawa, Can. (20 minutes.)

"The Stable Fly, *Stomoxys calcitrans* L., an important Live Stock pest," by F. C. Bishopp, Dallas, Texas. (15 minutes.)

The severe outbreak of this pest in Texas during 1912 is discussed. The importance of the species in other parts of the United States is considered and notes on the life history, habits, natural enemies and methods of control are included.

"Notes on comparative tests with Zinc Arsenite and Arsenate of Lead," by W. J. Schoene, Geneva, N. Y. (5 minutes.)

Includes feeding tests with Insects and effect on foliage.

"Results of the Arsenical Poisoning Investigation," by E. D. Ball, E. G. Titus, and J. E. Greaves, Logan, Utah. (10 minutes.)

Summary of results, effect of arsenicals and alkalies on leaves, on bark, and study of affected regions with suggestions as to real cause of trouble ascribed to above.

"Arsenical Residues on Fruit," by W. C. O'Kane, Durham, N. H. (12 minutes.)

Determinations of the amount of poisons adhering to ripe fruit after spraying; summary of analyses.

"How Contact Insecticides Kill," by G. D. Shafer, East Lansing, Mich. (8 minutes.)

On the influence of Carbon Disulphide and Gasoline vapors upon the activity of Oxidase Extract of Insects.

"Injuries following the application of Petroleum and Petroleum products to Dormant Trees," by E. P. Felt, Albany, N. Y. (15 minutes.)

"The Success of a Two-spray Calendar in a Kansas Orchard," by H. B. Hungerford, Lawrence, Kans. (10 minutes.)

Adjournment.

Program

Friday, January 3, 10 a. m.

READING OF PAPERS

"The Codling Moth and One spraying in the Hudson Valley," by E. P. Felt, Albany, N. Y. (10 minutes.)

"Fall Spraying for the Pear Psylla," by H. E. Hodgkiss, Geneva, N. Y. (10 minutes.)

Results of Experiments to protect pear orchards by fall spraying.

"Peach Stop-back, the work of the Tarnished Plant bug," by Leonard Haseman, Columbia, Mo. (15 minutes.)

Recent outbreaks, life history, food plants and remedies.

"Notes on Three Common Tree Crickets," by P. J. Parrott and B. B. Fulton, Geneva, N. Y. (15 minutes.)

Oviposition, habits and host plants.

"The Sugar Cane Insects of Porto Rico," by D. L. Van Dine, Rio Piedras, P. R. (15 minutes.)

A list, with notes, of the insects affecting sugar cane in Porto Rico.

"The Arrangement of Material in an Entomological Bulletin," by R. L. Webster, Ames, Iowa. (10 minutes.)

This paper considers an arrangement of matter for an entomological bulletin which separates the popular and technical discussion; the first being placed at the front portion of the bulletin, followed by the second.

"Entomological Pioneering in Arizona," by A. W. Morrill, Phoenix, Ariz. (15 minutes.)

Entomological conditions, experiences, observations and prospects in a field new to economic entomology.

"Apparatus for Maintenance of Thermal Climatic Conditions," by S. J. Hunter, Lawrence, Kans. (10 minutes.)

"The Sugar Beet Leaf-Hopper," by E. D. Ball, Logan, Utah. (10 minutes.)

Distribution, amount of damage, method of attack and remedial measures.

"Some Notes on *Laphygma frugiperda* in Porto Rico," by Thomas H. Jones, Rio Piedras, P. R. (10 minutes.)

Notes on occurrence and life history of the species in Porto Rico.

"Recent Studies on the Weevil and Bud Moth of the Walnut and a Saw fly attacking Blackberry," by W. E. Britton, New Haven, Conn. Lantern. (10 minutes.)

Brief presentation of life history and injury of each of these pests, about which little or nothing has previously been known.

"Controlling the Apple Leaf-Hopper in Missouri," by Leonard Haseman, Columbia, Mo.. (15 minutes.)

Notes on life history, work of the pest in Missouri and methods of controlling it.

"The Unspotted Tentiform Leaf-miner of the Apple," by Leonard Haseman, Columbia, Mo. (15 minutes.)

Life history, recent outbreaks in Missouri and methods of control.

Final Business Session

Report of committee on auditing.
Report of committee on resolutions.
Report of committee on membership.
Report of other committees.
Report of committee on nominations.
Election of officers.
Miscellaneous business.
Fixing the time and place of the next meeting.
Final adjournment.

A. F. Burgess, *Secretary*,
Melrose Highlands, Mass.

W. D. Hunter, *President*,
Dallas, Texas.

JOURNAL
OF
ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Vol. 5 DECEMBER, 1912 No. 6

NOTES ON THE BIOLOGY OF CHELONUS TEXANUS CRESS[1]

By W. Dwight Pierce and T. E. Holloway, *Bureau of Entomology, U. S. Department of Agriculture*

In this paper we describe the very peculiar life-history[2] of *Chelonus texanus* Cresson. In brief the adult Chelonus deposits its eggs in the eggs of its hosts but the parasite emerges not from the egg, but from the larva developed therefrom. Oviposition in the host's egg and retarded development of the parasite to permit the host to hatch and grow to considerable size has been pointed out by Marchal (Summarized by Bugnion, 1907. Smithsonian Report for 1906. pp. 310-314) with reference to the *Encyrtus fuscicollis* Dalman which oviposits in the eggs of *Hyponomeuta malinella*, etc., and by Silvestri (Biologia del *Litomastix truncatellus* (Dalm.). Portici, pp. 4, 5, 10. 1906) with reference to *Litomastix truncatellus* Dalman which oviposits in the eggs of *Plusia gamma* Linnæus and other Lepidoptera. *Litomastix truncatellus* is polyembryonic and possibly pædogenetic in alternate generations; *Encyrtus fuscicollis* is also polyembryonic, but the Chelonus we have observed is a single and simple parasite. The Litomastix adult measures only 1.9 mm. in length and the egg of Plusia measures 0.6 mm. in diameter. Chelonus measures fully 5 mm. and the eggs of Heliothis measure about 0.5 mm. in diameter, while those of Laphygma are still smaller. Thus the contrast is much more striking when one observes Chelonus ovipositing than it would be in observing Litomastix.

---

[1] Published by permission of the Chief of the Bureau of Entomology.

[2] It appears since sending in the above manuscript that during the summer of 1912 Mr. R. A. Vickery, of the Bureau of Entomology, at Brownsville, Texas, confirmed these observations in regard to Chelonus and Laphygma. It also appears that Mr. T. H. Parks, also of the Bureau of Entomology, reared Chelonus from Laphygma through two generations at Greenwood, Miss., confirming in all respects the observations reported by Mr. Pierce in the above article.

The earliest record in the files of the Southern Field Crop Laboratory indicating the habit of oviposition of Chelonus was made by Mr. J. D. Mitchell at Victoria, Texas, August 17, 1909, when he observed several adults of *Chelonus texanus* apparently ovipositing in the numerous egg masses of some undetermined Lepidopterous insect on the walls of a house.

At Brownsville, Texas, on March 11, 1911, the junior author made the following note:

> "While collecting eggs of *Heliothis obsoleta* Fabr. on young corn this morning I noticed a Hymenopterous parasite on a leaf. I disturbed it slightly but it would not leave its place. I then noticed that it was standing over a dark Heliothis egg, with its ovipositor in the position for parasitizing the egg."

The parasite, which was found to be *Chelonus texanus* was caught and was taken to the laboratory, where it was placed in a tube with about two hundred Heliothis eggs. It oviposited in one egg after another, spending from five to thirty seconds at each egg. Heliothis larvæ emerged from the eggs on March 13 to 15. A number of these larvæ were reared and observed for parasitism. On April 6 one larva was dead and a white Chelonus larva had emerged from it. The dead Heliothis larva was about one fourth of an inch in length and the parasite larva was about the same length. The body of another Heliothis larva, which had probably died a day or two earlier, was dried into a small lump. The Chelonus larva which had emerged from this second Heliothis larva was very active. Both of these Chelonus larvæ died without pupating, but by April 13 two Chelonus cocoons were obtained from the lot of Heliothis larvæ from the parasitized eggs. On April 24 one adult of Chelonus emerged from one of these cocoons and was placed with another Chelonus, both from eggs of the original female. Both parasites seemed to be females, though one was larger than the other. They seemed to desire to escape from the glass tube in which they were confined, and they showed no desire to copulate. On April 25 fifty Heliothis eggs were placed in the tube, but oviposition was not observed. By May 12 the smaller parasite, which must have been a male, had died. The other parasite was given Heliothis eggs on a piece of corn leaf. It examined the corn leaf and then the eggs, and forthwith began to oviposit.

The parasite collected on March 11 was placed with about seven hundred Heliothis eggs in four lots of from one to two hundred eggs. During the period from March 11 to March 20 the parasite probably oviposited in most of these eggs. It was given drops of a solution of sugar and water for food, and sometimes it fed greedily. The parasite had a habit of drawing up its legs and feigning death when disturbed, as does the boll weevil and many other insects. The ovipositor is blunt at the apex. It is pressed straight into the egg. An interior process undoubtedly pierces the shell of the egg.

At the time the notes mentioned were made, the junior author spoke of the matter to several entomological friends, but they were all so reluctant to believe that a Braconid which was approximately half as large as a house fly would oviposit in Heliothis eggs or in any eggs at all that nothing was published on the subject.

While searching for egg masses of *Laphygma frugiperda*, which were quite abundant at Dallas on many kinds of trees, the senior author on September 23, 1912, twice observed specimens of *Chelonus texanus* on egg masses, apparently ovipositing. They were very easily removed with the eggs to tubes without in the least disturbing them. The egg masses probably contained about one hundred and fifty eggs each and the parasities were at least as large in bulk as half the mass. They would feel with their antennæ over the surface of the eggs and then advance and insert the slender ovipositor in an egg, then in less than a minute would withdraw the ovipositor and insert it in the next egg. This process continued for a long time, with many surveys for unparasitized eggs.

The unusual abundance of egg masses which were beginning to hatch on September 23 was preceded a few days before by large flights of moths. Coincident with this abundance was the appearance of many adults of *Chelonus texanus* which were exploring grass and trees, and were often found at the nectaries of cotton, castor-bean and peach. It was therefore a simple matter to collect specimens for isolation with egg masses not too far advanced. This abundance of Chelonus was noticed at the same time in 1911.

On October 15, just twenty-two days after the large series of egg masses were collected, the first two Chelonus larvæ left their hosts, which were but slightly more than one-half inch long, and began to spin their beautiful, thin-meshed white cocoons.

Fifty-seven broods of Laphygma larvæ were under observation subsequent to September 23, and from twenty-five of these, Chelonus was bred. The first cocoon was formed October 18, and the others during a period of ten days thereafter. From these twenty-five broods, after they had reduced their own numbers by cannibalism, there were only forty surviving worms and fifty-five parasites. In fourteen broods the last surviving worms were parasitized. Records of the period prior to cocoon formation were made on twenty-six parasites with the range twenty-five to thirty-two days and with an average of twenty-six days.

On October 5, from an egg mass collected September 12 at Argenta, Ark., only three worms remained, they having gradually exterminated their mates although in the presence of plenty of food. All three of these worms were parasitized by *Chelonus texanus* and the parasite larvæ issued between October 5 and 8, leaving nothing but skin and head shield. The hosts were about one-half inch long when killed. Two of these parasites became adult between October 17 and 28, after a twelve to eighteen-day period in their cocoons.

The parasitism has a peculiar effect on the Laphygma larvæ. They grow and feed apparently quite normally and their cannibalistic habits are not in the least diminished by the presence of a larva within their bodies, perhaps they are more cannibalistic. When about one-half inch long, if parasitized, the worm makes a cell. This would probably be in the soil under normal conditions. This cell is supported by a fine meshed yellow silk cocoon. Within two days after completing the cell the larva dies, and on the next day the parasite larva emerges from a hole about the middle of the body. There remains nothing of the host larva but the shrivelled skin and the head shield. The parasite proceeds to spin its beautiful white cocoon within its host's yellow cocoon, taking one or two days for the process. The time of emergence of the parasite seems to depend almost entirely upon the size of the host. If it grows and feeds slowly, so does the parasite within.

The premature spinning of a cocoon by the host larva long before it could possibly be ready to pupate is a striking example of the results of parasitism. This habit also gives added security to the parasite when it emerges.

It is also of interest to compare the two host species thus far studied. Heliothis deposits single uncovered eggs and Laphygma deposits great masses of eggs in several layers (several hundred to a mass) and covers them with scale like hairs.

It appears that this habit of oviposition may not be characteristic of all species of Chelonus for Silvestri in describing the habits of *Chelonus elæaphilus* Silvestri and *C. orientalis* Silvestri indicates that oviposition probably occurs in the very young larval hosts (Silvestri. La Tignola dell'Olivo. Portici. 1907. pp. 154–157).

The determination of the Chelonus was made by Mr. Henry L. Viereck, to whom we owe our acknowledgments of his kindness.

THE LIFE HISTORY OF TETRASTICHUS ASPARAGI CRAWF.[1]

By H. M. Russell and F. A. Johnston, *Bureau of Entomology, United States Department of Agriculture*

Tetrastichus asparagi was first recorded in July, 1909, as an enemy of the common asparagus beetle (*Crioceris asparagi* Linn.), by Dr. H. T. Fernald,[2] who published another short article on the same insect in August of that year.[3] In these papers Doctor Fernald described the habits of the female in ovipositing in the egg of the host and stated that it appeared as if this insect would be an efficient egg parasite of the asparagus beetle. Unfortunately, through press of other matters, he could not devote sufficient time to this insect so that he did not rear the adult, and so failed to observe the strange life cycle, and the equally interesting feeding habits of the mature insect. This species was described by Mr. J. C. Crawford, of the United States National Museum, in October, 1909.[4]

While the writers were located at Riverhead, Long Island, N. Y., during the summer of 1912, this insect was observed in large numbers. The observations here recorded were made on its life history and habits at that time. The junior writer by his careful manipulation was successful in carrying this insect through its complete life cycle.

On June 10 the writers were inspecting a field of asparagus at Aquobogue, that was being cut for market. This field had a few uncut rows that had been left as a trap to attract the asparagus beetles and on these rows the asparagus beetle was very abundant and the eggs were found on the plants in large numbers. Associated with these beetles in noticeable numbers were the adults of this parasite, often from five to seven occurring on a single stalk. Observation revealed that these were ovipositing repeatedly in the eggs of the asparagus beetle and at the same time destroying many of the eggs by feeding on them. This feeding was so extensive that out of 2,097 eggs counted on 28 stalks of asparagus, 1,495 had been destroyed.

A number of adults of this parasite were brought into the laboratory and allowed to oviposit in the eggs of the asparagus beetle. Instead of the adult parasite emerging from these eggs, however, the larvæ of the beetle came out, but died from lack of tender food. This result

---

[1] Published with the permission of the Chief of the Bureau of Entomology.

[2] A parasite of the Asparagus Beetle, Cir. 23, Mass. Agr. Exp. Sta. (1909).

[3] A Parasite of the Asparagus Beetle, Journal of Economic Entomology, vol. 2, pp. 278–279 (1909).

[4] *Tetrastichus asparagi* n. sp. Proc. Ent. Soc. Wash., vol. 11, p. 150 (1909).

was very astonishing, as this insect had been looked upon as an egg parasite. However, it confirmed the opinion of the senior writer that, inasmuch as the adult was twice as large as the host egg, it could not develop to maturity in the egg. It seems that, unknown to the writers, Mr. W. F. Fiske of the Bureau of Entomology had held the same view, for he suggested to Doctor Chittenden last fall that, as the parasite was so much larger than the egg of the asparagus beetle, it could not possibly breed from it, but must come from a much larger beetle. He thought that a species of *Trirhabda* which feeds on *Solidago* sp. was most likely to be the true host of this insect and that its habit of feeding on eggs of the asparagus beetle was an acquired one. Mr. Fiske, however, also missed the connection in the curious life history of this insect, possibly because he had not observed it in the field.

As true oviposition had been noted in the eggs of the asparagus beetle, and as this parasite refused to feed on the eggs of the potato beetle (*Leptinotarsa 10-lineata*) and of the elm leaf-beetle (*Galerucella luteola*), even when confined with nothing else, the senior author held to the view that the asparagus beetle, in some stage, must be the true host. Dissection of the eggs of the host, by the junior author, revealed the eggs of the parasite and it appears as if this insect must develop in the larva of the beetle.

On June 10, when this insect was first observed, the senior author collected a number of nearly mature beetle larvæ and brought them into the laboratory. These entered the ground on June 21 and formed pupal cells. These cells were dug up on July 2 and examined. Many contained the pupæ of the beetle, but one was found to be packed with six white parasitic larvæ and nothing remained of the host but the black larval skin. These larvæ were about mature and some days later changed to pupæ, but all died in that stage. Thus, for a second time this life-history problem failed of being solved, as it was not proven that the insect that parasitized the egg of the host belonged to the same species as the larvæ that developed in the host larvæ. The writers, nevertheless, felt encouraged to continue the investigation.

About July 10 another lot of asparagus-beetle larvæ was collected by the junior author and placed in large vials in the laboratory. When examined July 24, many had changed to adults of the asparagus beetle, but in one vial there were three pupæ of a parasite similar to those previously observed. On August 1 and 2 the adult parasites emerged and were identified by Mr. J. C. Crawford as *Tetrastichus asparagi.*

During the last half of July, after an absence of several weeks, the adult of this parasite was again discovered in the asparagus fields feeding and ovipositing in the eggs of the beetle. At that time the plants were large and the eggs scattered widely throughout the fields, so that the parasite had also scattered and was very hard to find. A number of the parasites were collected, however, and taken into the laboratory by the junior author and confined in vials with eggs of the asparagus beetle. When the parasites had oviposited in them these eggs were removed and the sprigs of the plant bearing them were put in moist earth until the larvæ of the beetle hatched. These larvæ were carefully supplied with fresh food from time to time and when full grown were allowed to pupate in the bottom of the vials in soil provided for that purpose. Many formed their pupal cells along the sides of the vials and could be observed from time to time without being disturbed.

A few days after going into the soil the beetle larvæ began to change to pupæ and still later numbers of them were observed from which the parasitic larvæ had emerged.

The larva of *Tetrastichus asparagi* when mature is from 2 to 2.5 mm. long and 1 mm. wide; it is ovate and widest near the head, which is bent under the body. The color is white, with the alimentary canal appearing greenish. The surface is smooth and shining and devoid of hairs. There are no legs and the larva seems to be incapable of motion except to move the end of the abdomen around when disturbed. In a few days after destroying the host, the parasitic larva changes to the pupa.

The pupa of this insect is about 1.5 mm. long and 0.5 mm. wide and is yellowish white in color. It is convex dorsally with the head bent under and the inconspicuous wing pads are folded along the side, while the antennæ and legs are folded under ventrally. The head, thorax and abdomen are distinctly differentiated from each other, the abdomen tapering posteriorly. During the latter part of the pupal period, the pupa darkens considerably and just before emergence is nearly black, with the eyes bright red. From 7 to 11 days were spent in the pupal stage and as the adults emerged from the ground in from 24 to 36 days after the host eggs were parasitized, the egg and larval stages together required 17 to 25 days.

The living adult of this insect has the head and thorax bluish green, and the abdomen green with coppery iridescence. The antennæ are black and the eyes dark red while the wings are hyaline with black venation. The legs are black, except tips of femur, tibia and tarsi which are orange-yellow. The head is transverse and the abdomen well rounded and ovoid. This insect is variable in size ranging from about 1.5 to 2 mm. in length.

As soon as the adults emerged from the pupæ they began an active search for the eggs of their host and within a few minutes after being placed with eggs began feeding and ovipositing in them.

The process of feeding is best described by the field notes as follows: The insect began a careful search over the asparagus, moving around very slowly with the antennæ held down in front of the head, but in constant vibration. In a short time the female discovered an egg and examined the surface all over with her antennæ. Then she climbed up on the egg until her head and thorax were above the top of it. The ovipositor was then exserted, from the underside of the abdomen, almost at right angles to the body. She then began an upward and downward movement of the abdomen and speedily forced the ovipositor into the egg. This was alternately thrust in to its full length and withdrawn for fully three minutes. During all of this time the antennæ were dropped in front of the head and held motionless. The female then withdrew her ovipositor and climbed down from the egg. She then placed her mouthparts to the tiny hole and sucked up all of the exuding egg contents. After this she climbed upon the egg again and after inserting the ovipositor drilled for eight minutes, after which she suddenly left the egg and went in search of another. When feeding began she always raised the antennæ to the horizontal, but kept them in constant vibration.

A number of adults that were observed in the field and in the laboratory were found to occupy from 1 1-2 minutes to 23 1-2 minutes in puncturing and feeding on a single host egg. Thirteen females that lived an average of 7.8 days, during their life time destroyed by feeding, 260 eggs of the asparagus beetle or an average of 20 each at the average rate of 2.5 per day. The largest number of eggs destroyed by a single female was 61 and the largest number destroyed in a single day was 12.

The process of oviposition was as follows: The female slowly crawled over the plants with the antennæ held forward and bent down, but in constant motion, carefully examining each object that she encountered. When she found an egg of the host, she carefully examined it with the antennæ and if satisfied climbed up on one side of the egg and lowered the abdomen a trifle. Then the ovipositor was exserted and thrust into the egg. There it was held for a short interval and then withdrawn—quite in contrast with the feeding habits, as the ovipositor was not worked up and down in the egg at all. Immediately the female left the egg and continued her search for more and when these were found she either continued oviposition, or began feeding again.

So far as this investigation has gone, reproduction has been observed by the asexual method entirely, as in two successive generations no males have been reared. Females confined in separate vials as soon as they had emerged from the pupæ began oviposition in the host eggs and the adults were reared in these experiments.

