HARVARD UNIVERSITY

LIBRARY

OF THE

Museum of Comparative Zoology

13,895

PROCEEDINGS

OF THE

Indiana Academy of Science

1913

PROCEEDINGS

OF THE

Indiana Academy of Science

1913

H. E. BARNARD - - - - - - - - EDITOR

INDIANAPOLIS:
WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING
1914

TABLE OF CONTENTS.

CONSTITUTION.

ARTICLE I.

SECTION 1. This association shall be called the Indiana Academy of Science.

SEC. 2. The objects of this Academy shall be scientific research and the diffusion of knowledge concerning the various departments of science; to promote intercourse between men engaged in scientific work, especially in Indiana; to assist by investigation and discussion in developing and making known the material, educational and other resources and riches of the State; to arrange and prepare for publication such reports of investigation and discussions as may further the aims and objects of the Academy as set forth in these articles.

WHEREAS, The State has undertaken the publication of such proceedings, the Academy will, upon request of the Governor, or of one of the several departments of the State, through the Governor, act through its council as an advisory body in the direction and execution of any investigation within its province as stated. The necessary expenses incurred in the prosecution of such investigation are to be borne by the State; no pecuniary gain is to come to the Academy for its advice or direction of such investigation.

The regular proceedings of the Academy as published by the State shall become a public document.

ARTICLE II.

SECTION 1. Members of this Academy shall be honorary fellows, fellows, non-resident members or active members.

SEC. 2. Any person engaged in any department of scientific work, or in original research in any department of science, shall be eligible to active membership. Active members may be annual or life members. Annual members may be elected at any meeting of the Academy; they shall sign the constitution, pay an admission fee of two dollars and thereafter an annual fee of one dollar. Any person who shall at one time contribute fifty dollars to the funds of this Academy may be elected a life member of the Academy, free of assessment. Non-resident members may be elected from those who have been active members but who have removed from the State. In any case, a three-fourths vote of the members present shall elect to membership. Application for membership in any of the foregoing classes shall be referred to a committee on application for membership, who shall consider such application and report to the Academy before the election.

Sec. 3. The members who are actively engaged in scientific work, who have recognized standing as scientific men, and who have been members of the Academy at least one year, may be recommended for nomination for election as fellows by three fellows or members personally acquainted with their work and character. Of members so nominated a number not exceeding five in one year may, on recommendation of the Executive Committee, be elected as fellows. At the meeting at which this is adopted, the members of the Executive Committee for 1894 and fifteen others shall be elected fellows, and those now honorary members shall become honorary fellows. Honorary fellows may be elected on account of special prominence in science, on the written recommendation of two members of the Academy. In any case a three-fourths vote of the members present shall elect.

ARTICLE III.

Section 1. The officers of this Academy shall be chosen by ballot at the annual meeting, and shall hold office one year. They shall consist of a President, Vice-President, Secretary, Assistant Secretary, Press Secretary and Treasurer, who shall perform the duties usually pertaining to their respective offices and in addition, with the ex-presidents of the Academy, shall constitute an Executive Committee. The President shall, at each annual meeting, appoint two members to be a committee, which shall prepare the programs and have charge of the arrangements for all meetings for one year.

Sec. 2. The annual meeting of this Academy shall be held in the city of Indianapolis within the week following Christmas of each year, unless otherwise ordered by the Executive Committee. There shall also be a summer meeting at such time and place as may be decided upon by the Executive Committee. Other meetings may be called at the discretion of the Executive Committee. The past Presidents, together with the officers and Executive Committee, shall constitute the council of the Academy, and represent it in the transaction of any necessary business not especially provided for in this constitution, in the interim between general meetings.

Sec. 3. This constitution may be altered or amended at any annual meeting by a three-fourths majority of the attending members of at least one year's standing. No question of amendment shall be decided on the day of its presentation.

BY-LAWS.

1. On motion, any special department of science shall be assigned to a curator, whose duty it shall be, with the assistance of the other members interested in the same department, to endeavor to advance knowledge in that particular department. Each curator shall report at such time and place as the Academy shall direct. These reports shall include a brief summary of the progress of the department during the year preceding the presentation of the report.

2. The President shall deliver a public address on the morning of one of the days of the meeting at the expiration of his term of office.

3. The Press Secretary shall