In confinement this insect has continued oviposition from 1 to 17 days and lived from 5 to 21 1-2 days and during that time oviposited in from 1 to 41 eggs of the host besides destroying from 1 to 61 by feeding. In the few eggs of the host that have been dissected from 1 to 5 eggs of the parasite were found.

The egg of the parasite is reniform with one end more slender than the other, about 0.24 mm. long and 0.0825 mm. wide, and is of semi-transparent milky color with a granular appearance within. While the eggs may be laid singly, in a number of cases they were found in pairs side by side.

In rearing this parasite from 1 to 9 adults have emerged from a single host larva, so that apparently for every egg of the parasite one adult results. Polyembryony, therefore, as in *Encyrtus*, *Litomastix*, and *Copidosoma*, so fully studied by Dr. Paul Marchal[5] and others and reviewed by Dr. L. O. Howard,[6] appear not to occur in *Tetrastichus asparagi*.

Apparently this insect has three generations a year in Long Island, for it was very abundant early in June at the time the first generation of the host was appearing, after which it disappeared, only to be found again in July with the second generation of the host. Since that time two generations have been reared under nearly normal conditions.

Undoubtedly this is a parasite of much promise, for not only does it check the asparagus beetle by its parasitic development, but it seems to do even more good from its habit of feeding so energetically on the eggs of this insect. The field where these observations were made has until this year always been sprayed to prevent serious injury by the asparagus beetle, but this year, although it received no treatment whatever, the asparagus beetles were so scarce that no damage resulted.

---

[5] Récherches sur la Biologie et le Developpement des Hyménopteres Parasites—La Polyembryonie Spécifique on Germinogonie. Arch. Zool. Exp. (4), vol. 11, pp. 257–335, pls. IX–XIII (1904).

[6] Polyembryony and the Fixing of Sex. Science n.s., vol. 24, pp. 810–818 (1906).

NOTES ON LIXUS CONCAVUS

By Harry B. Weiss, *New Brunswick, N. J.*

This beetle commonly known as the rhubarb curculio emerges from its winter quarters about the last week of May in the latitude of New Brunswick. It hibernates, presumably under débris commonly found in the field, inasmuch as two specimens were taken last December from under dead leaves and rubbish and one from under a loose piece of bark at the base of a stump. Careful searches at different times later in the winter resulted in none being found.

Egg deposition commences soon after emergence, as eggs were collected in the field on the first of June in the stems of *Rumex crispus*, which is undoubtedly the favorite food plant of the larvæ. Sunflower and thistle were examined for egg punctures with negative results and in one instance only, eggs were found in a species of polygonum or smartweed.

In dock the egg punctures occur from the base of the stem all the way to the tip of the plant and it is not uncommon to find from fifteen to twenty punctures in a stem three feet high. Occasionally they occur in the leaf petiole. Not all of these punctures, however, contain eggs, only a comparatively few. Upon cutting into some stems, many egg cavities were found to be empty and the surrounding tissue showed no evidence of larval activity. Other stems showed many empty egg cavities together with channels eaten by the first hatched larvæ. Sometimes these channels cut through egg cavities and other times cleared them. In either case more egg cavities were empty than should have been the case, especially as only one or two larvæ were usually found. From this one is forced to conclude that the beetles are either often disturbed during oviposition and get no further than the cutting of the cavity, or that the first larvæ which hatch out eat any eggs they may come across on their way to the root. No matter how many egg punctures are in a stem, not more than two or three larvæ can be found early in the season and later not more than one.

In the laboratory, eggs hatched in from seven to nine days during June and in the field egg laying continued up until July 20, after which no eggs were found. Egg deposition, however, is practically over by the middle of June as on June 19 one egg was found to eighteen larvæ.

The newly hatched larva first eats out a little chamber about a quarter of an inch or less above the egg cavity. This is really an enlargement of the egg cavity. It then goes down through the stem, cutting a more or less irregular channel, until the root is reached, where it remains and does practically all of its feeding until full grown. There is one exception to this. Where the stem is thick and does not dry out rapidly, some larvæ eat a fairly large cavity in the base of the stem before attacking the root.

When the larvæ are young it is possible to find two or three in different portions of a single stem. Later, however, one to a single plant is the rule except where the root is large and supports several stems, then it is possible to find as many as three occupying different parts of the root. On seven different occasions I found larvæ feeding upon other larvæ and I feel that this explains the fact that only one larva is found in a plant containing numerous egg punctures. Inasmuch as they are carnivorous, they undoubtedly devour eggs also.

The first born larva evidently makes its way down the stem and feeds on any eggs into which its channel may cut. The second hatching from a place above the first or from an egg which escaped the first also makes its way down the stem and lives only until it reaches the cavity in the root made by the first, when it is devoured, assuming that the largest is always the victor. The second may also eat some eggs on the way down. I imagine that this procedure is kept up until only one remains. If the first larva goes some distance down in the root, larvæ hatching later may live longer if they cut a different channel, but in a small root supporting only one stem, the cavities are bound to run together and not more than one is found in a root of this kind. Undoubtedly some of the eggs which are laid late are crushed by the drying and contraction of the stem, as by July 3 the tops of many plants are dry and brown. From a large root supporting five stems, containing fifty-eight egg punctures, only three larvæ were found and these were in different cavities.

Of course some of these punctures may have been made for feeding purposes, but as the beetles also feed on the edges of the leaves, it seems somewhat unlikely that they would prefer the harder tissue of the stems.

From eight to nine weeks are required by the larvæ to reach maturity and in middle and south Jersey the majority are full grown by the second week in August. Owing to the period over which oviposition extends it is, of course, possible to find larvæ only one third grown at this date. As late as August 14, I have taken larvæ one third grown, full grown larvæ, pupæ and an immature beetle all on the same day. In the field the first pupæ were collected August 1 and the first adults on August 6.

From the second to the fourth week in August, the majority in the field were undergoing pupation and during the first week in September many adults emerged. By September 11 practically all had emerged.

The pupal period as determined in the laboratory, varied from ten to twelve days. Pupation takes place in cells of varying lengths, the tops of which are always on a level with the surface of the ground. When ready to emerge, the beetle cuts an oval opening about three sixteenths of an inch in diameter in the now dry stem usually an inch or two above the ground. If the weather is warm it feeds somewhat on the young leaves around the base of the dock, but from the scarcity of beetles in the field after the first week in September, they evidently go into winter quarters soon after emerging.

If *Rumex crispus* is cut off several inches from the ground between the middle and end of July and rain occurs soon afterwards, a large percentage of the larvæ will die owing to the decay which sets in, practically all being in the roots at that time.

THE SUGAR-BEET WEB WORM

Loxostege sticticalis Linn

F. B. Paddock, *College Station, Texas*

The investigation represented in this paper was stimulated by an outbreak of the pest in the sugar-beet fields of Colorado in the summer of 1909. At that time the insect had inflicted severe damage before the growers were aware of it and were at a loss for control measures. A similar outbreak had occurred in 1903 but had evidently been of short duration. The writer endeavored to determine the life history and habits of the insect in that locality and to find, if possible, some control measures.

"For some reason writers on this species appear to have overlooked the fact that it is not native, but introduced from abroad, presumably on the Pacific coast, whence it spread eastward to Colorado and Nebraska. From specimens in the National Museum it seems that the insect was collected at Palmer, Utah, in July, 1869, which is evidence that it must have been introduced many years earlier. In 1873, it was taken in Central Missouri. It is also recorded from Winnipeg, Manitoba, as well as from several localities in Nebraska, Kansas and Michigan." [1]

The insect made its first appearance in Colorado in 1891 but did not become a pest until 1903.[2] In Nebraska the first outbreak of the

---

[1] Chittenden, F. H. Bureau of Entomology Bulletin, No. 33 pp. 46–49.

[2] Gillette, C. P. Colorado Experiment Station Bulletin No. 98.

pest occurred in 1893 [3] and in Michigan the first injury was noted in 1899.[4]

"Meyrick records this species as inhabiting England, Ireland, western and central Europe, and northern Asia as well as North America." [1] This species is known to European entomologists as *Eurycreon sticticalis* Linn. In central Europe the pest occurs periodically and in such numbers as to devastate the crops. The superstitious peasants consider these outbreaks a visitation of Providence, consequently control measures are rarely attempted and the pest spreads at will.

Food Plants. This species has been found feeding upon pig-weed (*Amarantus*), lamb's quarter (*Chenopodium*) beets, onions, cabbage and alfalfa in America. In Europe it has been found feeding upon a pig-weed (*Artemisia*), bindweed, wolfsbane, corn, the blossoms of plum, apple, cherry and peas and grasses.

Losses. As a result of the ravages of *L. sticticalis* growers estimate losses from 35 to 55 per cent in tonnage; analyses of the beets show a loss of 2 to 5 per cent in sugar percentage with a corresponding decrease in purity of the juice. In sections of Europe entire districts have many times been destroyed and the factories have remained closed. The farmers at such times left the beets in the ground, considering them profitable fertilizer for the soil.

Review of the Season of 1909. From notes made at Sterling, Colorado, by the writer, the following are quoted:

From June 18th to 30th the moths of the first brood were numerous on weeds and alfalfa around the beet fields. By July 15th the moths of the second brood were numerous in many beet fields. On July 23d a few eggs were observed and the moths seemed very active around the beets. A general outbreak of the worms throughout the entire district occurred on July 25th and by this time the moths were becoming scarce. The worms reached their maximum in numbers from June 26th to 31st. Considerable spraying was done during the first twelve days of August though the worms were rapidly disappearing. By August 23d the moths of the third brood were very numerous in the areas that were so badly eaten by the last brood of worms. The moths began at once to spread to the dense foliage of the beets surrounding the injured area. A few eggs were found on August 25th. By August 29th the moths were getting scarce and the few left were unable to fly, only fluttering along between the rows of beets. Parasites were taken on August

---

[3] Bruner, Lawrence. Bureau of Entomology Bulletin No. 30. (O. S.) p. 37.
[4] Pettit, R. H. Michigan Experiment Station Bulletin No. 180 p. 254.

30th which proved to be *Agathis* (*Cremnops*) *vulgaris*. The moths had entirely disappeared from the fields by the first of September.

Lantern traps were tested against the second brood of moths but were put out too late to be of value as the moths fly only at night during the first few days after emergence.

Paris green was used by many farmers, applied by means of a dust sprayer, at the rate of one pound per acre. This did not seem effective against the worms and it severely burned the foliage of the beets. Some used the liquid spray, two pounds of Paris green and one pound of lime to fifty gallons of water. This did not prove effective and the burning was slight.

White arsenic, one part to four of flour, was used by some. This was very unsatisfactory as it burned the foliage badly and was not effective.

A tobacco decoction, one pound of stems to one gallon of water was tried. This solution was quite effective burning through the skin of the worms and there was no ill effect on the foliage.

A 10 per cent solution of kerosene emulsion was used but was not successful.

Review of the Season of 1910. An outbreak of the pest was expected during the season of 1910 and a careful inspection was maintained. It was possible to verify the life history and secure further information on the habits of the insect.

From notes made at Sterling, Colo., by the writer the following are extracted.

On May 13th a few moths were noticed on weeds in waste places some distance from the beet fields. A cold, windy spell occurred and much retarded the activity of the moths so that fertilization was not generally accomplished until May 30th. The first eggs were observed on June 8th and the male moths were becoming scarce. By June 17th the worms were quite abundant and the moths had practically disappeared. Parasites were taken often from June 21st to 29th. On July 11th moths of the second brood were taken and on the 13th they seemed very abundant, though in defined areas. The first eggs were observed on the 16th and the moths were spreading over the entire fields. The maximum number of worms occurred about July 22nd. Parasites were very abundant during this brood and the decreased number of worms evidenced their work. A few moths of the third brood were seen on August 1st. There were practically no larvæ of this brood as the parasites had killed most of the moths.

During the season of 1911 there were very few moths and those were mostly in weeds in neglected places. There was no injury to the beets that year by the web worms and it will no doubt be several seasons before they occur as a pest again.

The Moth. The moth is from 10 to 11 mm. long and spans 21 to 22 mm. The upper wings are dark or grayish brown and carry four bands of brown. The under wings are much lighter and uniform in color. Most species of moths are on the wing only after dark or in twilight but this species is active at night only in its early life, never after egg deposition has started. During the day the moths are very active in the dense foliage, usually depositing their eggs on the under surfaces of the leaves. When disturbed they make a short irregular flight, usually alighting on a leaf, sometimes on the ground. They are very watchful and active.

Moths have been captured and found full of eggs, others taken at the same time contained none. This would indicate a range in the time of emerging or the time in reaching sexual maturity. This accounts for the worms hatching at different times. The male moths live but a short time; they do not apparently emerge earlier than the females. The females live a few days after the eggs are deposited. It has been estimated that one moth deposits from 500 to 700 eggs, these mature gradually during the period of oviposition. As a rule the moths appear in a field seven to ten days before the worms appear.

The Egg. The eggs are usually deposited singly, though occasionally in rows of three or five overlapping. The egg is pearly white in color, oval in form and about one mm. long and seven-tenths in diameter. They may be found on either side of the leaf, more often on the under side. After once seeing the eggs they are readily observed with the unaided eye. "At the end of the second day a black speck appears near one end of the egg which is the head of the young worm developing within the egg. In three more days the little worm eats a ragged exit hole in the shell and escapes." (Gillette.)

The Larva. The young larvæ are pale green, with a black head. They are so small when first hatched, measuring only four mm., that they are easily overlooked. Very soon the larvæ construct a small dense web, which serves as a protection while they are young. This is used only for the first two or three days and if disturbed while out feeding they will quickly draw under this web and curl up. During the first two or three days the larvæ eat but little and skeletonize the leaves instead of devouring them.

The mature larvæ are from 15 to 21 mm. long averaging 18 mm., with the head small and pointed. The body color is green with a preponderance of longitudinal markings. A light strip on the dorsal side carries an entire black line; the lateral stripes carry rudiments of black lines. The second and third generations are much darker than the first, at times almost olive in color instead of green. The larvæ live for two weeks but do not eat during the last three or four days. During this period they are very restless and active, especially between ten o'clock a. m. and three o'clock p. m., until they have found a suitable place to pupate. The cocoon is twice the length of the larva and three times the length of the pupa.

The injury is done so quickly, sometimes within 36 hours, that the owner of the field is led to believe that the worms migrated from the adjoining fields during the night. No general migrations of the larvæ have been observed.

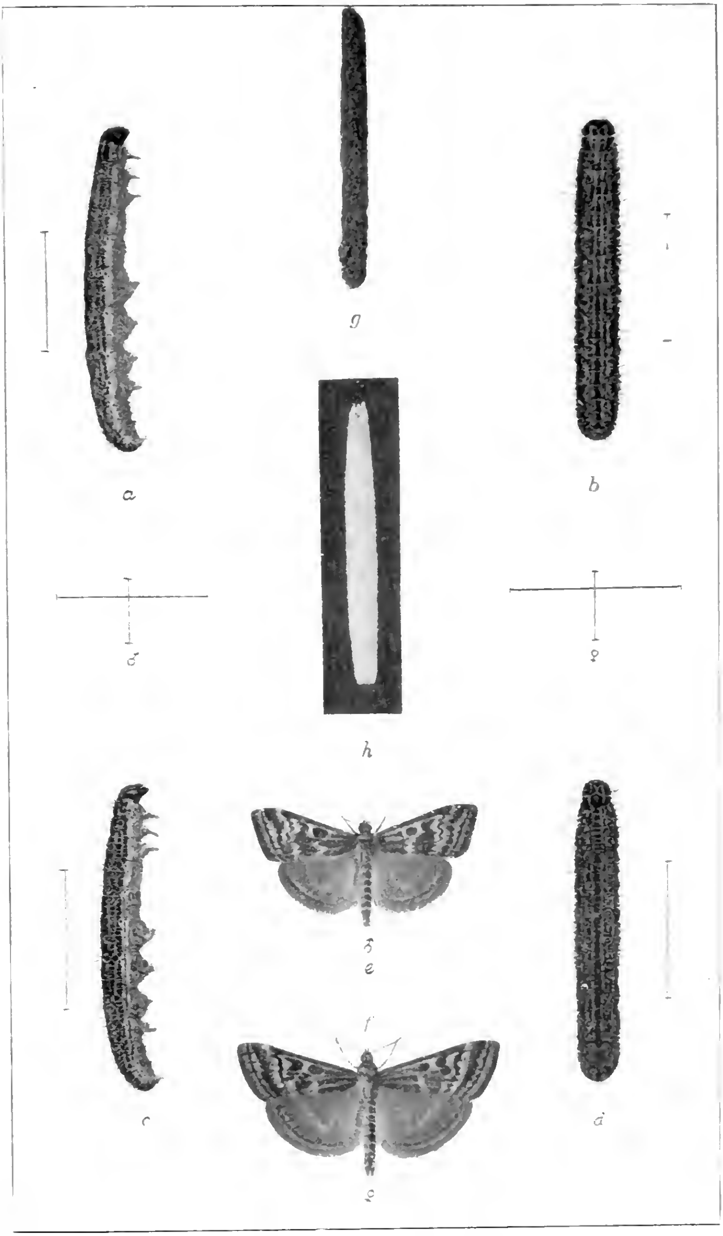
A peculiarity of the attacks by this insect is that in nearly every instance the heavy injury is well into the field, rarely ever along the edge. A small area of infestation will apparently spread each day, due to the fact that the moths in depositing their eggs work outward from their place of emergence. Cases have been noted where the worms in the center of the field had burrowed into the ground, while on the outer edges of the field they were still active. The injuries appear to be worse on fields that were exceedingly weedy the previous season. No difference in the infestation of beets on light soil and on heavy soil has been noted. Frequently a field may be badly infested and the adjoining one will be unharmed. On individual plants the young tender leaves were always last to be eaten. Only in extreme infestation are the beets eaten, and almost never is the entire leaf-crown destroyed. Beets that have been badly eaten usually send forth three or four small crowns of leaves.

The Pupa. Unfortunately it is hard to obtain uninjured pupæ. They are about 12 mm. long and of a bright bronze color. Pupation takes place in the ground in a silken cocoon, usually one-half to three-fourths of an inch below the surface. It is very tough and is covered with a layer of soil. The cocoon is three times the length of the pupa in the summer broods and four times in the over-wintering brood.

Life History. The hibernating larvæ pupate in May and soon emerge as moths. These give rise to the June brood of larvæ, seldom observed and not very abundant. These appear on weeds such as goosefoot (*Chenopodium*) and pigweed (*Amarantus*). Sometimes alfalfa serves as food for this first brood of larvæ.

The second brood of larvæ is at its height the later half of July. This brood is very short lived, requiring only two weeks for maturity of the larvæ and the appearance of the moths. The larvæ of this brood pupate almost immediately upon entering the ground. This is often the destructive brood of the season as it feeds entirely upon beets.

The third brood of larvæ reaches its maximum the latter half of



The Sugar-Beet Web Worm. *Loxostege sticticalis* L.: *a* and *b*. larvæ of the first generation; *c* and *d*. larvæ of the second generation; *e*. male moth; *f*. female moth; *g*. cocoon with the adhering soil; *h*. cocoon without the soil. (From "Über die im Jahre 1901 beobachteten Krankheiten der Zuckerrübe."

August. This one may prove the most destructive of the season, often repeating the destruction by the July brood. The larvæ of the August brood enter the ground for hibernation. A few larvæ, however, pupate and emerge as moths during the latter half of September. There may be, then, three full broods and a partial fourth of this pest in a season.

Remedies. In general one could recommend, as a means of destroying the moths, the catching of them at night with lantern traps though this must be done in the early life of the moth. The lighting of a stubble field at night, adjoining the beet field, will attract the moths and they will fly into the flames. We learn many interesting methods employed in Europe where this pest is destructive. Few preventive means have been employed in America and most are unsatisfactory as the moths are not active after deposition of eggs has commenced.

Many interesting and effective devices are used in Europe to destroy the worms, but these have not proven practical under our conditions. It is very important to keep the fields free from weeds. If the worms are noticed in a limited area, a small stream of running water will confine them. If the worms have completed their destruction, the beets should be stimulated to growth as quickly as possible by good cultivation. In irrigated sections, the beets should be irrigated at once and then cultivated as soon afterwards as possible.

Fall plowing will, no doubt, do more than any other farm operation to prevent an outbreak of the web worms. If a beet field has become infested the ground should be well stirred in the late fall: this will break up many cocoons and expose the larvæ to the birds and the effects of freezing, also many cocoons will be buried so deeply that the moths can not emerge. Crop rotation is a great aid in the control of this pest and too much can not be said for clean farming methods.

Poisoning the Worms. The worms accomplish their work of destruction so rapidly that it is very important that the beet grower should be prepared to check the injuries as soon as they appear. As has been said, the worms live a few days after they have finished eating and for this reason much disappointment is experienced because the poison is applied too late to be of any benefit. "The safe way to control the pest is to poison the worms when young; they are hard to kill and poison must be applied in liberal doses." (Johnson.)

The Poison to Use. From experiments conducted it would seem that the best poison to use is arsenate of lead, applied either as a dust or liquid spray. This is effective against the worms and does not burn the foliage. If a dry spray is desired, two pounds of powdered arsenate of lead per acre may be safely used. If a liquid spray is used, two pounds of lead arsenate paste to fifty gallons of water is an efficient and safe spray.

If Paris green is used one pound per acre applied dry or two pounds to fifty gallons of water with one pound of lime added, is all that can be safely applied.

Natural Enemies. Insect-eating birds devour the worms in large quantities and are the best friends of the farmer. When the worms are abundant blackbirds will be attracted in flocks of hundreds; cases have been reported where they completely destroyed the worms. The most useful birds are the blackbird, meadow lark, English sparrow and quail, in Europe the English sparrow heads the list.

This pest is unusually subject to parasitism by several species of Hymenoptera and Diptera. One of the most common is the parasitic fly *Agathis* (*Cremnops*) *vulgaris*. This parasite has often been reported as the means of preventing the August brood of moths from becoming destructive. By means of a long ovipositor it inserts an egg in the body of its host, which may be the larva or pupa. The limited number of this parasite is due to a secondary parasite *Mesochorus agilis* Cress.

Much valuable assistance has been given the writer by Prof. C. P. Gillette and Prof. S. Arthur Johnson of the Colorado Experiment Station, Mr. W. L. Lawson of Sterling, Colorado, and Mr. Oscar Rabbethge of Germany.

September 10, 1912.

References

1892. Riley, C. V. The Sugar-Beet Web Worm. Annual Report of the Entomologist.

1893. Maxwell, Walter. Report of Station Work at Schuyler, Nebraska. (Mention of the outbreak). Bureau of Chemistry, Bulletin No. 36 pp. 51–54.

1893. Riley, C. V. The Sugar-Beet Web Worm. Bureau of Chemistry, Bulletin No. 36 pp. 68–70.

1893. Bruner, Lawrence. The Beet Web Worm. Bureau of Entomology Bulletin No. 30. (O. S.) pp. 37–40.

1893. Howard, L. O. The Sugar-Beet Web Worm. Insect Life, Vol. V. pp. 320–322.

1894. Howard, L. O. Complete Life History of the Sugar-Beet Web Worm. Insect Life, Vol. VI. pp. 369–373.

1899. Pettit, R. H. Garden Web Worm. Michigan Experiment Station, Bulletin No. 80 p. 254.

1900. Forbes, S. A. The Beet Web Worm. Twenty-First Report of the State Entomologist of Illinois. Pp. 109–111.

1901. Stift, A. The New Beet Pest. Ueber die im Jahre 1901 beobachteten Krankheiten der Zuckerrübe.

1902. Stift, A. *Eurycreon sticticalis* L. Ueber die im Jahre 1902 beobachteten Krankheiten der Zuckerrübe.

1902. CHITTENDEN, F. H. Origin and Distribution of the Beet Web Worm. Bureau of Entomology, Bulletin No. 33 pp. 47–49.
1903. CHITTENDEN, F. H. The Sugar-Beet Web Worm. Bureau of Entomology Bulletin No. 43 pp. 38–39.
1905. PETTIT, R. H. Beet Web Worm. Michigan Experiment Station, Bulletin No. 233 pp. 8–9.
1905. GILLETTE, C. P. The Beet Web Worm. Colorado Experiment Station, Bulletin No. 98 pp. 3–12.

WILL THE MEDITERRANEAN FRUIT FLY (CERATITIS CAPITATA WIED.) BREED IN BANANAS UNDER ARTIFICIAL AND FIELD CONDITIONS?[1]

HENRY H. P. SEVERIN, PH.D., *Honorary Fellow, University of Wisconsin,* AND WILLIAM J. HARTUNG, B.S.

On June 24th, 1911. California placed a quarantine against all Hawaiian fruits excepting pineapples and bananas. A few months later extensive experiments were started at the College of Hawaii by the writers in order to determine whether the Mediterranean fruit fly could develop in green, ripe and over-ripe pineapples and bananas. While this work was in progress, the following letter was received from the president of the College of Hawaii:

November 9, 1911.

Prof. H. H. Severin,
College of Hawaii,
Honolulu, T. H.

Dear Sir.—

I was yesterday informed by Judge Henry E. Cooper, President of the Board of Regents, that considerable anxiety exists regarding the possibilities of the Mediterranean fruit fly attacking bananas, and that this anxiety finds one of its phases in the investigations which you are conducting on the problem as to whether the fruit fly may naturally or artificially be propagated on this fruit. So great is this anxiety that a number of requests have been lodged with the President of the Board to have this work stopped and the *publication* or *announcement* of any data on this question thus far withheld. The President of the Board feels that if an affirmative report on this question should get out great damage would result to the banana industry and the College would be brought under severe criticism.

It is my personal opinion that the question is of great scientific importance whether negative or positive results are secured. However, it is my duty to convey to you

[1] Most of the results of this investigation were read by Mr. William J. Hartung before the Forty-first State California Fruit Growers' Convention at Santa Barbara, Cal., on June 13, 1912. See Mon. Bul. Cal. Hort. Comm. No. 9, Vol. 1, 566–69.

the wishes of the President of the Board that the investigations on this subject be stopped and the *publication* or *announcements* of results already obtained be withheld.

Very respectfully,

(Signed) JOHN W. GILMORE,

President.

Over a hundred breeding jars containing bananas and several dozens containing pineapples were emptied into a garbage can following this order from the Board of Regents. A request was made to the president of the College of Hawaii for sufficient time to await the results of these experiments, but this was not granted.

Mr. E. M. Ehrhorn, superintendent of entomology in the Hawaiian Islands, who was most bitter in his criticism against the work as it was conducted, argued that impossible conditions were created, from which false conclusions would be drawn and that nature would be tempted, for if the fruit flies were forced to breed in bananas, some of the specimens of the new generation might escape from the breeding jar and these would probably breed in bananas again. These arguments are not worth further consideration.

Realizing that millions of dollars were at stake in the United States if the fruit fly was able to breed in bananas and pineapples under natural conditions, for almost every week a steamer is carrying either bananas or pineapples into California from the Hawaiian Islands, we considered it our duty as entomologists to continue this investigation. As soon as this work was stopped at the College of Hawaii, a private room not in connection with this institution, was equipped with the necessary apparatus to conduct the interrupted research.

The first problem which we attempted to solve was: *Will the acids of the peel or the pulp of green Chinese bananas prevent the eggs of the Mediterranean fruit fly from hatching, and if not, what effect will these acids have upon the developing maggots?*

Female fruit flies, captured in the field while they were ovipositing in oranges, were taken to the laboratory and vivisected in order to obtain eggs; most of the eggs were dissected from the ovaries, others from the two oviducts and a few from the oviductus communis. Some of these eggs were inserted into the peel and pulp of green Chinese bananas and others within the peel and pulp of California oranges. If the eggs were to develop in the California oranges and not in the green Chinese bananas, we would have some fairly good experimental evidence that the fruit fly eggs cannot develop in green Chinese bananas. The eggs did not develop in either the oranges or the bananas. In all probability the eggs dissected from the ovaries and two oviducts were not fertilized, and since it was open to question whether the eggs from the oviductus communis were fertilized, another method of attacking the problem was started.

Hundreds of Mediterranean fruit flies were captured in the field while they were laying their eggs in oranges, and these were placed in captivity in jars and fed on dilute molasses daubed on the sides of the jars. A few days later the females, now overloaded with eggs, were observed ovipositing on the sides of the jar. These eggs were introduced into different parts of green Chinese bananas, some of them being inserted within the peel, others within the pulp. Again as a check, California oranges were used. None of the eggs developed in either the bananas or oranges. The fact that the eggs did not develop in the oranges and bananas may have been due, it was thought, to the absence of the secretion which the female flies pour over the eggs or to a bacterial or fungus growth which always appeared, sooner or later, in the region of the fruit where the eggs were planted.

To obtain eggs over which the secretion had been poured by the female fruit flies, tropical almonds (umbrella tree or "kamani" nuts), which are seriously infested by this pest, were gathered from the trees. The tropical almonds contain weak acids, one of which is probably malic, while the green Chinese bananas contain stronger acids, one of which is tannic. The eggs of the fruit fly were now transferred from the tropical almonds into various parts of green Chinese bananas, some of the eggs being placed within the peel, others directly beneath the peel and still others within the pulp. In some cases the flower scar of the banana was cut out cone-shaped, the eggs were inserted into the pulp, and then the flower scar was placed back into its normal position again. All parts of the banana that had been cut, were sealed with soft paraffine to keep out bacteria and fungus spores. From 352 eggs which were placed in different parts of the bananas, only 2 female flies succeeded in completing their entire life cycle; both of these specimens developed from the eggs which had been placed within the pulp of the green Chinese bananas. Through the vitelline membrane of one of these eggs, the young maggot, especially the jaws at the anterior pole, could be plainly seen, whereas little or no development was apparent in the other egg when it was first introduced.

In the next experiment 73 eggs were transferred into various parts of Chinese bananas not as green as those used in the previous experiment. From these bananas 13 male and 18 female fruit flies emerged. Of the total number of eggs introduced into the peel and pulp of these bananas, 42 per cent gave rise to maggots which were able to complete their life cycle.

An experiment similar to the preceding was now performed with green Brazilian bananas. A total of 215 eggs were planted in these bananas, 3 to 15 eggs being inserted in each fruit. Forty-eight male and 55 female flies succeeded to complete their life history in this case, i. e., over 47 per cent of the total number of eggs introduced into the bananas gave rise to fruit flies.

In our previous experiment with the green Chinese bananas it was found that from 352 eggs inserted into these fruits only 2 fruit flies succeeded in completing their entire life history. In order to determine whether the eggs actually hatch and the young maggots die in the acid medium of green Chinese bananas, 100 eggs were placed within the peel of 10 green Chinese bananas. A small piece of the peel was sliced off, the eggs were inserted into the wound and then the thin portion of the peel was placed back in its normal position and covered with soft paraffine. The vitelline membrane of the eggs turned black almost immediately after the eggs were introduced; this was probably the result of the chemical action of the tannic acid. Four days later the paraffine was removed, the small slice of the peel was raised and it was found that 69 eggs had hatched. Not one of these maggots, however, succeeded in completing its life history.

Half-grown maggots were now placed within the pulp of green Chinese bananas by first removing the flower scar as described in one of the previous experiments. The majority of these maggots died.

A similar experiment was performed with 20 nearly full grown maggots, one maggot being placed in each green Chinese banana. The results were as follows:

10 maggots bored out of the bananas and pupated.
2 maggots bored out of the bananas and died.
8 maggots pupated inside of the bananas.

The fact that 8 maggots pupated inside of the bananas instead of boring out indicated that the acid medium of the banana was unfavorable for the development of the larvæ. The maggots which bored out of the bananas and pupated in the jars were placed in moist sand and later issued as apparently normal flies.

The second problem which we attempted to solve was: *Will the Mediterranean fruit fly in captivity lay its eggs in green, ripe or overripe Chinese bananas?*

Again, hundreds of the adults were captured in the field while they were laying their eggs in oranges and these flies were then confined in jars containing from 6 to 12 green Chinese bananas. Occasional observations showed that the specimens did not deposit their eggs within the bananas, but only on the sides of the jars and the external surface of the bananas. The eggs deposited upon the peel, however, did not develop.

In the next experiment green Chinese bananas were immersed in orange juice from 12 to 48 hours with the hope that the odor of this juice would induce the insect to oviposit in the fruit. Again, as in the preceding experiment, specimens of Ceratitis that had been captured in the field were confined for several days in jars, each of which contained 2 bananas. After the lapse of this time, these bananas were transferred to jars containing about 2 inches of sterilized sand. No adults were bred from these bananas.

Fruit flies were next confined from 1 to 3 days in dozens of jars each of which contained 2 ripe bananas with the peel intact. As in the preceding experiment, the bananas at the end of this time were transferred to jars containing about 2 inches of sterilized sand. From all of these bananas there were but two from which adults were bred and these together gave rise to 19 male and 13 female flies.

Fruit flies were confined with ripe bananas from 4 to 5 days. These bananas, when transferred, showed evidence of blackened or decayed areas on the peel. The results from this experiment were as follows: 22 males, 18 females bred from 4 bananas that had been kept with the fruit flies for 4 days; 24 males, 14 females bred from 4 bananas that had been kept with the fruit flies for 5 days.

The third problem which we attempted to solve was: *Will the Mediterranean fruit fly in confinement deposit its eggs in the exposed pulp of green or ripe Chinese bananas?*

Fruit flies that had been captured in the field were confined for several days in jars, each of which contained 2 green Chinese bananas with a portion of the peel removed. In this experiment a crust soon formed over the exposed pulp and later became covered with a fungus growth. From time to time both the crust and the fungus were scraped off with a knife. With one exception, no fruit flies were bred from the green bananas treated in this manner. In the exception, the pulp of the banana had split longitudinally, the peel had been removed so as to expose this crack and also a considerable amount of pulp immediately surrounding the split region. Decay set in along the split region and from this banana fruit flies were bred.

An experiment similar to the preceding was then performed with ripe bananas. The exposed pulp served not only as a favorable food material for the adults, but also a suitable medium for the growth of the maggots. The late Mr. F. W. Terry of the Hawaiian Sugar Planters' Experiment Station was the first to obtain and report this result, and this was later confirmed by Mr. D. T. Fullaway of the Hawaii Agricultural Experiment Station.

Forcing the Mediterranean fruit flies to breed in green or ripe Chinese *bananas under artificial conditions would not prove that they will breed in bananas under field conditions.*

During the mosquito campaign, when the banana trees were cut down in Honolulu, hundreds of bunches of bananas were examined to see if there was any evidence that that pest was breeding in bananas under field conditions. Hundreds of bananas containing maggots were removed from these bunches and placed in jars containing sterelized sand. From these bananas a small number of Mediterranean fruit flies, numerous specimens of an Anthomyid, *Acritochæta pulvinata* Grims.; 2 species of Ortalidæ, *Euxesta annonæ* Fabr. and *Notogramma stigma* Fabr. and a number of species of Drosophilidæ were bred. The fruit flies were bred from but 2 bananas, one of which when taken from the bunch was decayed at the flower scar and had a bruise extending through the peel. This banana when removed from the bunch was yellow in color beneath the decayed area and gradually shaded over to green towards the other end. The Anthomyid and two species of Ortalids mentioned above were also bred frequently from green Chinese bananas removed from bunches on growing trees in banana plantations. These bananas were decayed around the flower scar as shown in the following photograph:

Fig. 10. Chinese banana with decayed area around the flower scar. From such green bananas the Anthomyid, *Acritochata pulvinata* Grims. and the Ortalids, *Euxesta annonæ* Fabr. and *Notogramma stigma* Fabr. were bred and from a similar banana but riper, the Trypetid, *Ceratitis capitata* Wied. was reared.

The following experiment shows that the Mediterranean fruit fly may possibly attack bananas in the field when not enough of their preferred fruits are available. During the latter part of April it was observed in an orchard that green and ripe lemons were covered with a resinous material which had oozed from wounds produced by the ovipositor of female flies. In this orchard there was little or no other citrus fruit present at this time of the year. The fact that the females were actually observed stinging the lemons, suggested the idea that the flies might deposit their eggs in bananas when this fruit was suspended among the branches of the lemon trees. Hundreds of green Chinese bananas, in bunches from 2 to 6, were hung in lemon trees for 8 days. From only two of all of these bananas did we succeed in breeding fruit flies and from these, 8 males and 5 females were obtained; these bananas, when taken down from the lemon trees, were yellow with black or decayed areas in the peel. Dozens of ripe bananas with the peel intact were suspended for two days among the branches of lemon trees, and from all of these bananas there were but two from which we were able to rear the adult fruit flies. From these two fruits 3 males and 1 female were obtained. From an over-ripe banana with the peel entirely black and which had remained in the lemon trees for two days, 1 male was bred.

In a discussion over the results of this paper before Dr. A. J. Cook, E. K. Carnes, F. Maskew, E. O. Essig, and H. A. Weinland, officers of the California State Commission of Horticulture, Mr. Weinland who is connected with the fruit fly work in the Hawaiian Islands gave his results of an experiment which he performed with the Mediterranean fruit fly and these results he has kindly permitted me to publish. In his experiment, bananas were suspended in an orange tree which had been stripped of its fruit; the tree was then covered with cheese cloth and the fruit flies were allowed to emerge from infested fruit within this tent. He claims that the pest was bred from ripe bananas with the peel intact and also from ripe bananas with a portion of the peel removed.

Although the fruit fly has been bred under field conditions from ripe and over-ripe bananas with the peel intact, Mr. F. Muir of the Hawaiian Sugar Planters' Experiment Station in a discussion on this subject raised a point worth mentioning. This point was that the tannic acid in bananas decreases in strength when the fruit is removed from the bunches on growing trees and for this reason the field conditions were not strictly natural conditions.

Mr. George Compere has kindly called my attention to a bulletin written by Kirk[1] of New Zealand in which it is stated that the Mediterranean fruit fly was actually bred from bananas and pineapples intercepted at the wharf.

This paper had been sent to Prof. E. P. Felt, editor of the Journal of Economic Entomology, when we came across, in the library of the University of Wisconsin, a reprint from the *Journal of Agriculture*

[1] Kirk, F. W. 1909. Fruit Flies. Bull. 22, Dep't of Agric. New Zealand, p. 9.

of Victoria, May 8, 1907, by C. French, Government Entomologist, Department of Agriculture, Victoria, on Fruit Flies, Bulletin No. 24, Department of Agriculture and Intelligence of South Australia. Since French claims that he has proved eggs to have been deposited in green bananas by the Mediterranean fruit flies on many occasions, we requested the editor to return our manuscript so that we could quote this author in full.

In the first paragraph of his paper he says that the Mediterranean fruit fly "larvæ have been found in peaches, pears, quinces, apricots, plums, nectarines, guavas, oranges, lemons, apples, citrons, loquats, mangoes, pumpkins, *bananas*, tomatoes, *pineapples*, etc.

"The larvæ of this fly were found in bananas imported from Queensland on the 14th August, and on being placed in the breeding jars pupated on the 20th August; the perfect flies emerged on the 4th October and lived for several weeks, etc.

"It has frequently been stated in Queensland and New South Wales that the flies will not attack green fruit. This is a mistake, as I have on many occasions proved eggs to have been deposited in green bananas before shipment, as no half-ripe bananas are ever shipped from Queensland to Melbourne."

Speaking of the origin of the pest in new localities French writes, "From observations made in the field, I am speaking of the northeast part of Victoria, the trouble has been traced through the medium of imported fruits, bananas and oranges especially, infested fruits of both kinds being commonly obtainable in Melbourne, the suburbs, and in the country townships.

"As one who has seen the fly at work both in New South Wales and Queensland, I assert that the ravages of the Mediterranean fly in Victoria are quite as bad as either the Queensland or New South Wales experiences have been able to record, half-green peaches being attacked as badly as those either ripening or ripe. . . . It has been questioned by some persons whether this fly is found in Queensland at all, but the fact of it having been reared by us from bananas and oranges from Maryborough places the matter beyond the shadow of a doubt. If such be not the case, then the fruit must have been affected during transit, a theory which I for one, will not entertain."

I wish to call attention to the fact that French is well aware of the fact that the Queensland fruit fly (*Dacus tryoni* Froggatt) is a serious pest of the banana, for he writes, "The maggots are always found in over-ripe or decaying fruit or in cracked bananas, and these are the ones that should be discarded as soon as the bunches are looked over."

Summary

We are hardly justified in drawing conclusions as to whether or not the fruit fly will breed in green Chinese bananas under natural conditions from the results of the investigation carried on under artificial conditions.

From 452 eggs which were placed in different parts of green Chinese bananas, only two fruit flies succeeded in completing their entire life history. One hundred of these eggs were planted within the peel of green Chinese bananas and 4 days later 69 eggs had hatched; but all of these maggots died, probably from the effect of the tannic acid. From Chinese bananas which were not quite so green as those used in previous experiments, 42 per cent of the eggs that had been inserted within these gave rise to adult flies. The majority of the maggots that were inserted when they were about half grown within the pulp of green Chinese bananas died in the acid medium. Nearly full grown maggots, when placed within green Chinese bananas, usually completed their larval development but often pupated within the fruit.

Mediterranean fruit flies were bred both under artificial and field conditions from ripe and over-ripe bananas with the peel intact and from ripe bananas with the pulp exposed. Under laboratory conditions, the peel of a green Chinese banana was removed around a longitudinal split extending within the pulp; decay set in along this crack and from this banana fruit flies were also bred. Under field conditions, green Chinese bananas were hung among the branches of lemon trees; and from these bananas, when they became ripe and overripe, adults were reared. Fruit flies also emerged under field conditions from 2 bananas which were removed from the bunches of banana trees that had been cut down during the mosquito campaign in Honolulu. One of these bananas was decayed at the flower scar and a bruise extended through the peel beneath this region; this banana was yellow in color below the decayed area and gradually shaded over to green towards the attached end.

We wish to express our sincere thanks to Mr. Frederick Knab of the Bureau of Entomology, Washington, D. C., for the identification of *Notogramma stigma* Fabr. and to Mr. J. R. Malloch of the same Bureau for the identification of *Acritochæta pulvinata* Grims.

THE POISON EXPONENT: A SYMBOL OF THE TOXICITY OF CHEMICALS IN THEIR RELATION TO INSECTS[1]

By T. E. Holloway, *Bureau of Entomology, U. S. Department of Agriculture, Audubon Park, New Orleans, La.*

During the season of 1910 the writer, under the direction of Mr. W. D. Hunter, conducted a series of experiments with certain poisons on larvæ of the cotton boll worm, *Heliothis obsoleta*. While preparing a report of these experiments the writer felt the need of some method of expressing the toxic value of chemicals to insects, and he finally concluded that this value might be obtained by comparing the number of days of life of the poisoned insect and of the unpoisoned insect. To illustrate: if the poisoned insect lived one day while the unpoisoned or check insect lived three days, both being subject to the same environmental conditions except that of the poison, the relationship between the life of the poisoned insect and the life of the unpoisoned insect might be expressed by the following proportion: life of poisoned insect is to life of unpoisoned insect as 1 is to 3. Or,

$$\frac{\text{Life of poisoned insect}}{\text{Life of unpoisoned insect}} = \tfrac{1}{3} = .33+,$$

which number may be taken as the indicator of the toxic value of the poison. Lack of data prevented the publication of this theory.

On account of other work the writer was unable to continue the poison investigations until this year, when preparations were made to determine the toxic values of a number of poisons to Heliothis. An outline[2] was made which was similar to that used in 1910, but under field conditions it was changed in the matter of food and cages for the larvæ. The experiments were then started, but before they had progressed very far an important obstacle was noticed. The poisoned larvæ died within a day or two, but the unpoisoned larvæ lived for a much longer period, in the natural course of their life cycle. It was obvious that the environmental conditions to which the unpoisoned larvæ were subject after the death of the poisoned larvæ were of not the slightest value in the determination of correct toxic values. In

[1] Published by permisssion of the Chief of the Bureau of Entomology.

[2] This outline was thoroughly discussed with Mr. W. D. Hunter and Mr. W. Dwight Pierce, of the Bureau of Entomology. Mr. Pierce suggested experimenting with each instar of Heliothis, and gave the writer a list of poisons to be tested. The writer takes this opportunity of thanking Messrs. Hunter and Pierce for their kindness in coöperating.

order to obtain indicators which were even approximately correct it would have been necessary to conduct all experiments in a place where temperature and humidity were unvarying or varying always in the same degree. The pupation of the unpoisoned larvæ complicated the matter further. In outlining the experiments the time of pupation of a larva was arbitrarily taken as the end of an experiment, but this procedure is of course open to objection.

The experiments were discontinued and a new outline[3] of work was prepared. This outline took Paris Green as the standard poison, and larvæ subjected to it were taken as checks. Paris Green, besides being universally known, kills the larvæ very quickly, so that the entire life of a check larva is of use in determining the toxic value of a poison. The original outline had called for experiments with many different dosages of the different poisons, but because of other work it was necessary to adopt a uniform dosage of two milligrams per leaf, which is equivalent to a rather thorough field poisoning.

The idea of the toxic value of a poison was also changed. The present conception may best be explained by algebraic symbols.

Let $x =$ an unknown poison.

Let Paris Green $= 1$, or standard in toxic value.

Let us suppose that an insect subjected to x dies after 10 hours, and that an insect subjected to Paris Green dies after 5 hours.

---

[3] The outline as finally adopted is in part as follows:

Paris Green Lavanburg will be taken as the standard, and the larvæ subjected to this poison will be known as checks.

The Poison Exponent for any poison will be obtained by comparing the length of life of the larvæ subjected to that poison with the length of life of a larva subjected to Paris Green Lavanburg at the same time. Duplicate experiments will be conducted if sufficient larvæ are available.

The poisons will in every case be evenly applied to the leaves in the form of a dust. Two milligrams per leaf will be applied.

Experiments will be conducted with tin boxes as cages, a two-ounce size for the larger larvæ and a one-ounce size for the smaller larvæ.

One larva to a box.

Larvæ will be given young cowpea leaves of as nearly a uniform size as possible.

After forty-eight hours' exposure to poison in each case, unpoisoned food will be provided until death.

Notes to be made at bi-hourly intervals of feeding in each cage.

Records to be kept on cards, devoting one card to a larva.

For duplicate experiments, cards will be numbered with letters following the regular numbers as 1a, 2a, etc., for the first set of duplicates, 1b, 2b, etc., for the second set, and so on.

The experiments will fall into two series:

Series I. Tests with all instars.

Series II. Tests with the most resistant instar as determined by the tests in Series I.

It will be noticed that the toxic values of the two poisons vary inversely as the lengths of life of the insects subjected to them, if the length of life of the poisoned insects be taken to indicate the toxic values of the chemicals. Then, toxic value of x is to toxic value of Paris Green as 5 is to 10.

The product of the means of a proportion being equal to the product of the extremes, we have,

10 (toxic value of x) = 5 (toxic value of Paris Green).
Then, toxic value of x = 5-10 (toxic value of Paris Green).
But toxic value of Paris Green = 1.
Then toxic value of x = 5-10 × 1 = .50, which may be called the Poison Exponent of x.

In the case of a quicker poison than Paris Green let us suppose again that the insect subjected to Paris Green dies after five hours, while the insect subjected to x dies after 4 hours.

Again the toxic values of the two poisons vary inversely with the lengths of life of the insects subjected to them.

Then toxic value of x is to toxic value of Paris Green as 5 is to 4.

4 (toxic value of x) = 5 (toxic value of Paris Green),
Toxic value of x = 5-4 (toxic value of Paris Green),
Toxic value of Paris Green = 1,
Toxic value of x = 5-4 × 1 = 1.25 = Poison Exponent of x.

It seems that we have here reached a law which may be stated as follows: *If the length of life of a poisoned insect may be taken to indicate the toxic value of the chemical to which that insect is subjected, then the toxic values of two chemicals vary inversely with the lengths of life of two insects respectively subjected to them, assuming that the insects are of the same species and at the same period of their life cycle, and that environmental conditions are equal.*

The experiments with all instars of *Heliothis* will give some examples of the actual determination of Poison Exponents. The poison used was Arsenate of Iron Grasselli. A first instar larva subjected to this poison died within 8 hours, while one subjected to Paris Green under the same environmental conditions and at the same time died within 4 hours. To obtain the Poison Exponent of Arsenate of Iron Grasselli for the first instar of *Heliothis*, we divide 4 by 8, which gives .50. The other instars were treated in a similar manner. At this point a word of comment may not be out of place. The Poison Exponent of .50 for Arsenate of Iron Grasselli for the first instar of *Heliothis* merely indicates that a larva subjected to that poison lives twice as long as a larva subjected to Paris Green, other environmental conditions being equal. But to say that Arsenate of Iron Grasselli is therefore worth only half the market price of Paris Green is to make a statement that may or may not be true. Factors other than the Poison Exponent are to be considered in determining the market value of a poison.

Second instar: The larva subjected to Arsenate of Iron died within 6 hours, while the larva subjected to Paris Green died within 2 hours. Poison Exponent = 2-6 = .333+.

Third instar: The larva subjected to Arsenate of Iron died within 27 hours, while the larva subjected to Paris Green died within 22 hours. Poison Exponent = .81+.

Fourth, fifth and sixth instars: The larva subjected to Arsenate of Iron died within 46 hours, while the larva subjected to Paris Green died within 22 hours. The Poison Exponent for each of these instars is .47+. Attention is called to the fact that observations were made bi-hourly through the day from eight or nine in the morning till five or six in the evening. When larvæ died during the night the deaths were not recorded until the next morning. The larvæ of all the instars but the first and second died during the night, with one exception, so that the Poison Exponents for the larger instars are most probably not correct. In future work it will be necessary to make observations at bi-hourly intervals continuously until the deaths of the larvæ. In order to obtain correct Poison Exponents it will also undoubtedly be necessary to make many duplicate experiments and take the average of the results obtained for any one exponent. This probable necessity arises from the fact that conditions for work are seldom ideal and that mistakes and incorrect interpretations will be made. The average of a large number of results will tend to obviate the discrepancies of a few of them.

Larvæ of *Heliothis* were not found after these preliminary experiments were made, and as other work was more pressing the greater number of the outlined experiments were not conducted. If they had been carried out as planned, however, the necessity for continuous observations would have rendered many if not all of the results valueless, as the services of no one were available for the night observations.

As to the economic benefit to be derived from the application of the Poison Exponent, we can only try to imagine what might occur if it came into use. Many new chemicals have been put on the market within the last few years, and the properties of the greater number of them are probably unfamiliar to most entomologists. The Poison Exponents of these chemicals for a number of species could be ascertained in a comparatively few months, while years would be consumed if the new poisons were to become known in the slow process of unrelated experiments by scattered workers. This is one of the uses of the Poison Exponent, but it is likely that others would develop. For instance, the statement of a reputable manufacturer that his new preparation has a Poison Exponent of .75 to the most resistant instar of the boll worm would doubtless convey in the course of time a more definite idea to the mind of the entomologist than would a chemical analysis, valuable though the latter might be.

Whether the Poison Exponent is ever used or not, however, the writer cannot but believe that the subject of toxic values of chemicals to insects is a matter that is worthy of some consideration, and he hopes that other workers will give it the attention it deserves.

NOTES ON INSECT DESTRUCTION OF FIRE-KILLED TIMBER IN THE BLACK HILLS OF SOUTH DAKOTA

By Philip L. Buttrick, *New Haven, Conn.*

This paper attempts to outline the results of the work of insects following forest fires in the Black Hills of South Dakota; and to suggest remedies for their depredations. It is the result of casual observations of the writer, made while Forest Assistant on the Black Hills National Forest in 1911, and later as Forester for the Lanphere-Hinrich Company, a lumber company operating in the Black Hills. The observations do not pretend to approach completeness; but may be of some value in the absence of more definite data.

Character of the Forest in the Black Hills. Western Yellow Pine (*Pinus ponderosa*) is the predominant tree. It occurs pure over large areas, being the only commercial tree found. The forest tends to be even-aged in groups, but many stands are all-aged or roughly two-storied. The Government manages its holdings by a rough application of the shelter-wood system, the intention being to come back in twenty to thirty years for the second cut.

Enemies of the Yellow Pine. Forests in the Hills have suffered excessively from insects and fire. The chief insect enemy, the Black Hills Beetle[1] is too well known to require description. Its depredations have now been controlled by natural agencies, and by cutting large bodies of infested timber. A close watch is now kept by the

[1] *Dendroctonus ponderosæ* Hopk.

Forest Officers for all signs of beetle infestation, and all infested trees are at once cut and the bark destroyed.

A leaf scale, probably *Chionaspis pinifoliæ*, occurs, chiefly on seedlings and saplings. Its attacks are sometimes fatal. However, so long as it is not more abundant it need not be regarded as dangerous; perhaps it is slightly beneficial, since it usually occurs in dense overstocked thickets of young growth, where a thinning is badly needed.

The dry climate and the character of the forest operate to render fires numerous and severe, especially so in young growth where they often burn into the crowns. In old stands, particularly if there is no reproduction on the ground, they are confined to the surface and do less harm. Fires burning through irregular stands where the flames mount into the tops of the smaller trees, kill most of the stand but destroy little timber.

Destruction of Fire-Killed Timber. As a result of fires many thousands of feet of otherwise merchantable timber are killed annually. Much of this is never used. A knowledge of the rate of its subsequent destruction and methods of preventing it would result in saving much of it, thus reducing the drain on the live timber of the region.

Both insects and fungi attack trees killed by fire, their attacks being to some degree interrelated.

Fungi. Von Schrenk has given an account of two important fungi attacking beetle-killed trees, and they are also found on trees killed by fire. One, the "blue" fungus (*Ceratostomella pilifera* Winter), speedily stains the sapwood; the other, the Red-Rot (*Polyporus ponderosa* von Schrenk), follows after a longer interval, and causes the wood to decay. Other fungi attack live trees, but are not important here.

Insects. The chief insects infesting dead timber are, in the Black Hills, ambrosia beetles and the larvæ of Cerambycid and Buprestid beetles.

Hopkins lists two ambrosia beetles, *Gnathotricus sulcatus* LeConte, and *G. occidentalis* Hopkins, as occurring on beetle infested pine in the Black Hills. It is probable that these are the forms which occur on fire-injured and killed trees. Their attacks seem more apt to be directed towards injured than dead trees.

Ambrosia beetles bore in sapwood and to a less extent in heartwood. They cultivate a fungus in their burrows which stains the adjacent wood. These burrows also serve as a means for the extension of the "blue" fungus. The seasonal history for the species in the Black Hills has not been worked out in detail. The adults, however, seem to fly throughout the growing season, and to hibernate in their burrows during the winter, several generations are doubtlessly produced in a season.

More important than the ambrosia beetles are the deep-wood borers,—the Cerambycid and Buprestid beetles,—whose larvæ make large burrows deep into the wood.

The destructive "Sawyer" (*Monohammus titillator*) of the Southern States seems not to be present in the Black Hills. The chief damage is done by the larva of a Buprestid beetle, probably the Heartwood Pine Borer (*Chalcophora virginiensis*) or one of its western forms *oregonensis*, or *angulicollis montana*. The three forms mentioned do not differ materially. All are large metallic lustered, bronze colored beetles, about an inch long and a quarter of an inch wide. They fly with a distinct buzzing sound.

The larvæ are elongated, whitish, flatheaded, legless grubs. The head is yellowish to brownish, and armed with strong jaws, which can be heard as it excavates in its burrow. The length at maturity is an inch and a half or more.

The adults fly in July, during the third week of that month the woods are full of them, but by the end of the first week in August all seem to have disappeared. The flying season probably lasts from the middle of June to the last of August at the outside.

The eggs are layed in holes cut in the bark by the female, occasionally in living, more often on recently dead trees. They hatch in a few days, and for a few weeks bore in the bark. Under favorable circumstances they may enter the wood within a month; by the end of two months, if conditions are favorable, they may have bored into it for two inches. The larval stage lasts till the following season, and may last for two years. Their activity does not continue after cold weather sets in, and the wood freezes.

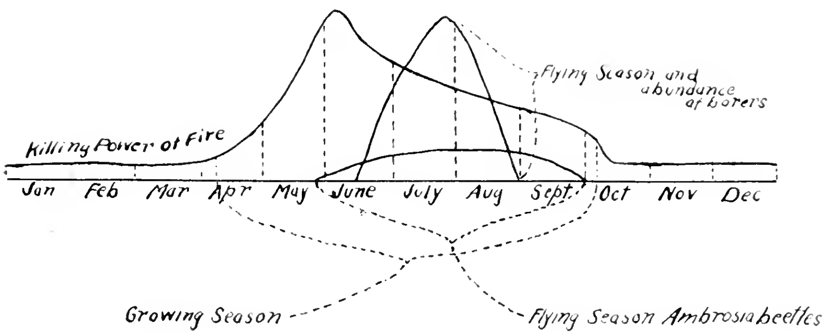
Character of Insect Damage. Ambrosia beetles aid in bluing fire-killed timber, but it is seldom that the sapwood escapes bluing even without their assistance. If timber is cut before it is badly infested by the larger borers, the work of the ambrosia beetles is usually removed with the slabs.

The larger borers if abundant will in time completely riddle a log, so that it is worthless save as firewood. In a single season they may reduce its value from thirty to fifty percent.

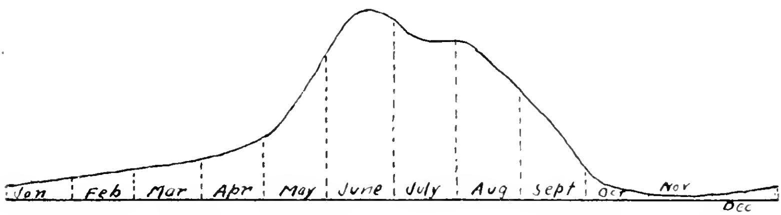
Effect of the Season of the Fire. The severity of attack by boring insects varies with the season of the fire. It can of course take place immediately after one only during the season when the adults are flying. The further removed from this period the fire comes the less will be the strength of the beetle attack, since the wood has more chance to dry out and the bark to become detached.

Plate 14

CURVE I.

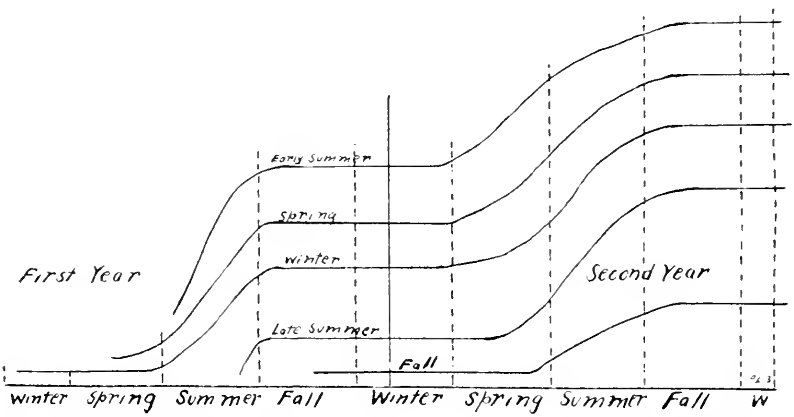


CURVE II



Degree of infestation following fires at different seasons

CURVE III



Probable rate of destruction by borers of timber killed at different seasons

The optimum conditions for attack seem to be following fires occurring early in the growing season. At such times the killing power of fire is at its highest. The moist condition of the wood causes fermentation and a rise of temperature. This favors the rapid growth of the larvæ, giving them time to become well established before seasoning of the wood and cold weather interferes.

On a large area burned about the middle of June, infestation by the last of August was so severe that the ground under the trees was white with the dust from the borings, which could be seen drifting to the ground like a light snow. The gnawing of the larvæ sounded like the croaking of innumerable frogs. An area close by burned in March was much less severely infested.

Rate of Destruction. Foresters and lumbermen in the Black Hills recognize the fact that fire-killed timber is generally worthless after it has stood two years. The relation of the season of the fire to the rate of destruction is not so well understood.

Timber killed just before the flying season will be practically worthless in fifteen months, or by the following fall, while timber killed after the growing season may not be as badly riddled after two years and a half. A close study of the rate of destruction would be of great value.

An attempt is made to express some of the facts regarding infestation and destruction graphically. The curves shown are for the most part relative as we do not possess sufficient data to make them entirely specific. The table derived partly from Curve III., would, if accurately worked up, be of value, by showing the time necessary to effect the injury and destruction of timber killed at different seasons.

Influence of Site on Severity of Attack. Wood borers prefer moist wood, and are therefore most frequent in localities where the wood is damp, such as in canyons, on steep north slopes etc., where there is protection from the sun and winds. On the tops of ridges exposed to wind and sun timber seasons quickly, and infestation is therefore often slight. The writer has examined timber from such localities that was unaffected by borers although it had been dead for several seasons. The proximity of a burned to an infested area is favorable for the spread of the pests.

These facts should be kept in mind in projecting a cutting in a recently burned area to prevent infestation. Timber in damp situations and that near infested areas should be removed or barked first.

Natural Checks. The large amount of dead timber scattered through the Black Hills as a result of the beetle invasion and the numerous fires have given a splendid and not neglected opportunity for wood borers.

It is probable that the pure character of the forest acts in their favor, the same as it does with other insect pests.

Woodpeckers eat many beetle larvæ, and are apt to congregate in burned areas where they are numerous. The Hairy Woodpecker is quite common and is the chief bird enemy of the Buprestid larvæ. Early in September the writer observed many at work in an area burned in June. They seemed to confine their attentions largely to the smaller trees, mostly the saplings fifteen to twenty-five feet high. They dug an inch or more into the wood for the grubs. Other woodpeckers occur in the Hills, but were not observed eating larvæ on recently killed trees. Probably Chickadees and Nuthatches eat the eggs and small grubs before they enter the wood, but are not able to dig into it after them.

Birds seem to serve more in keeping down the numbers of the pests than in saving timber already infested, since after borers are two or three inches into the wood only the larger woodpeckers can reach them, and then only when the wood is partly decayed.

Remedies. The obvious remedy for the destruction of fire-killed timber is of course to prevent fires. This attempt is made on the National Forests and the more valuable private holdings; but, like fires in cities, some forest fires will always occur despite all precautions.

The next best thing is to harvest the burned timber at once. This is often impossible, since it takes time to effect a timber sale on a National Forest, even when a purchaser is at hand. When roads and camps must be built it may require several months to prepare for cutting. If a fire occurs between June first and August fifteenth, it is almost impossible to get at the timber before infestation commences, much less remove any large bodies of it. However, if it can be cut and sawed within six weeks little damage would be done since the borers would still be near the surface, and would be removed with the slabs.

If timber is killed after the middle of August, there is a longer time for safe removal, although it will be attacked by ambrosia beetles and the bluing fungus till the coming of heavy frosts.

Lumbermen frequently want to know how to prevent the destruction of dead material without at once removing it. It is often proposed to cut and bark it, removing it to the mill at a more convenient season. This if carefully done is effective, but more costly than might be supposed. Barking costs about fifty cents per M feet B. M., which is half as much as felling itself costs. There would be no profit in barking small top logs, since it does not pay to handle these except under the best of conditions. It is doubtful if any large amount of timber could be kept from bluing by this method.

If logs are badly infested and the larvæ are well into the wood, it is doubtful if merely barking them would destroy the pests. In such cases it would be better to build skidways in the open above the surface and pile the logs onto them in such a way that the air could get at them from all sides, so as to facilitate seasoning. Care should be taken not to deck them up in tiers, as this interferes with seasoning. Such a method would be more expensive than letting the logs lie on the ground; but would tend to prevent bluing, and would probably kill all borers.

Another remedy often proposed is to cut dead or infested material and immerse it. This not only prevents all infestation, but kills all larvæ already in the wood, and prevents fungus attacks. It is not suitable in the Black Hills, since no natural ponds exist, and the cost of building dams large enough for the storage of large quantities of logs is prohibitive. The running of infested material through a log pond to kill the borers has been suggested. This works if the logs are in the water long enough. The writer has noticed that good sized logs after remaining in the pond at the Lanphere-Hinrich mill for two or three days had live borers at their centers when sawed. Logs would have to remain in the pond until they were thoroughly soaked out, perhaps a week or more, rendering the process slow, and perhaps not possible for any large amount of timber.

If a systematic attempt were made to apply this method, it might be well to experiment with poisonous solutions in the water, such as copper sulphate or mercuric chloride. These might shorten the time necessary for immersion, and would tend to prevent reinfestation, or fungus attacks.

Uses for Infested Material. A lumberman frequently finds himself in possession of an amount of infested timber, which he does not wish to lose. What can he do with it?

It may of course be manufactured into common lumber and sold for what it will bring as "number two common." Or perhaps it may be disposed of as firewood. The demand for both of these is small, and no large amount of either can be marketed at one time, moreover the profit is small. For it costs as much to handle burned as green timber, and the price on the finished product is from a third to a half lower, in addition to a greater waste in manufacture.

Railroad ties are sometimes sawed from fire-killed timber, but are not very satisfactory. However, if they could be treated with a timber preservative, they would be more valuable in many cases than green ties. While the larger railroads in the Black Hills have treating plants, they draw their timber supplies mostly from elsewhere.

The establishment of a commmercial treating plant in the Black Hills would solve many of their problems of wood utilization.

The use of untreated infested material for mine timbers is not usually advisable, since the moist conditions prevailing in most mines allow the continued existence of both insects and fungi, which speedily destroy the timbers, necessitating frequent renewals.

A certain lumberman in the Black Hills has solved for himself the problem of the use of fire-killed and infested timber, by turning it into box boards. There is a large and steady demand throughout the Middle West for them by the large meat packing companies. He has no difficulty in disposing of any fire-killed material, no matter how much blued or infested, so long as it is not affected with red-rot.

This solution of the difficulty is not at the disposal of the small man with a portable mill, for it requires a special outfit to saw the match box boards. He might in some cases sell his burned material to a box mill after sawing it out in the rough.

Summary. Destruction of fire-killed timber is largely accomplished by Buprestid beetles, whose larvæ riddle it. In from fifteen months to two years and a half they, in combination with fungi, entirely destroy it for commercial purposes.

The rate of damage varies with the locality of the timber and the season of the fire, being at its maximum in moist localities, following fires in the early part of the growing season.

Remedies. Prevent fires, cut and remove fire-killed timber at once, if this is not possible, bark burned and infested trees and place them on skidways to season. Ponding is the best remedy, but is not generally possible. Running of infested logs through a log pond would destroy borers if the logs were left in long enough. The use of poisonous solutions in the water should be tried.

Infested material can be used in small amounts for low grade products, and for box boards; but often it will not pay to handle it.

TABLE I.

PRELIMINARY TABLE SHOWING RATE OF DESTRUCTION OF FIRE KILLED TIMBER.

Season of Fire	Infested	Partially destroyed	Entirely destroyed
Spring	In a few months	That fall	Following fall
Early Summer	Immediately	That fall	Following fall
Late Summer	Partially at once fully following season	Following fall	Two years
Fall	Following Summer	Following fall	Two–three yrs.
Winter	Following Summer	Following fall	Two–three yrs.

Literature Consulted

CASEY, T. L. Studies in the American Buprestidæ. Proc. Wash. Acad. Science. XI. pp. 47–178, 1909.

HOPKINS, A. D. Insect enemies of the pine in the Black Hills Forest Reserve. Bull. 32 N. S., Div. Ent. U. S. Dept. Agr. 1902.

——— The Black Hills Beetle. Bull. 56, Bur. Ent. U. S. Dept. Agr. 1906.

HUBBARD, H. G. Ambrosia beetles of the United States. Bull. 7, N. S., Div. Ent. U. S. Dept. Agr. 1897, pp. 9–30.

VON SCHRENK, H. The "bluing" and the "red-rot" of the western yellow pine, with special reference to the Black Hills Forest Reserve. Bull. 36, Bur. Pl. Ind. U. S. Dept. Agr. 1903.

WEBB, J. L. The Southern Pine Sawyer. Bull. 58, Pt. IV., Bur. Ent. U. S. Dept. Agr. 1909.

NOTES OF THE SEASON FROM CONNECTICUT

By W. E. BRITTON, *Agricultural Experiment Station, New Haven, Conn.*

During the year some interesting and rather important investigations have been conducted by this department. In Connecticut the walnut weevil, *Conotrachelus juglandis* Lec., has been so destructive that for several years it has been nearly impossible to obtain fruit of the various imported and cultivated walnuts belonging to the genus *Juglans.*

In nearly all of the scanty literature this weevil is said to breed in the nuts, but in Connecticut, the larvæ do much greater damage by tunneling in the new shoots, causing them to wither and die before they can produce fruit. My assistant, Mr. H. B. Kirk, has worked out the life history of *C. juglandis* the past summer. Very little has heretofore been known regarding it. A bud moth, *Acrobasis* sp., also attacks and injures the new growth and Mr. Kirk has studied this insect, finding three generations each season.

Though these studies represent only one season's work, the results indicate that both the weevil and the bud moth can be controlled by spraying the foliage and shoots with lead arsenate. A complete account of the work mentioned above, including bibliography, and distribution of the walnut weevil in the United States will appear during the winter in the next report of the Station (12th Report of the State Entomologist of Connecticut).

For three years Mr. B. H. Walden has been making observations upon a sawfly found defoliating cultivated blackberries in a field near New Haven. A knowledge of its life history is now complete and the insect being a new species of the genus *Pamphilius* was described by Prof. A. D. MacGillivray in *Canadian Entomologist,* Vol. XLIV, October, 1912, page 297, as *P. dentatus*. The work of this insect, which will be described in the report mentioned above, resembles that of the peach sawfly, *P. persicum* MacG., studied five years ago by Mr. Walden, and which is still doing sufficient damage in some Connecticut orchards, to warrant the spraying with lead arsenate of several thousand trees in 1912.

Studies are also in progress upon the white pine weevil, *Pissodes strobi* Peck., and other insects attacking the pine trees in Connecticut.

The cold wet spring seemed favorable for the increase of aphids of nearly all kinds. The rosy apple aphis, *A. sorbi* Kalt., was more abundant and caused more injury than since 1909, and the green apple aphis, *A. pomi* DeG. was also common.

White grubs, *Lachnosterna*, did more damage than I have seen in the state during a residence of eighteen years. Not only were grass fields injured, but the roots of corn and strawberries were eaten, and in some cases the potato crop was nearly destroyed by them. In one forest nursery nearly 25 per cent. of the seedling pines, spruce and deciduous trees were eaten off under ground.

The fall army worm, *Laphygma frugiperda* S. & A., was received from Stonington, Groton and from two different localities in New Haven in September. In three places it was devastating lawns, and in the other case it was feeding upon a field of millet.

The flight of the cotton moth, *Alabama argillacea* Hubn., was much less noticeable than in 1911, and occurred more than two weeks later in the season. Around New Haven the moths were not nearly so abundant as last year, but were most numerous on October 11 and 12. In 1911 the date of their greatest abundance was September 26.

Good progress has been made in the control of the gypsy moth, *Porthetria dispar* Linn. At Stonington no caterpillars have been found since 1910, and it is regarded as wholly exterminated there. At Wallingford, 26 caterpillars were found last summer where 1,551 were taken in 1911 and 8,936 in 1910. Both localities will be watched for some time and in a few weeks, both state and federal scouts will examine them for egg masses.

The brown-tail moth, *Euproctis chrysorrhœa* Linn., has spread southward slightly since last year, involving portions of the towns of Brooklyn, Plainfield and Sterling. An isolated colony was discovered during the summer at Norwich several miles southward and a single winter nest was found at Stafford Springs several miles west of the previously infested area near the northern border of the state.

The birch leaf skeletonizer, *Bucculatrix canadensisella* Chamb., though much less abundant in the eastern portion of the state than in 1910, was found over the entire state as in 1911, and was particularly noticeable on the yellow birches in Litchfield County in September. It was also received at this office on cut-leaf and other ornamental birches from various localities.

In addition to the insects mentioned, the usual pests such as the San José scale, *Aspidiotus perniciosus* Comst., the tulip tree scale, *Toumeyella liriodendri* Gmel., the pine bark aphis, *Chermes pinicorticis* Fitch., the spruce gall louse, *Chermes abietis* Linn., the woolly maple leaf scale, *Phenacoccus acericola* King., various aphids, the spiny elm caterpillar, *Euvanessa antiopa* Linn., the elm leaf beetle, *Galerucella luteola* Müll., the red humped caterpillar, *Schizura concinna* S. & A., the white marked tussock moth, *Hemerocampa leucostigma* S. & A., the fall canker worm, *Alsophila pometaria* Harr., the bumble flower beetle, *Euphoria inda* Linn., the rose chafer, *Macrodactylus subspinosus* Fabr., and the various species of cutworms have all been in evidence.

Increased interest in the control of the house fly and mosquito nuisance has been manifested in various parts of the state, by the demand for illustrated lectures and for information regarding these insects. Mosquito control work has been taken up in a number of shore towns and nearly 3,000 acres of salt marsh have been drained the past season.

NOTES FROM KENTUCKY

By H. Garman, *Lexington, Ky.*

The San José scale has shown a disposition to extend its distribution in Kentucky with very great rapidity during the past two years. Our recent examinations of the Kentucky nurseries have shown that a larger proportion became infested during 1912 than in any previous year of my experience as state entomologist. Just what this rapid spread is due to would be difficult to explain. I have sometimes suspected that nurseries of other states were sending in infested stuff that was not properly fumigated and perhaps not inspected. A rapid growth of interest in fruit growing has accompanied this increase in the prevalence of the scale. Perhaps the two are associated.

Several other insects have attracted special attention during the past season. One is the chinch-bug, ordinarily not a troublesome insect pest in Kentucky and only appearing locally and occasionally in numbers sufficient to call for treatment. We have had a number of demands for the white fungus with which to destroy chinch-bugs doing mischief in some of our counties along the Ohio River this year.

A second insect worthy of notice is the fall army worm (*Laphygma frugiperda*), which began to attract attention in Kentucky in mid-summer because of its injuries to millet and alfalfa. It continued until fall, doing most of its mischief to plantings of alfalfa and rye. The insect is believed to be a migrant and during the summer to come to us from the South. The adult, however, is constantly present in Kentucky during hot weather, though this is the first time in all my experience, covering more than a dozen years, when the injuries have attracted the attention of farmers.

The third insect deserving special mention is the southern cotton worm (*Alabama argillacea*). It is to be remembered that Kentucky is not now a cotton-growing state. A few bales are produced each year in the extreme southwestern corner of the state, but it is hardly regarded as a crop of sufficient importance to be worthy of notice by our people gathering agricultural statistics. The cotton worm moth is a rare insect in the state. It appears suddenly at long intervals about the electric lights of our cities, where it was extremely common September 23, 1911. Nothing was seen of it in 1912, until late in the summer when a few appeared again about the electric lights in September, and occasional specimens have been observed from time to time during early October. So far as I know the insect does not breed in the state, but simply migrates northward from southern cotton fields.

The pickle worm (*Diaphania nitidalis*) has been more destructive during the past summer than I have ever known it before. Whole plantings of cucumbers and cantaloups were so badly damaged as to be scarcely fit for market. It works upon the cucumbers when half as long as one's finger, and continues until they are of some size, the invasion being followed by a soft rot which soon extends throughout the whole fruit. It has proved injurious also to other vegetables of the same family, such as squashes and simlins.

I have had more complaints of the twig-girdler (*Oncideres cingulatus*) this year than ever before. It has been sent to me by a number of correspondents and reported injuring very badly persimmon, and hickory and pecan. Associated with the injury on pecan trees was the hickory shuck worm (*Grapholitha caryæ*.) This worm perforates the hulls, sometimes penetrating the young and soft nut, and while not always destroying the nut, seems capable of doing a good deal of mischief.

The Buffalo gnat is commonly considered a southern insect, pretty closely restricted to the bottom lands along the Mississippi River, so far as its injuries are concerned. It is sometimes very common locally in Kentucky, generally along the Mississippi in the extreme western end of the State and also along the lower part of the Ohio River. I found it very common early last spring in Daviess County near the Ohio River. Horses working in the fields were so worried by the attacks that it was necessary to apply a mixture of lard and coal oil to keep it away. It is said to have been very much more common in this region in early days when more woodland was present. It is a serious pest still at times.

The bag worm (*Thyridopteryx ephemeræformis*) is a conspicuous Kentucky insect. At times it overruns our deciduous trees, though when least abundant it is commonly restricted to cedars and other evergreens. I have seen it in large numbers on the trees about the campus of this University, so that it became a very severe drain upon their vitality. Its parasites then appeared in immense numbers and now seem to have all but exterminated it. I have seen very few of them for several years. Trees formerly with large numbers of the sacks hanging from the twigs are now entirely free.

For a number of years I have been watching the movements of the monarch butterfly (*Anosia plexippus*). In September and early October it begins to move southward through Kentucky, coming to us from Michigan and Ohio, and as I write at my desk on sunny days during this period a constant succession of individuals is to be seen moving past my window and over the building. A careful study of the movements of the insect would afford facts of interest to entomologists. It is as regular in its migrations as are some of the warblers among the birds. On several occasions I have seen it moving southward along the shores of Lake Michigan in early September.

I will mention just two other insects, though many others have attracted my attention in one way or another during the season. The black locust is a very common tree in Kentucky. It is frequently seen in woodland pastures and is sometimes planted along the roadsides for shade. At times it is severely damaged by leaf-miners, among which the small yellow beetle with black back (*Odontota dorsalis*) is noticeable. This insect places a cluster of eggs on the leaves, from which its flat larvæ hatch and push into the interior, often occupying all of the leaflet attacked. In August the trees are frequently rendered completely brown by this insect, working with several Tineid leaf-miners. Quite frequently the trees over whole counties are embrowned at this season of the year and look as if they had been singed by fire. The injury was very noticeable in Fayette and Clark counties this year.

Among the most reliable Kentucky fruits are the different varieties of grapes of American origin. They are sometimes badly damaged by insects. This year, locally, the grape berry moth (*Polychrosis* *botrana*) was common, and on some trellises the greater part of the fruit was found affected. The insect is not difficult to deal with by careful pruning, clearing away all rubbish, and spraying, as it is generally on vines that are somewhat neglected that it does mischief.

One of the most common birds about Lexington is the crow blackbird (*Quiscalus quiscula*). It begins to flock soon after it has produced its young in the early part of the season and thereafter constantly forages in the country surrounding Lexington, coming into town in the evening at dusk in immense numbers to roost about certain premises. For years thousands of these birds have passed over the Experiment Station on their way to a group of evergreen and other trees a short distance beyond the Station grounds. They sometimes become so numerous that citizens complain of them because of the litter they make and of their noise and clatter when roosting in the trees. Because of this, numbers of them have been shot at times. Some years ago I made a study of the food of the birds and found that while they undoubtedly pick up a good deal of grain, most of it is refuse, and they destroy large numbers of insects, such as June-bugs, weevils and the like, which they find on sod land. The appearance of the fall army worm in the vicinity this year led me to think that the bird might be doing good by destroying this insect, since its food is taken almost entirely from the ground. I had a number of birds shot, and on examining the contents of the stomachs found that they were feeding almost entirely on grasshoppers which had been everywhere common during the season. The thousands of birds gathering in this region must do the farmers valuable service in the destruction of these insects. I estimated that 93.8 per cent of the food consisted of insects, most of it grasshoppers and the rest fragments of beetles with traces of a few other insects. No fall army worms were found in the stomachs examined.

INSECTS OF THE YEAR 1912 IN IOWA

By R. L. Webster

Following a winter of extremely low temperatures the spring of 1912 in Iowa opened late. Excess of snow during the winter made the soil quite moist when this melted, but the summer was dry over most of the state. The late summer was characterized by much rain. The following notes are extracted from the insectary and field records of the entomological section of the Iowa Agricultural Experiment Station at Ames.

Lepidosaphes ulmi Linné. Evidently due to the extremely low temperature of January, this troublesome insect received a setback from which it will not immediately recover. Early in the spring, before any growth had started, I noticed that many eggs under the oyster-shell scales were yellowish in color instead of the usual white. These eggs retained their normal shape and since I had seen similar conditions previously I thought nothing of the matter. Not all of the eggs under the scales were yellowish; many were white.

Planning to make some spraying experiments when the young scale insects were hatching I made daily observations in May on some badly infested apple trees at Ames. On one limb of an old tree at Ames I found crawling young insects May 23. Strange to say, however, I found them nowhere else on that tree, nor even in the orchard. The following day, in a badly infested orchard at Hampton, Iowa, I found no crawling scale insects, although apparently sound eggs were extremely abundant under the scales. Again, May 25, at Iowa Falls, Iowa, practically the same conditions were found. These two localities are to the north of Ames, the difference in latitude being about fifty miles for Hampton and thirty-five miles for Iowa Falls. Both these places were visited again late in June but even then there were no signs that any eggs had hatched. Moreover, outside of the one instance mentioned, not another living scale insect of this species was found at Ames.

The monthly mean temperatures for January, 1912, at Ames were 12.7° for the maximum and —6.5° for the minimum. For three weeks at the first of the year there was some very cold weather and in order to show that it may sometimes be cold in Iowa I have included here the minimum temperatures taken at Ames for the first fifteen days of January. These figures are from the Iowa Climatological service of the Weather Bureau, Report for January, 1912.

January	1	−16	January	9	− 7
	2	−18		10	−11
	3	−10		11	−19
	4	−12		12	−35
	5	−20		13	−23
	6	−18		14	+ 2
	7	−31		15	−20
	8	−10			

Carpocapsa pomonella Linné. Following an abundance of apples in 1911 the crop in 1912 in Iowa was short, being only 15 per cent of normal. This condition was favorable to the codling moth and wormy apples were abundant generally. Even where consistent spraying was practised wormy apples were more common than usual. Such was the case around Hamburg, one of the apple centres in southwestern Iowa. But in some of the unsprayed orchards in that locality practically every apple was wormy by the first of August.

Tibicen septendecim Linné. As was expected the 17-year-cicada appeared over a large portion of southern, central and southeastern Iowa. It was not abundant at Ames, although for some weeks the woods were ringing with their notes. Since the distribution of this brood will be discussed in a paper by Professor Summers, the insect needs no further notice here.

Monostegia ignota Norton. Of the two common species of strawberry slugs in Iowa, this one has been for years the more abundant. The name as here given is incorrect, so Mr. S. A. Rohwer tells me, but I have used it tentatively until the matter of nomenclature may be straightened out. The insect was abundant in May around Ames, and also at several other points in the state, causing severe damage in some cases.

Phlegethontius sexta Johanssen. In the fall of 1910 this insect was very abundant on tomato plants at Ames, although it was heavily parasitized. Since that time, however, the larvæ have been rare. From my notes on the insect no larvæ were observed at all at Ames during 1911, but in 1912 a few were found. I am crediting this scarcity to the abundance of *Apanteles congregatus* in the fall of 1910, even though the Apanteles cocoons were themselves much parasitized by two species of hyperparasites at that time.

Peridroma margaritosa saucia Hubner. In June reports came in to the experiment station of damage to alfalfa by "army-worms" in Pottawattamie and Mills counties, in southwestern Iowa. These turned out to be the variegated cutworm, which occasionally becomes so abundant that it adopts the habits of the true army-worm. A trip to Council Bluffs June 24 revealed the fact that most of the larvæ were then about mature, and also heavily parasitized by tachinid larvæ, so the damage had practically all been done at that time. While there was considerable injury to alfalfa, this was only local.

From some of these larvæ sent to the insectary, the moths emerged in July. The same species was reared again in the insectary in the fall. A single mass of eggs collected outside August 10 hatched, and the moths were reared, these emerging early in October. Not all the larvæ in some cages have been accounted for, and some may winter as pupæ. The great majority, however, emerged in October.

Macrosiphum solanifolii Ashmead. This aphid is not generally considered as much of a potato pest in Iowa, but in July the species became excessively abundant on potatoes at Ames. The prompt action of *Hippodamia convergens*, with the aid of certain hymenopterous parasites, checked the outbreak.

Lachnosterna spp. A serious outbreak of white grubs occurred in northeastern Iowa in 1912, corn and meadows being greatly damaged. This outbreak is to be considered elsewhere by Professor Summers, so it need not be taken up here.

PRELIMINARY REPORT OF THE COMMITTEE ON ENTOMOLOGICAL INVESTIGATIONS

By Thomas J. Headlee, Ph.D., *Chairman*

In accordance with the desire of the American Association of Economic Entomologists its committee on entomological investigations has collected data for the preparation of a list of projects. Any workers in Canada or in the United States who have not had a chance to contribute have either been inadvertently overlooked, or have previously refused to coöperate.

At the suggestion of several of the leading entomologists, this committee has reduced the ordinary number of questions and included one intended to furnish information for the making of a taxonomic directory.

A Remedy for Chrysanthemum Leaf Miner. During the spring and summer of 1912 a very serious outbreak of the chrysanthemum leaf miner, *Napomyza chrysanthemi* (Kowarz), occurred in two Milwaukee (Wis.) greenhouses which had imported infested chrysanthemums and marguerites from Boston. Similar injuries were reported from Chicago and other points. The growers were facing an entire loss of their blooming plants caused by complete infestation of the leaves by the mining larvæ of this fly.

While experimenting with contact insecticides for their control, the nicotine solutions, especially "Black Leaf 40" used as a spray with or without whale oil soap solution proved a complete and satisfactory control. One part of nicotine in 400 parts of water, killed the eggs and larvæ readily, as well as newly formed pupæ. The pupæ of all ages were killed with 1-200 nicotine solution. It is evident that the nicotine affects the larvæ through the leaf epidermis by osmòsis. Several types of lepidopterous and coleopterous leaf miners were killed by the use of nicotine sprays in an experimental way, but time was not available for field tests. It would be advisable to test this method in the control of the blackberry leaf miner which is a serious pest in some seasons.

J. G. Sanders, *College of Agriculture, Madison, Wis.*

The following communication was sent out:

MY DEAR SIR:—

In accordance with my duty as chairman of Committee on Entomological Investigations, I am transmitting to you the request for information formulated by this committee. The committee hopes to publish a list of the subjects of investigation in that issue of the JOURNAL OF ECONOMIC ENTOMOLOGY which comes out just previous to the next meeting, and earnestly requests the favor of an immediate reply to points 1–3. The committee would like to have you send in your statements on point 4 as soon as convenient and not later than December 1, 1912. The committee will appreciate all suggestions for "the good of the order."

Hoping that we may have your hearty coöperation, I am,

Very sincerely yours,

REQUEST FOR INFORMATION

1. What are the subjects of investigation you have now under consideration?
2. If consonant with your pleasure to answer, will you state what progress has been made on each project?
3. In what group or groups of insects are you now willing to do classification work for other members of the profession? What are the conditions under which you will do this work?
4. If you can find time please prepare a brief statement of what you believe to be the characteristic marks of worthy entomological investigation.

Please do not delay answering points 1–3 until you can discuss point 4; but answer such of 1–3 as you are willing to give information on and send your ideas on No. 4 by December 1st, 1912.

In the following list the name or names immediately following the address indicate the person or persons reporting the project, and in the absence of specific statement as to the person in charge of a given project may and probably do in most cases indicate the person or persons pursuing the investigation.

Investigations dealing with Crustacea

Mississippi, Agricultural College,—R. W. Harned.

1. The Crayfish of Mississippi.

Substantial progress in the collection of data on life history and habits of all species found and on methods of control.

Investigations dealing with Acarina

Canada, Ottawa,—C. Gordon Hewitt.

2. Ticks, especially Dermacentor spp.

North Carolina, Raleigh,—Franklin Sherman, Jr.

3. The life history, biology, food plants and methods of control of the cotton red spider, *Tetranychus bimaculatus*.

Just begun.

New York, Geneva,—P. J. Parrott.

4. Monographic study of the Eriophyidæ of New York. In immediate charge of H. E. Hodgkiss.

The maple species already listed and described.

Tennessee, Knoxville,—E. C. Cotton.

5. North American fever tick.

Well advanced.

Investigations dealing with Thysanoptera

Arizona, Phoenix,—A. W. Morrill.

6. The citrus thrips, *Euthrips citri.*

Completed this season.

Canada, Ottawa,—C. Gordon Hewitt.

7. Thrips affecting cereals.

Florida, Gainesville,—J. R. Watson.

8. Thrips on tomatoes.

Massachusetts, Amherst,—H. T. Fernald

9. Methods for the control of onion thrips on large fields.

Have not as yet found right treatment.

New Mexico, Agricultural College,—D. E. Merrill.

10. Onion thrips.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

11. An investigation of thrips on onions in New York with means of control. J. C. Faure in immediate charge.

Two thirds completed.

New York, Geneva,—P. J. Parrott.

12. The life history, habits and distribution in New York of the pear thrips, *Euthrips pyri.*

Progress in obtaining data on oviposition, pupation and activities of adults.

Investigations dealing with Mallophaga

California, Stanford University,—V. L. Kellogg.

13. Preparation of a complete host catalogue of the Mallophaga of the world, together with an examination of the conditions of distribution and species forming among the Mallophaga.

Catalogue and study complete except for the entry of about 500 records which have been made since the work began.

14. The study of a considerable collection of the Mallophaga from birds of India.

Work approaching completion.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

15. A study of the Mallophaga parasites of domestic fowls.

Nearing completion for a preliminary report.

Investigations dealing with Orthoptera

Kansas, Manhattan,—T. J. Headlee.

16. The habits and methods of destroying injurious native grasshoppers. F. B. Milliken in immediate charge.

Progress—a publication in press.

Nebraska, Lincoln,—Myron H. Swenk.

17. Grasshopper control. Lawrence Bruner in charge.

Substantial progress.

New Mexico, Agricultural College,—D. E. Merrill.

18. Grasshoppers.
New York, Geneva,—P. J. Parrott, B. B. Fulton.
19. Life histories, habits and means of controlling the tree crickets, *O. niveus* and related species.
Completed and being prepared for publication.
Ohio, Wooster,—H. A. Gossard.
20. Grasshoppers.
Some data accumulated.
West Virginia, Morgantown,—W. E. Rumsey.
21. The control of the walking stick.

Investigations dealing with Hemiptera

Arkansas, Fayetteville,—George G. Becker.
22. The supposed immunity of Northern Spy stock to the attack of woolly aphis.
Little progress thus far.
Canada, Guelph,—Lawson Caesar.
23. Capsids attacking the fruit or foliage of the apple.
Substantial progress. Three species have been discovered during this work, a number of photographs of injury have been made and a considerable amount of data collected.
Canada, Ottawa,—C. Gordon Hewitt.
24. Capsid and aphis injuries in British Columbia.
25. The chinch bug in Ontario.
Colorado, Fort Collins,—C. P. Gillette.
26. Life histories, food plants and remedies for the plant lice of Colorado.
Well advanced.
27. Life history and methods of controlling the tomato psyllid. S. Arthur Johnson in immediate charge.
Florida, Gainesville,—J. R. Watson.
28. White fly studies.
Substantial progress.
Illinois, Urbana,—S. A. Forbes.
29. Tests on a large scale of improved methods of individual and community operation against outbreaks of the chinch bug.
Campaign this year very successful.
Iowa, Ames,—R. L. Webster.
30. Oyster shell scale, *Lepidosaphes ulmi*.
Kansas, Manhattan,—T. J. Headlee, J. W. McCulloch.
31. The life economy and better measures of controlling the chinch bug.
Substantial progress, some circulars published and a bulletin ready for press.
Kansas, Manhattan,—T. J. Headlee.
32. Control of San José scale.
Substantial progress, two reports, some circulars already published and a bulletin now ready for the press.
Maine, Orono,—Edith M. Patch.
33. Ecological and morphological investigations of Aphididæ.
34. Ecological and morphological investigations of Psyllidæ.
Mississippi, Agricultural College,—R. W. Harned.
35. Scale insects of Mississippi (food habits and life history of the native species).
Progress good, some publication.
Missouri, Columbia,—Leonard Haseman.

36. The tarnished plant bug and its work on peach and other plants.
Well under way.
37. The apple leaf hopper.
Well under way.
New York, Geneva,—P. J. Parrott, H. E. Hodgkiss.
38. Life history, habits, and means of protecting pear orchards from the false tarnished plant-bug, *Lygus invitus* Say.
Almost completed.
39. A study of the activities of the late summer broods of the Pear Psylla and finding of more efficient means of control.
Principal progress in demonstrating in a large way that different stages of the first brood are susceptible to spraying mixtures.
New York, Geneva,—P. J. Parrott.
40. The life history, habits and means of controlling the grape leaf hopper. F. Z. Hartzel in immediate charge.
Progress along lines of demonstrating efficient spraying practices.
New York, Cornell University, Ithaca,—C. R. Crosby.
41. Tarnished plant bug.
New Mexico, Agricultural College,—D. E. Merrill.
42. The grape leaf hopper.
North Carolina, Raleigh,—Franklin Sherman, Jr.
43. Laundry soap in water as a remedy for aphids.
Most of serious aphids yielded readily to treatment with a mixture composed of 1/2 lb. soap in 4 gals. of water.
North Carlina, West Raleigh,—Z. P. Metcalf.
44. Life history and methods of controlling the gloomy scale, *Chrysomphalus tenebricosus* Comst.
Well started.
Ohio, Wooster,—H. A. Gossard.
45. The control of the chinch bug.
Progress satisfactory.
46. The Coccidæ of Ohio.
Progress satisfactory.
47. The control of the apple woolly aphis.
Tennessee, Knoxville,—E. C. Cotton.
48. The hog louse.
Just definitely taken up.
Virginia, Norfolk,—T. C. Johnson.
49. Life history of the spinach aphis
50. Cabbage aphis
51. Pea aphis
52. Cucumber aphis
} In charge of F. H. Chittenden.
West Virginia, Morgantown,—W. E. Rumsey.
53. The control of the apple tree aphis through the destruction of its eggs.
Lime-sulphur proved better than any other substance tried.
54. The control of the woolly aphis.
Not yet begun.

Investigations dealing with Lepidoptera

Arkansas, Fayetteville,—George G. Becker.
55. Life history and methods of control of *Sanninoidea exitiosa*.

Substantial progress.

Arizona, Phoenix,—A. W. Morrill.

56. Life history and control of the codling moth under the widely varying conditions found in Arizona.

Well under way.

Canada, Ottawa,—C. Gordon Hewitt.

57. Bionomics of the brown-tail moth in Canada.

58. Establishment of the parasites of the brown-tail moth and of the Calosoma beetles.

59. The native parasites of the fall web-worm and of the tent caterpillars in Nova Scotia and New Brunswick.

60. Life history and control of the green fruit worms (Xylina) in Nova Scotia.

61. Life history and control of the eye-spotted bud moth in Nova Scotia.

62. The lesser apple worm in British Columbia.

63. Cut worms, especially in western Canada.

Colorado, Fort Collins,—C. P. Gillette.

64. Life history and better measures of controlling the codling moth in Colorado.

65. The fruit-tree leaf roller investigations. George P. Weldon in immediate charge.

Nearly ready for publication.

Connecticut, Storrs,—G. H. Lamson.

66. The use of hogs in controlling the codling moth in apple orchards.

Florida, Gainesville,—J. R. Watson.

67. *Heliothis obsoleta* on tomatoes.

68. The life history and control of *Anticarsia gemmatilis* Hbn. on velvet beans.

Indiana, Lafayette,—James Troop.

69. The life history of the codling moth for northern, central and southern Indiana.

Just begun.

70. Number of broods of the fall army worm in north and south ends of the State of Indiana.

Just begun.

Kansas, Manhattan,—T. J. Headlee, J. W. McCulloch.

71. The life economy and measures of controlling the corn ear worm.

Substantial progress, one paper and one circular published and a bulletin now ready for the press.

Missouri, Columbia,—Leonard Haseman.

72. The unspotted tentiform leaf miner of the apple.

Ready to report.

73. Peach tree borer.

Just begun.

Nebraska, Lincoln,—Myron H. Swenk.

74. Cut worm injury to Nebraska crops.

Considerable data accumulated.

New York, Geneva,—P. J. Parrott, W. J. Schoene.

75. The life history, habits and distribution of the apple and cherry ermine moths.

Completed and being prepared for publication.

New York, Albany,—E. P. Felt.

76. A study of the efficiency of spraying for the control of the codling moth.

In the Hudson Valley under normal crop conditions one thorough application results in 95–98 percent of worm free fruit.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

77. Fruit tree leaf roller.

Preliminary report has been made but further experiments in control are under way.

78. Life history and control of the codling moth in western New York. R. W. Braucher in immediate charge.

Nearly completed.

79. The larch case bearer.

Completed.

North Carolina, West Raleigh,—Z. P. Metcalf.

80. Investigations of the imported cabbage web worm, *Hellula undalis* Fabr.

Tennessee, Knoxville,—E. C. Cotton.

81. Peach tree borer.

Well along.

Utah, Logan,—E. G. Titus.

82. Life history of the codling moth.

Investigations dealing with Diptera

Canada, Guelph,—Lawson Caesar.

83. Life history, distribution in Ontario and control of the apple maggot, *Rhagoletis pomonella*.

Substantial progress.

84. Life history, distribution in Ontario of the cherry fruit flies, *Rhagoletis cingulata* and *R. fausta*.

Just well started.

Canada, Ottawa,—C. Gordon Hewitt.

85. Life history, bionomics and control of the apple maggot in Ontario, Quebec and eastern Canada.

86. Root maggots.

87. Bionomics and control of the house fly, lesser house fly and stable fly.

Connecticut, Storrs,—G. H. Lamson.

88. The use of hogs in controlling the apple maggot.

Connecticut, New Haven,—W. E. Britton.

89. The control of the mosquito nuisance in Connecticut and the effect of drainage on the salt marsh flora and yield.

A beginning made.

Indiana, Lafayette,—James Troop.

90. The life history of the Hessian fly in northern, central and southern Indiana.

Just begun.

Illinois, Urbana,—S. A. Forbes.

91. The occurrence and life history of the black flies of Illinois with particular reference to the possibility of these insects serving as agents in the transmission of pellagra.

Kansas, Manhattan,—T. J. Headlee.

92. The life economy and methods of controlling the Hessian fly.

Substantial progress, a paper and some press bulletins already published, a bulletin now in press.

Massachusetts, Amherst,—H. T. Fernald.

93. Methods for the control of onion maggot on large fields.

Do not as yet appear to have found the right line of treatment.

New Hampshire, Durham,—W. C. O'Kane, C. H. Hadley, Jr.

94. The apple maggot.

Practically complete.

95. The control of root maggots by the use of insecticides.
96. The control of black flies, deer flies and midges.
Substantial progress, will complete in another year.
New York, Albany,—E. P. Felt.
97. A monographic study of the biology and the taxonomy of the gall midges.
Well along, largely in manuscript.
New York, Geneva,—P. J. Parrott.
98. The life history, habits and means of controlling the grape midge. F. Z. Hartzell in immediate charge.
99. Life history and habits of the Hessian fly (in coöperation with the U. S. Bureau of Entomology.)
100. The life history, habits and methods of control of the cabbage maggot. This involves a special study of the reaction of the puparia to heat and desiccation, and of the methods of protecting seed beds. W. J. Schoene in immediate charge.
Completed and being prepared for publication.
Ohio, Wooster, H. A. Gossard.
101. Occurrence and seasonal history of the Hessian fly.
102. The wheat leaf miner, *Agromyza parvicornis*.
Ready to report.

Investigations dealing with Coleoptera

Alabama, Auburn,—W. E. Hinds.
103. The life history and control of the rice or black weevil, *Calandra oryza*.
Life history worked out and valuable information gained as to the possibility of greatly reducing the injury done by the species through selection of seed corn that shall produce a crop characterized by a long tight-fitting shuck. Another series of control experiments using carbon bisulphide should be completed by January 1.
Arizona, Phoenix,—A. W. Morrill.
104. Experiments in the control by means of arsenicals of the "corrupted lady bird" on beans, *Epilachna corrupta*.
Completed during 1913.
Arkansas, Fayetteville,—George G. Becker.
105. Life history, habits and methods of control of *Saperda candida*. This is really two projects; (1) life history and habits (2) the measures of control.
The first is just begun and in the second a large amount of data has been accumulated and will soon be able to recommend efficient measures.
Canada, Ottawa,—C. Gordon Hewitt.
106. Life history and control of the plum curculio in Quebec.
107. Life history and control of the apple curculio in Quebec.
108. Life history and control of the *Ipidæ*.
Colorado, Fort Collins,—C. P. Gillette.
109. The life history and practicable means of controlling *Epilachna corrupta* Muls. S. Arthur Johnson in immediate charge.
Connecticut, New Haven,—W. E. Britton.
110. The life history and habits of the walnut weevil, *Conotrachelus juglandis* LeC.
Completed and about ready for publication.
111. The life history, damage and prevention of the white pine weevil in Connecticut.
A beginning made.
Illinois, Urbana,—S. A. Forbes.

112. Life history of the species of Lachnosterna (white grubs), the conditions bringing outbreaks on, and the practical use of insect and plant parasites in their control.

Complete cycle of *L. implicita* and *inversa* recently worked out.

Massachusetts, Amherst,—H. T. Fernald.

113. Methods for the control of wire worms.

Progress satisfactory.

Mississippi, Agricultural College,—R. W. Harned.

114. The boll weevil (testing powdered arsenate of lead against this species and studying its spread within the limits of the state).

Missouri, Columbia,—Leonard Haseman.

115. The hickory twig girdler.

Ready to report.

116. The striped cucumber beetle.

Just begun.

117. The clover leaf weevil.

Just begun.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

118. Means of controlling the elm leaf beetle.

Completed.

New York, Geneva,—P. J. Parrott.

119. The life history and methods of controlling the rose chafer.

F. Z. Hartzell in immediate charge.

120. The life history, habits and methods of controlling the grape root worm.

F. Z Hartzell in immediate charge.

North Carolina, West Raleigh,—Z. P. Metcalf.

121. Biological investigations of *Sphenophorous callosus* and other injurious members of this genus occurring in North Carolina.

Practically completed.

Ohio, Wooster,—H. A. Gossard.

122. Bark beetles (fruit?)

Well along.

123. Life histories and control of white grubs.

Little real progress.

Utah, Logan,—E. G. Titus.

124. The life history of the alfalfa weevil.

Well along.

Virginia, Norfolk,—T. C. Johnson.

125. The bean weevil
126. The Colorado potato beetle } F. H. Chittenden in immediate charge.

Investigations dealing with Hymenoptera

Arizona, Phoenix,—A. W. Morrill.

127. Ant control, *Pogonomyrmex barbata*.

Will be completed next season.

Canada, Ottawa,—C. Gordon Hewitt.

128. The spruce bud worm.

129. The larch saw fly.

Connecticut, New Haven,—W. E. Britton.

130. A new saw fly pest of the blackberry in Connecticut.

Completed and about ready for publication.

Colorado, University of, Boulder,—T. D. A. Cockerell.

131. Bees (Apoidea) of the world.
Substantial progress—a large part already published.
Iowa, Ames,—R. L. Webster.
132. Two species of strawberry slugs, *Empria maculata* and *Empria* sp.
Maryland, College Park,—A. B. Gahan.
133. Classification and host relations of the *Braconidæ,* sub-family *Opiinæ.*
Classification of described North American species of the group fairly well in hand and some progress made in other lines.
New York, Geneva,—P. J. Parrott, B. B. Fulton.
134. Life history, habits and methods of controlling the cherry saw fly leaf miner, *Profenusa collaris* MacG.
135. Distribution, life history and methods of controlling *Polydrosus impressifrons.*
W. J. Schoene in immediate charge.
New York, Cornell University, Ithaca,—C. R. Crosby.
136. Isosomas.
Utah, Logan,—E. G. Titus.
137. The life history of the wheat straw worm.

Investigations dealing with groups of insects or with insecticides or with both

Alabama, Auburn,—W. E. Hinds.
138. Carbon bisulphide and hydrocyanic acid gas as insecticides.
Substantial progress.
California, Stanford University,—V. L. Kellogg.
139. Certain prolonged experimental studies of inheritance in insects and the consideration of certain other bionomic factors in insect evolution.
Results of seven or eight years study of inheritance in silk worms already published.
Canada, Ottawa,—C. Gordon Hewitt.
140. Life histories of miscellaneous insects.
Colorado, Fort Collins,—C. P. Gillette.
141. Insect control through treatment of their eggs.
Much data collected and some of it published..
Colorada, University of, Boulder,—Theo. D. A. Cockerell.
142. Insect fauna of Colorado.
Substantial progress.
143. Fossil insects.
Data accumulating.
Connecticut, New Haven,—W. E. Britton.
144. Insects attacking the white pine in Connecticut.
A beginning made.
Connecticut, Storrs,—G. H. Lamson.
145. Insects that attack cucurbits.
146. Insects that attack peach.
Iowa, Ames,—R. L. Webster.
147. Potato insects.
Kansas, Manhattan,—T. J. Headlee.
148. The relation of climate to injurious insects.
Some progress, one paper published and further data accumulated.
149. The local life economy of the codling moth and curculio, *Conotrachelus nenuphar* Hbst, and spraying for their control.

Substantial progress. One general bulletin including some data published, much data accumulated and a paper on brood study of the former ready for publication.

150. The life economy and measures of controlling mill and stored grain insects. George A. Dean in immediate charge.

Substantial. A paper on high temperature as a means of controlling mill insects already published and a bulletin ready for the press.

Louisiana, Baton Rouge,—E. S. Tucker.

151. Insects affecting stored rice.

Progress has been made in determining the life history of the principal species and their resistance to fumigating agents under warehouse conditions.

Massachusetts, Amherst,—H. T. Fernald.

152. A study of the causes producing the burning of foliage by insecticides.

Progress satisfactory.

153. Investigations of the real amount of benefit obtained by the work of the different groups of parasites.

Progress satisfactory.

154. Distribution limits of pests in Massachusetts.

Progress satisfactory.

155. Strength of fumigation safe on different greenhouse crops as compared with strength necessary for destruction of the pests.

Progress satisfactory.

Michigan, East Lansing,—R. H. Pettit.

156. How contact insecticides kill. E. G. Shafer in immediate charge.

Substantial progress. One bulletin published and another ready.

157. The life histories and control of various fruit and field crop insects.

Much data accumulated.

158. The life histories and control of insects injurious to Michigan forests.

Much data accumulated.

Mississippi, Agricultural College,—R. W. Harned.

159. Insects affecting pecans (mainly life history studies).

Michigan, Detroit,—Parke, Davis & Co.

160. Testing penetrating power of carbon disulphide and other gases in connection with killing shade tree borers.

161. The feasibility of exterminating insects by inoculating the plant.

Nebraska, Lincoln,—Mryon H. Swenk.

162. The prairie dog.

163. The rôle of insects in tripping alfalfa blossoms and the subsequent effect of such tripping on the size of the seed crop.

Progress satisfactory.

164. A monographic account of the insect enemies of alfalfa.

Progress satisfactory.

New Hampshire, Durham,—W. C. O'Kane.

165. Insect outbreaks (a provision to take advantage of the unusual opportunities for study offered by these outbreaks).

166. A determination of the amount of arsenic left on fruit, foliage and grass following applications of sprays.

Substantial progress.

167. Museum work (a provision for increase and care of insect collections).

New York, Albany,—E. P. Felt.

168. Shade and forest tree insects.

Data have been accumulated to show that on the more valuable trees hickory bark borer may be destroyed by use of insecticides after the females have entered the trees.

169. The effect of petroleum on dormant trees.

New York, Cornell University, Ithaca,—Glenn W. Herrick.

170. Investigation of clover pests with means of control.

Just begun.

171. Investigation of the life histories of insects injurious to hops with methods of control. F. W. Pettey in immediate charge.

Just begun.

Ohio, Wooster,—H. A. Gossard.

172. Peach and apple orchard spraying and its effect on insect pests.

173. Collections and exhibits.

174. Miscellaneous life histories.

175. Mill fumigation.

Much data accumulated.

176. Efficiency of different spraying nozzles.

Progress substantial. Bulletin now in press.

Utah, Logan.—E. G. Titus.

177. Arsenical poisoning of fruit trees.

Well along.

West Virginia, Morgantown,—W. E. Rumsey.

178. The control of the apple and peach tree borers.

Progress satisfactory.

Taxonomic Directory

Thysanoptera

W. E. Hinds, Auburn, Ala., will classify for privilege of retaining duplicates and of naming and describing the new species.

Mallophaga

V. L. Kellogg, Stanford University, Cal., will classify when sendings are of sufficient size to make probable the discovery of new species, or of interesting new records of distribution, and when in small lots if material has been taken from unfamiliar birds, or from birds of the remote geographical regions.

Orthoptera

B. H. Walden, New Haven, Conn., will classify in so far as other work will permit.

Membracidæ, Jassidæ, Cercopidæ and *Fulgoridæ.*

Z. P. Metcalf, West Raleigh, N. C., will classify for permission to retain new and unusual forms for further study, and to dispose of a fair number of such forms as he may see fit.

Jassidæ

E. D. Ball, Logan, Utah, will classify North American forms under the usual conditions.

Aphididæ

C. P. Gillette, Fort Collins, Colo., will classify provided data on food plants and date and location of capture are furnished, and the privilege of retaining the specimens of special interest when there are duplicates.

Aphididæ and *Psyllidæ*

Edith M. Patch, Orono, Maine, will classify on receipt of mature material in good condition with record of food plant accurately determined on which the species developed.

Aleyrodidæ

J. R. Watson, Gainesville, Fla.

A. W. Morrill, Phoenix, Ariz., will classify for permission to retain specimens if desired.

Coccidæ and *Aleyrodidæ*

W. E. Britton, New Haven, Conn., will classify in so far as other work will permit.

Coccidæ

R. H. Pettit, East Lansing, Mich., will classify in so far as other work will permit.

Chironomidæ and *Mycetophilidæ*

O. A. Johannsen, Cornell University, Ithaca, N. Y., will classify for the privilege of retaining desiderata.

Itonididæ

E. P. Felt, State Education Building, Albany, N. Y., will classify provided the midges are new, from new localities or have been reared and food record is available.

Megastigmus

C. R. Crosby, Cornell University, Ithaca, N. Y.

Aphidiinæ and *Opiinæ*, sub-families of *Braconidæ*

A. B. Gahan, College Park, Md., will classify on condition that specimens may be retained if desired.

Sphecidæ

H. T. Fernald, Amherst, Mass., will classify provided work be not required immediately on receipt of specimens. Assistant will classify *Elidinæ* and graduate students the sub-family *Aporinæ* of the family *Psammocharidæ* (*Pompilidæ*).

Apoidea

E. G. Titus, Logan, Utah. For permission to retain types and specimens not present in his collection.

Myron H. Swenk, Lincoln, Neb., will classify members of this group from Nebraska, and any North American member of the following genera—*Colletes*, *Nomada* and *Anthidium*.

PRELIMINARY LIST OF THE SCALE INSECTS OF SOUTH CAROLINA WITH SOME NOTES ON THE BEHAVIOR OF LECANIUM QUERCIFEX FITCH

By Wilson P. Gee

No previous systematic attempt seems ever to have been made to collect and identify the scale insects of South Carolina, and except for specimens which have found their way into the collections of workers in other states, there are no records of just what *Coccidæ* occur there. During the past year and a half the writer has attempted a partial collection and classification of the scales of this state, and has been able to secure at least the more generally distributed of these. He wishes to acknowledge here his appreciation of the ready response of Prof. J. G. Sanders, Department of Entomology, University of Wisconsin, to the request for the check identification of all of the soft-scale insects in this list, and to Mr. E. R. Sasscer, Bureau of Entomology, Washington, D. C., for a similar service in regard to the *Diaspine* scales.

The following is a list of the scale insects with their host plants.

1* *Chrysomphalus aonidum*, Linn. on Palm.
2* *Chrysomphalus dictyospermi* Morg. on Sabal Palm.
3 *Chrysomphalus tenebricosus* Comst. on Acer sp.
4* *Aspidiotus hederæ* Vall. on *Cycas revoluta.*
5 *Aspidiotus forbesi* Johns on Peach.
6 *Aspidiotus perniciosus* Comst. on Peach, Plum, Apple, Pear, Rose, and Cherry.
7 *Lepidosaphes beckii* Newm. on Fig.
8 *Lepidosaphes ulmi* Linn. on *Pyrus malus.*
9 *Chionaspis furfura* Fitch on *Pyrus malus.*
10 *Chionaspis euonymi* Comst. on *Euonymus japonicus.*
11* *Parlatoria pergandei* var. close to *camelliæ* on *Euonymus japonicus.*
12* *Parlatoria pergandei* Comst. on *Citrus lemonæ.*
13 *Fiorina theæ* Green on *Euonymus japonicus.*
14 *Lecaniodiaspis tessellata* Ckll. on Persimmon.
15 *Toumeyella liriodendri* Gmel. on *Liriodendron tulipifera.*
16 *Saissetia hemisphaerica* Targ. on Persea and *Cycas revoluta.*
17 *Pulvinaria vitis* Linn. on Acer sp.
18 *Pulvinaria acericola* Walsh and Riley on Acer sp.
19 *Pulvinaria camellicola* (?) on *Cornus florida.*
20 *Lecanium corni* Bouche on Elm.
21 *Lecanium nigrofasciatum* Pergande on Plum.
22 *Lecanium quercifex* Fitch on *Quercus aquatica.*
23 *Aulacaspis rosæ* Bouche on Rose.
24* *Coccus hesperidum* on Laurel and Cerimon.
25* *Pseudococcus citri* on *Citrus aurantium.*
26 *Pseudophillipia quaintancei* Ckll. on Pine.

* Greenhouse species.

General Behavior of Young of Lecanium quercifex Fitch. Eggs of this species were hatching May 15, in such abundance as to afford ample material for the study of some features of its behavior. While not exhaustive in character, many of these results are new and of considerable interest in the explanation of certain activities of not alone this species of scale insects, but also many related ones.

Phototaxis. To light of a 16 candle power intensity, the young insects showed a very marked positive reaction, orientation being very decidedly parallel to the direction of the rays of light. A very few specimens seemed entirely indifferent to the effect of the light rays, but taken as a whole, the reaction reminds one very much of the effect that the electric current has on Paramecium as described by Jennings.[1] Almost as soon as the light is placed at the other end of the dish, the direction of the movement of the scale insect is reversed and it again moves in the direction of the source of light. The scales of this form occur towards the outer portions of the twigs on the newer wood, and the light reactions of the insect are no doubt an important factor

[1] Jennings, H. S. Behavior of the Lower Organisms. New York, 1906.

in determining this, since the stronger light is to be found towards the tips of the branches.

Geotaxis. When placed on a thin cork board, in a vertical position, the young scale insects began climbing upward against the direction of gravity. This did not continue in all cases until the form had reached the top of the board, but many of the specimens seemed to stop when they reached a height of six or eight inches, though several continued to the top of the board, twelve inches in height. This method of reaction, crawling upward, or *negative geotaxis*, affords us another factor in the assistance of the light in aiding the young scale insects to reach the newer portions of the growth of the branch, since this part usually projects upward.

Chemotaxis. A very small amount of strong hydrochloric acid, nitric acid, and 95 per cent alcohol were placed in the midst of a large number of young scales on a glass slide, and their movements observed under a binocular. To each of these substances all of the young scales showed a very marked negatively chemotactic response. It would be interesting to test out the effect of a weak tannic acid solution in this relation, and also an extract of the juices of the twigs of the oak, where we would expect a positive reaction; but though this was the intention of the writer, the matter was overlooked until all of the young scales had become old enough to have fixed themselves in their places on the tree.

Thigmotaxis. The young scale insects show very strongly positive thigmotactic propensities. A young nymph which had become turned on its dorsal surface was observed to juggle an unhatched egg, much as a clown would a ball, moving it about with its legs from nine o'clock one morning until five o'clock that afternoon. Observations were discontinued at that time for the day; but the next morning, the performance was still in progress, and continued until about two o'clock that afternoon. At that time the young scale emerged from the egg and it was only with difficulty that the newly emerged individual could escape from the grasp of its young foster-parent. All of this misspent energy came from the attempt of the form to " right " itself, and having caught hold of the egg in its efforts to do this, it lacked sufficient organization of its nervous system to profit from an experience of this kind and continued its futile efforts in this direction until the hatching of the egg relieved it of the object of its misdirected energies. When placed upon their dorsal surfaces they grasp very quickly and cling tightly to such objects held out to them as the fibres of a camel's hair brush, small straws, etc. This positive thigmotaxis is, of course, highly adaptive in nature, and serves to keep the animal in contact with the twig on which it has hatched and will continue to spend its further existence.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1912

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints may be obtained at cost. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The transmission of diseases affecting man by insects has been regarded, up to recent years, as being limited in considerable measure to tropical or sub-tropical regions. Successive discoveries have led to a modification of this opinion, and the recently demonstrated connection between the deadly infantile paralysis and the stable fly still further emphasizes the danger of too intimate association with certain Hexapoda, especially Diptera. This discovery made by the entomologist working with the medical man is a most important contribution to knowledge and of incalculable value in the successful control of one of the more deadly infections to which man is subject. Similar investigations of relations which may possibly exist between obscure diseases and insects is most advisable and is an exceedingly promising field for future work.

A correct biology is a postulate of efficient practical entomology. The great demand for economic work has reacted upon insect biology and many investigators in widely separated sections of the country have been stimulated to undertake the elucidation of special problems. Our European confreres have not overlooked this field; pedogenesis and polyembryony were demonstrated abroad and confirmed in this country. The same is true of parasites ovipositing in the egg and an arrested development making possible the nourishment and growth of the Hymenopteron at the expense of the larval host. It is a striking coincidence that two groups of American investigators, whose papers appear in this issue, should work out the same problem on opposite borders of this country and demonstrate the occurrence of this peculiar life history in representatives of two of the great families of the parasitic Hymenoptera, namely the Chalcididæ and the Braconidæ, while the earlier work of Marchal, alluded to above, showed the same to be true of the Proctotrypidæ. Another striking instance along the same line is the confirmation by American writers, of the peculiar oviposition habits of certain Tachinid flies first worked out by a Japanese student and for a time deemed almost incredible. These facts are most interesting from a scientific standpoint and are frequently of material service in applied work. It is gratifying to note that American entomologists are not overlooking the value of research in an attempt to obtain immediate results. Those who have added to the sum of human knowledge are to be congratulated upon their good fortune, while all Americans should realize that we have in the Bureau of Entomology at Washington, a peculiarly efficient research organization which reflects great credit upon its gifted chief.

Work upon insecticides, aside from general field comparisons, has received too little attention from the economic biologist. We are dealing with living organisms, and while the percentage of poison in a given insecticide and the relative activity of that poison from a mechanical standpoint is most valuable, still there should be some knowledge of the reaction of the poison upon the living insect. One American student has thrown much light on how certain insecticides kill, and in this issue we print a discussion of the possibilities and probabilities of establishing some such criterion as a poison exponent based upon the reaction of the insect under recorded conditions to standard amounts of various poisons. The inquiry is most praiseworthy and should be extended along several lines in a search for some practical test which will give much more accurate information than the comparatively gross field experiments which have been our principal source of information in the past.

Reviews

26th Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois, by S. A. FORBES pp. 1–160, figs. 42. 1912.

The increasing importance of shade tree and shrub pests is shown by the discussion at the outset of some 27 species occupying 60 printed pages. We note the absence in this list of the false maple scale, *Phenacoccus acericola* King, a species more generally injurious to hard maples in the vicinity of New York City than the cottony maple scale. The sugar maple borer is another New York pest which escapes notice. A chapter by Mr. Hart is devoted to miscellaneous economic insects and gives a particularly valuable discussion of the green fruit worms and their identity. There is an excellent opportunity for more work on these closely allied insects. The remainder of the report is devoted to the more important insects of truck farms and vegetable gardens, followed by directions for the preparation and use of the standard insecticides. The discussions are brief, practical, and the text well illustrated, a number of figures being original.

A Preliminary Report on the Alfalfa Weevil, by F. M. WEBSTER, U. S. Dep't. of Agric., Bur. of Ent., Bul. 112, pp. 1–47, figs. 27, pls. 13. 1912.

This preliminary report summarizes the earlier work against the pest, records the appearance of the clover leaf weevil, *Hypera punctata* Fabr. between the Rocky and Cascade Mountains and discusses the life history, habits and methods of control of the alfalfa weevil. The employment of an ordinary street sweeper and of wire brushes, apparently a modification of the horse rake, was found of much service in crushing the larvæ and pupæ, though somewhat expensive. A specially interesting chapter is that devoted to the natural enemies, particularly the portion relating to imported forms. Two egg parasites and five larval and pupal enemies were introduced from Italy through the agency of Mr. W. F. Fiske early in 1911. The outcome of these importations will be watched with much interest by economic entomologists. The bulletin is admirably illustrated with a large series of original line and process figures.

Insect Pests of the Lesser Antilles, by H. A. Ballou. Imperial Department of Agriculture for the West Indies, Pamphlet, Ser. 71, pp. 210, figs. 185. 1912.

This useful compilation, designed, in the words of the author: "To present in plain and simple language, a brief general account of our present knowledge of some of the principal insect and mite pests of the crops grown in the Lesser Antilles; also of the pests attacking man and domestic animals as well as those of the household," will appeal particularly to entomologists located in Tropical and Subtropical regions. The comprehensive nature of the work involves brief notices of many species, following a short chapter on the natural history of insects and another giving the characteristics of the more important orders. The grouping will appeal to the agriculturist, since it is designed to facilitate the recognition and control of the various forms attacking plants or animals. Considerable space relatively is given to a discussion of mosquitoes and fleas, an indication of their importance in that latitude.

In treating of the control of insects, the author rightly emphasizes first of all, the value of preventive measures and then gives detailed information respecting the various insecticides and their method of operation. The author discusses and recommends to a limited extent, the use of corrosive sublimate and phosphorus, two extremely dangerous poisons rarely advised by entomologists in temperate regions. Many of the illustrations are excellent, not a few being from American Government or State publications while some are rather crude. The author is to be congratulated upon having prepared such a convenient compilation.

Scientific Notes

Stable Fly and Infantile Paralysis. The successful transmission of infantile paralysis in monkeys through the bite of the blood-sucking stable fly (*Stomoxys calcitrans*) has been announced by Prof. M. J. Rosenau of the Harvard Medical School and C. T. Brues of the Bussey Institution, Harvard University, and their results have been confirmed by Dr. J. F. Anderson of the Public Health and Marine-Hospital Service.

The hypothesis advanced last year by Brues and Sheppard that the stable fly is the carrier of this disease has thus been given experimental proof, although it is still possible that other channels of infection may exist. With the exception of the investigations of Doctor Anderson, the work was done under the auspices of the Massachusetts State Board of Health, and the announcement appears in the *Monthly Bulletin* of that board for September, 1912.

Note on a Parasite of White-grubs. While following the plow in the spring of 1909, to learn the degree of infestation by white-grubs in fields near Aurora and Bloomington, Ill., the writer noticed in the earth many cocoons resembling those of *Tiphia inornata*, but somewhat larger, more nearly elliptical, and without the necklike constriction near one end often seen in Tiphia cocoons. They were also much smoother, and lacked the loose fluffy coating of silk characteristic of Tiphia. The remains of Lachnosterna larvæ, especially parts of the mandibles and other portions of the head, and in some cases the dried skin, were attached to very many of these cocoons. From a number of them collected near Bloomington, imagos emerged in the early summer of 1909, and were identified by Charles A. Hart as *Myzine sexcincta* Fab.

Myzine cocoons have now been taken in considerable numbers behind the plow, in central and northern Illinios, during the years 1910, 1911, and 1912, over 75 percent of them with parts of white-grubs attached. Hence, while this insect has not been bred at the insectary direct from white-grubs, there can be little or no doubt that it is a parasite upon them.

In some field collections Myzine cocoons have outnumbered those of Tiphia, sometimes, no doubt, because they were more numerous in the soil, but sometimes apparently because they generally lie nearer the surface than those of Tiphia, and hence are more frequently thrown out in shallow plowing. In a field near Galesburg, for example, plowed for experiments with the corn root-aphis, careful note was made of all insects exposed, with the following result as to white-grubs and their parasites: In four plots of one acre each plowed to the depth of four inches, 75 cocoons of Myzine were collected, 41 of Tiphia, and 365 of living white-grubs; but in a single acre plowed six inches deep and containing 48 living grubs, the Myzine and Tiphia counts were 2 and 9, respectively.

In central Illinois large numbers of adult Myzine may usually be seen, from the middle of June to the latter part of August, about blossoms of sweet-clover (*Melilotus alba*), the males greatly outnumbering the females in this situation; and females have been noticed several times in corn fields, either crawling on the ground or flying just above it. The males, on the other hand, like other members of their family, have the habit of resting in numbers on the tops of weeds or grass at night. Twenty-two of them were taken, for example, from the top of a large ragweed with one sweep of a net.

Several hundred Myzine cocoons have been found during the last three years from plowed fields in central Illinois. Generally speaking, they are, in this district, nearly as abundant as Tiphia cocoons, and they must be an important factor in reducing the number of white-grubs.

W. P. Flint and G. E. Sanders.

Fall Army Worm (*Laphygma frugiperda* Sm. & Abb.). I notice that Dr. Felt reports that this insect was unusually abundant during September and October in the vicinity of New York City. I have never known this species to be as abundant in Indiana in the past 25 years, as it was this fall. It was first reported from South Bend the first week of September, and following that, specimens were received from about twenty different sections of the state, the last one being received on November 7th. Adults were bred from the first lot of larvæ on October 8 and the moths were found in the field, in other localities, as late as October 28. Only one Tachina fly was bred from fifty larvæ, thus showing that a comparatively small per cent of them was parasitized. The greater amount of damage was done to newly sowed alfalfa, although they did much damage to wheat, rye, and timothy.

J. Troop.

FEDERAL QUARANTINE NOTICE

Gipsy and brown-tail moths. Under authority of the Plant Quarantine Act, Acting Secretary of Agriculture, Willet M. Hays has declared a quarantine for the brown-tail moth against the following localities: All towns between the Atlantic Ocean and Robbinston, Charlotte, Cooper, Plantation XIX, Wesley, Plantation XXXI, Plantation XXX, Devereaux, Plantations XXVIII, XXXIII, and XXXII, Milford, Alton, Bradford, Atkinson, Dover, Sangerville, Parkman, Wellington, Brighton, Solon, Embden, Anson, New Vineyard, Farmington, Temple, Wilton, Carthage, Mexico, Rumford, Newry, Riley, *Maine;* Shelburne, Gorham, Randolph, Jefferson, Whitefield, Dalton, Littleton, and Monroe, *New Hampshire;* Ryegate, Newbury, Bradford, Fairlee, Thetford, Norwich, Hartford, Hartland, Windsor, Weathersfield, Springfield, Rockingham, Westminster, Putney, Dummerston, Brattleboro, and Guilford, *Vermont;* Leyden, Greenfield, Deerfield, Whately, Hatfield, Northampton, Easthampton, Holyoke, West Springfield, Springfield, Longmeadow, East Longmeadow, and Hampden, *Massachusetts;* Stafford, Union, Woodstock, Pomfret, and Killingly, *Connecticut;* Foster, Coventry, West Greenwich, East Greenwich, and North Kingston, *Rhode Island.* In addition to these the towns of North Adams and Clarksburg, *Massachusetts.* are also infested and are included in the quarantine area.

This quarantine applies to all deciduous trees or shrubs, including all deciduous field-grown florists' stock, vines, cuttings, grafts and scions.

The following territory is quarantined for the gipsy moth:

All the territory between (and including) the towns named and the Atlantic Ocean, as follows: Georgetown, Westport, Edgecomb, Damariscotta, Nobleborough, Newcastle, Alna, Whitefield, Chelsea, Pittston, Dresden, Richmond, Bowdoin, Webster, Lewiston, Auburn, Poland, Casco, Raymond, Windham, Standish, Limington, Cornish, and Porter, *Maine;* Freedom, Ossipee, Tuftonborough, Meredith, New Hampton, Hill, Danbury, Wilmot, Salisbury, Warner, Henniker, Hillsborough, Antrim, Hancock, Dublin, Troy, Richmond, and Winchester, *New Hampshire;* Warwick, Orange, Athol, Petersham, Barre, Oakham, Spencer, Sturbridge, Charlton, Dudley, and Webster, *Massachusetts;* Burrillville, Gloucester, Johnston, Cranston, Warwick, and North Kingston, *Rhode Island;* excepting the towns of Newport, Tiverton, and Little Compton, *Rhode Island;* Westport, Fall River, Somerset, Dighton, Freetown, Dartmouth, Fairhaven, and Mattapoisett, *Massachusetts.*

The gipsy moth quarantine applies to coniferous trees such as spruce, fir, hemlock, pine, juniper (cedar), and arbor-vitæ (white cedar), known and described as "Christmas trees," and parts thereof, and decorative plants such as holly and laurel, known and described as "Christmas greens or greenery."

Also forest plant products including logs, tan bark, posts, poles, railroad ties, cordwood, and lumber, and field-grown florists' stock, trees, shrubs, vines, cuttings, and other plants and plant products for planting or propagation excepting buds, fruit pits, seeds of fruit, and ornamental trees and shrubs, field, vegetable and flower seeds, bedding plants and other herbaceous plants and roots.

The above plants or plant products are not allowed to move interstate to any point outside the quarantined areas unless and until such have been inspected by the United States Department of Agriculture and pronounced free from the insects against which quarantine has been declared.

Current Notes

Conducted by the Associate Editor

Mr. J. L. Webb of the Bureau of Entomology, is now located at Crowley, La., where he is engaged in Southern Field Crop Investigations.

Mr. Bentley B. Fulton has been appointed assistant entomologist of the New York Agricultural Experiment Station at Geneva.

Mr. H. J. Webb has been appointed assistant in Entomology, at the Utah Agricultural College and Experiment Station.

Mr. W. H. Goodwin, Assistant Entomologist of the Ohio Station, is taking up work at the Ohio State University leading to the Master's Degree.

Mr. W. R. Thompson of Cornell University, has been detailed by Dr. L. O. Howard of the Bureau of Entomology, to study the Mediterranean fruit fly in Sicily, where he is now engaged in this work.

Mr. D. E. Fink of the department of Entomology, Cornell University, has accepted a position with the Bureau of Entomology, and is now located in Norfolk, Virginia, studying the pests of vegetables.

Mr. W. P. Gee has resigned as assistant professor of Entomology at Clemson College and Station, South Carolina, to take up graduate work at the University of California.

Miss Orrel M. Andrews of Fairmount College has been appointed Research Fellow in the Department of Entomology of the University of Kansas for the coming year.

Mr. A. G. Ruggles, Assistant Entomologist at the Minnesota Experiment Station is absent from the Station on a seven months' leave of absence, being engaged during that time by the Pennsylvania Chestnut Tree Disease Commission, with heaquarters at Philadelphia.

Mr. L. M. Sedgwick of Kansas City, Mo., has presented a valuable collection of tropical insects to the Entomological Museum of the University of Kansas. When mounted and placed in cabinets it will be known as the "L. M. Sedgwick Collection."

Mr. W. F. Schlupp, who spent several months with the Entomological Department of the Ohio Station during the summer, has taken up work with the Bureau of Plant Pathology, U. S. D. A., and is making an investigation of Ohio with reference to the chestnut blight.

Mr. J. S. Houser of the Ohio Station, received his Master's Degree in Science from Cornell University in June. He has recently been raised to the rank of associate entomologist.

Mr. R. D. Whitmarsh, Assistant Entomologist of the Ohio Station, has a leave of absence for a few months, and the first of November goes to Columbus for post-graduate study leading to the Doctor's Degree from the Ohio State University.

Mr. J. L. King of the Ohio Station, who has had a laboratory at Gypsum in the orcharding district along the lake shore during the spring, summer and fall months, will remove his headquarters to Wooster for the winter.

Mr. Oscar C. Bartlett, B. S. 1909, Ph. D. 1912, and formerly laboratory assistant Massachusetts Agricultural College, has been appointed Assistant State Entomologist of Arizona. His address hereafter will be Phoenix, Ariz.

Dr. Guy C. Crampton, Associate Professor of Entomology at the Massachusetts Agricultural College, was present at the meetings of the Second International Congress of Entomology at Oxford, England, last summer. By some error on the part of the secretaries, his residence was given as Glasgow, Scotland.

The publication of the Bulletin of the Brooklyn Entomological Society has been resumed after a lapse of twenty-eight years. The first number bears the date of October, 1912, and is Vol. VIII, No. 1. It has twenty pages and one plate. Short articles and collector's notes will be made a special feature of this Bulletin.

Dr. Robert Matheson has resigned from the Department of Entomology of Cornell University to accept a position as Provincial Entomologist of Nova Scotia. He is to be located at Truro. Most of his work is economic, but he will give some attention to teaching during the winter in the Agricultural College at Truro.

Mr. G. H. Grosvenor, an English Entomologist, who was Assistant Secretary of the recent International Entomological Congress, was drowned off the Cornish Coast while trying to save the life of another.

P. W. Mason, a recent graduate from the Michigan Agricultural College, has taken a position as Assistant Entomologist in Purdue University, LaFayette, Ind. Mr. Mason served three years as assistant to Prof. R. H. Pettit, at the Michigan College, and goes to his new work well equipped.

Dr. Oskar A. Johannsen, Entomologist of the Maine Agricultural Experiment Station, has resigned to accept the appointment of Assistant Professor of Biology in Cornell University in place of Doctor Matheson, resigned. Doctor Johannsen has already moved to Ithaca, N. Y., where mail should be sent to him. His present address is 417 East Buffalo Street.

Paul Hayhurst, Entomologist of the Arkansas College and Station, resigned several months ago and is now studying horticulture at the University of Illinois. Mr. George G. Becker, formerly assistant in the department, has been made Acting Entomologist and Acting State Nursery Inspector.

Mr. C. L. Metcalf, M. S., of the Ohio State University, has entered upon his duties as Assistant Entomologist, of the North Carolina State Department of Agriculture at Raleigh, succeeding his brother Z. P. Metcalf, who is now Entomologist of the North Carolina Agricultural College and Experiment Station at West Raleigh.

Mr. W. R. McConnell, Assistant in charge of the department of Zoölogy at the Pennsylvania State College, resigned at the close of the last college year to accept a position in the Division of Cereal and Forage Insects of the Bureau of Entomology. He is now located at Greenwood, Mass.

Mr. W. V. King of the Bureau of Entomology, who was formerly engaged in the investigation of the spotted fever tick in Montana and later in an investigation of the possible pellagra carriers in South Carolina, has recently registered in the school of Tropical Medicines in Tulane University, taking as his major subject, Medical Entomology, and for minors, Public Health and Parasitology.

Mr. S. W. Foster, a member of this Association, who for the past six years has been engaged in Deciduous Fruit Insect Investigations for the United States Bureau of Entomology, is now engaged in the Insecticide Business on the Pacific Coast as Entomologist and Manager of the Insecticide Department of the General Chemical Company of California at San Francisco. Mr. Foster will also be engaged in Research and Special Service Work as regards insect pests of orchard and truck crops.

Prof. S. J. Hunter of the University of Kansas read a paper on "Pellagra and the Sand-fly" before the Second Triennial Meeting of the National Association for the Study of Pellagra, at Columbia, S. C., on October 3. This was a presentation of the results of experiments in the transfusion of blood from Pellagrins to monkeys, and innoculations by means of Sand-flies from Pellagrins to monkeys. Mr. W. T. Emery, a graduate student, is his associate in this work. Thus far no conclusive evidence has been found to associate the Sand-fly with this disease.

In the September number (Vol. I, No. 10) of the *Monthly Bulletin* of the California State Commission of Horticulture, there is published a Host Index to California Coccidæ, by C. F. Baker and E. O. Essig, and a list of the Noctuidæ of the state, as the second installment of the Check List of California Insects, by Prof. C. W. Woodworth. The first installment appeared in the June number (No. 7) of the same volume of the *Bulletin*.

It is reported that the Park Commissioner of New York City has decided to establish in the Swedish schoolhouse, Central Park, a school of entomology, where nature lovers of all ages may learn about the different orders of insects. The Entomologist of the park department, Dr. E. B. Southwick, will have charge of this school.

Dr. E. W. Berger, Entomologist, University of Florida, has recently been awarded a silver medal and a certificate of honor by the Royal Horticultural Society of London, England, for an exhibit of fungus parasites of scales and white-flies in Florida.

Mr. James Walker McColloch, a graduate of Kansas State Agricultural College, who for the past two years has been a special agent for the department of entomology of the Kansas State Agricultural Experiment Station, has been appointed Assistant Entomologist of the Kansas State Agricultural Experiment Station.

Dr. M. C. Tanquary, who for the past three years has been Assistant Entomologist under Doctor Forbes of Illinois and who received his doctor's degree this summer from Illinois University, has been appointed Instructor in Entomology in the Kansas State Agricultural College and Assistant Entomologist of the Kansas State Agricultural Experiment Station.

Prof. George A. Dean, Associate Professor of Entomology in the Kansas State Agricultural College and Associate Entomologist of the Kansas State Agricultural Experiment Station, is now State Entomologist for the northern half of Kansas, is Acting Entomologist for the Kansas State Agricultural Experiment Station and Acting head of the Department of Entomology in the Kansas State Agricultural College.

Herbert T. Osborn of the U. S. Bureau of Entomology, who has been stationed at Salt Lake City on investigations of the alfalfa weevil, has been granted a leave of absence for six months, and will devote the time to graduate work at Ohio State University.

On account of a considerable demand for a course in beekeeping, Prof. J. G. Sanders, Entomologist, will offer such a course in the Wisconsin College of Agriculture during the second semester. Wisconsin was the first to appoint a State apiary inspector, Mr. N. E. France, who has served continuously during the past fifteen years. An effort will be made to amend the present laws and obtain an increased appropriation during the coming winter.

A bill will probably be introduced into the next Legislature of Missouri, providing for the inspection of nurseries and orchards and for extension work in entomology and horticulture. Heretofore there has been no legislation covering these points, though the Station of its own accord has done considerable work. It is the desire of those having charge of such work at the College and Station at Columbia, Mo., to have the new laws adequately cover the situation containing the good features of similar laws in other states, and suggestions to that effect will be welcomed.

A reorganization has been effected in the Maryland College Station and the State Horticultural Department in charge of Prof. T. B. Symons, by which C. P. Smith, botany, J. F. Monroe, vegetable culture, L. L. Burrell, small fruits, and B. W. Anspon, floriculture and landscape gardening, have been added to the staff for teaching and for extension and demonstration work. The inspection and other field work will hereafter be done by men who have received a broader and more thorough training than has been the case in the past.

The New York State Collections of Insects have been removed to the recently completed and magnificent State Education Building, a thoroughly modern fireproof structure. This gives the State Entomologist enlarged quarters and much better facilities, there being an approximate trebling of both office and exhibition areas.

Mr. C. L. Marlatt, Assistant Chief Entomologist of the United States Department of Agriculture, recently visited the Hawaiian Islands, where he remained about a month arranging for an inspection service in connection with the quarantine recently established on account of the Mediterranean fruit fly. He is now in Washington but is planning to visit California during the winter.

Mr. A. J. Cook, state commissioner of horticulture, of California, has issued a quarantine order, under the approval of Acting Governor A. J. Wallace, against all vegetables, nursery stock, scions, grafts, buds, cuttings, orange seeds, trees, vines, plants and shrubs of all kinds from the states of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Texas and other sections known to be affected with *Aleyrodes citri* (Citrus white fly) or *Aleyrodes nubifera* (another species of white fly.)

Early in September the Governor of Kansas called upon Chancellor Strong of the University of Kansas, to appoint a research commission to investigate the cause of the plague among horses then prevalent in the western half of the state. Prof. S. J. Hunter, entomologist, was placed in charge and associated with him were Dr. W. K. Trimble, pathologist, Dr. A. L. Skoog, neurologist, Prof. N. P. Sherwood, bacteriologist. A complete laboratory was established at Ness City, for experimentation and post mortem studies. The cause of the disease was found to lie in the forage, and is apparently associated with moulds and parasitic fungi. This disease is known in veterinary literature as "Forage Poisoning." A botanical survey of this region by Mr. O. T. Wilson, of the Department of Botany has just been instituted, to determine if possible the specific toxin.

A convention of the Mosquito Extermination Commissioners of New Jersey was held at Newark, October 23. A law passed at the last session of the Legislature provided for a commission of six members in each county, and there are twelve such county commissions in New Jersey. All work is subject to the approval of the Director of the Agricultural Experiment Station, who is also charged with carrying out the provisions of the state law providing for the drainage of salt marshes. At the meeting addresses were made by Dr. Jacob G. Lipman, Director of the Station, Dr. T. J. Headlee, State Entomologist and Dr. L. O. Howard, Chief of the Bureau of Entomology at Washington.

At the meeting before the Federal Horticultural Board at Washington, D. C., on October 30, in relation to establishing a quarantine against the Gypsy and Brown-tail Moths, the following officials were present, representing their respective states: J. P. Buckley, Commissioner of Agriculture, Maine; Prof. W. C. O'Kane, State Nursery Inspector, New Hampshire; Dr. H. T. Fernald, State Nursery Inspector and F. W. Rane, State Forester, Massachusetts; A. E. Stene, State Nursery Inspector, Rhode Island; Dr. W. E. Britton, State Entomologist, Connecticut; Mr. G. G. Atwood, in charge of nursery inspection, and Mr. C. R. Pettis, State Superintendent of Forests, New York. Dr. L. O. Howard and Mr. D. M. Rogers of the Bureau of Entomology spoke briefly at the hearing and Assistant Secretary of Agriculture W. M. Hays was present. There was a good attendance of nurserymen from Massachusetts, Rhode Island and Connecticut, several of whom gave their views to the board.

Mr. Frederick Blanchard, a Coleopterist of note, died at his home in Tyngsboro, Mass., November 2, at the age of 69 years. For many years Mr. Blanchard was cashier of the Prescott National Bank of Lowell. He leaves a widow and one brother. Mr. Blanchard was always ready to identify the captures of amateur collectors in the order Coleoptera and will be greatly missed.

There are over 1,000 beekeepers in the State of Tennessee and an attempt will be made to obtain from the next legislature a larger appropriation for inspection of apiaries. On account of insufficient funds for the two years since the law went into effect, this work has been limited. Prof. G. M. Bentley, State Entomologist, has charge of the inspection work.

The public address of the Cleveland meeting of the Entomological Society of America will be given by Dr. Philip P. Calvert of the University of Pennsylvania, on Wednesday evening, January 1, at 8.00 p. m. His subject will be: An Entomologist in Costa Rica. He will give an account of a year spent in this entomologically very rich country, primarily for the study of the seasonal distribution, life-history and habits of Odonata, but including references to other groups of insects, characteristics of various collecting grounds and topics of general interest. It will be illustrated by lantern slides.

The following note will undoubtedly be of interest to many entomologists:

Mr. C. E. Hood carried a policy in an Accident Insurance Company at the time of his death in a motorcycle accident at Urbana, Illinois. The Company has refused to make settlement with the beneficiary, who has been compelled to bring suit. The plea made by the Company is that the policy was issued to Mr. Hood under Class A (preferred), and that it should have been under Class D (hazardous), "as the work of an entomologist is very hazardous." The application executed by Mr. Hood referred to his duties as "Agent and Expert, U. S. Department of Agriculture." It will be news to entomologists that their occupation is considered hazardous and the outcome of the suit will be watched with interest.

Mailed Dec. 16, 1912.

INDEX

IMPORTANT NOTICE TO ALL SUBSCRIBERS.

¶ All Subscribers are requested to notify the Business Manager if any change of Address is desired.

¶ The Mailing List is carefully prepared for each issue and each Subscriber is requested to immediately report any failure to receive the Journal. Unless such Notice is received from Subscribers in the United States within sixty days or from foreign Subscribers within ninety days from date of mailing the issues, the missing numbers will be furnished only at the regular published rate.

Why not recommend

"PYROX"

(Reg. U. S. Pat. Off.)

"Pyrox" will do more than arsenate of lead will do, for it not only destroys leaf-eating insects but checks blights, fungous diseases, etc.

"Pyrox" will do more than Bordeaux mixture will do, for it not only checks blights, fungous diseases, etc., but destroys all leaf-eating insects.

"Pyrox" is something more than a mere combination of arsenate of lead and Bordeaux. Copper salts are the basis of the fungicide, and arsenic is the basis of the poison, but "Pyrox" should not be confused with Bordeaux Lead. As it differs in composition so it differs in results, which are uniform and satisfactory.

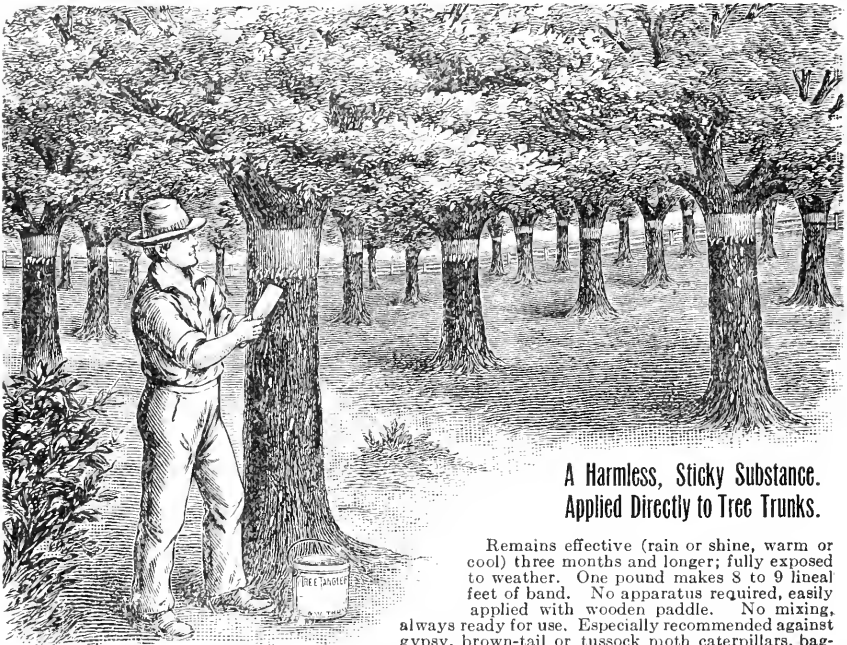
¶ Mechanically it is an exceedingly smooth, creamy paste which works up freely in water, and stays in suspension with very little agitation. It will cover much more foliage, and more thoroughly too, than other sprays because high pressure and very fine nozzles can be used without trouble from clogging.

"Pyrox" stands for the highest quality in mechanical and chemical excellence, and the results from using it are good fruit, good vegetables and pleased customers. You will be perfectly safe in recommending it.

BOWKER INSECTICIDE COMPANY

43 CHATHAM ST., : : : : BOSTON, MASS.

BAND YOUR TREES WITH TREE TANGLEFOOT



A Harmless, Sticky Substance.
Applied Directly to Tree Trunks.

Remains effective (rain or shine, warm or cool) three months and longer; fully exposed to weather. One pound makes 8 to 9 lineal feet of band. No apparatus required, easily applied with wooden paddle. No mixing, always ready for use. Especially recommended against gypsy, brown-tail or tussock moth caterpillars, bagworms, canker worms and climbing cutworms, although equally effective against any climbing pest. Don't wait until you see the insects—band your trees early.

(THAT SETTLES IT)

Price: One pound cans, 30c; 3-pound cans, 85c; 10-pound cans, $2.65; 20-pound cans, $4.80.

For sa'e by all reliable seed houses.

THE O. & W. THUM COMPANY **Grand Rapids, Mich.**

Manufacturers of Tanglefoot Fly Paper and Tree Tanglefoot. ☞ SEND FOR BOOKLET

EXCHANGES.

Exchanges or Wants of not over three lines will be inserted for 25 cents each to run as long as the space of this page will permit; the newer ones being added and the oldest being dropped as necessary. Send all notices and cash to A. F. Burgess, Melrose Highlands, Mass., by the 15th of the month preceding publication.

WANTED—Exp. Sta. Record, Vol. 3 No. 4 and Vol. 4 No. 5; Trans. of the Am. Ent. Soc. Vols. 2 and 3; Proc. of Ent. Soc. of Philadelphia, Vol. 2; Ann. Repts. Ent. Soc. of Ontario Nos. 2, 3, 7, 8; Papilo, Vol. 2 Nos. 2, 3 and 7, Vol. 3 No. 1. Will pay cash or exchange.

R. W. HARNED,
Agricultural College, Miss.

I offer in exchange for rare lepidoptera or coleoptera from the U. S. of N. A. specimens of the introduced species of Mantis—Tenodera sinensis; also, specimens of the rare beetle—Polyphylla variolosa.

Philip Laurent, 31 East Mt. Airy Ave., Philadelphia, Penn.

FOR SALE—The library of the late Frederic C. Pratt is in the hands of the undersigned for sale. It includes many rare experiment station bulletins, extracts from the Proceedings of the National Museum, and practically complete sets of the publications of the Bureau of Entomology. Price list will be furnished upon application, but it is suggested that persons who desire experiment station bulletins send lists of their desiderata immediately.

W. D. HUNTER,
P. O. Box 208, Dallas, Texas.

FOR SALE—$12.00—Arcana Entomologica, Westwood, J. O., London, 1845. 2 Vols., 96 Hand Colored Plates, perfect condition. Listed at 70m. ($17.00) by Felix Dames, List 107.

T. C. BARBER,
Audubon Park, New Orleans, La.

Will pay cash for the following numbers of Insect Life: Vol. IV, Nos. 3, 4 7, 8, 9 and 10; Vol. V, No. 5; Vol. VI, Nos. 1, 2, 3, 4 and 5.

C. W. COLLINS,
Bureau of Entomology, Gypsy Moth Parasite Laboratory,
Melrose Highlands, Mass.

WANTED—Will pay cash for Buls. 7, 8, 11, Tech. Ser. Bur. Ent. U. S. Dept. Agr.

H. A. GOSSARD,
Wooster, Ohio.

BACK NUMBERS WANTED.

Will pay 60 cents for No. 2, Volume I, and 30 cents each for No. 1 and No. 6, Volume II, No. 6, Volume III, and No. 2, Volume IV, to complete sets. Address:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS,
MELROSE HIGHLANDS, MASS.

FOR SALE—Bulletins 1 to 56 and 67 to 74 and circulars 1 to 67 of the Bureau of Entomology, all bound. Also bulletins 47 to 66 and from 75 to date and circular 68 to date unbound.

E. MEAD WILCOX, Lincoln, Nebraska.

WANTED—To buy, sell and exchange insects for demonstration and class work in economic entomology and bulletins and reports on all subjects from U. S. Department of Agriculture and Agricultural Experiment Stations, etc.

R. W. BRAUCHER, Kent, Ohio.

WANTED—Specimens of Calosoma beetles from all parts of the world. Write listing species that can be furnished.

A. F. BURGESS, Melrose Highlands, Mass.

Please mention the Journal of Economic Entomology when writing to advertisers.

JOURNAL

OF

ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN
AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

A bi-monthly journal, published February to December, on the 15th of the month, devoted to the interests of Economic Entomology and publishing the official notices and proceedings of the American Association of Economic Entomologists. Address business communications to the Journal of Economic Entomology, Railroad Square, Concord, N. H.

TERMS OF SUBSCRIPTION. In the United States, Cuba, Mexico and Canada, two dollars annually in advance. To foreign countries, two dollars and fifty cents ($2.50) annually in advance. Single copies, fifty cents. To members of the American Association of Economic Entomologists, one dollar annually in advance. 50 cents extra postage to foreign countries.

MANUSCRIPT for publication should be sent to the Editor, E. Porter Felt, Nassau, Rens. Co., N. Y.

CURRENT NOTES AND NEWS should be sent to the Associate Editor, W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

SUBSCRIPTIONS AND ADVERTISEMENTS may be sent to the Business Manager, A. F. Burgess, Melrose Highlands, Mass.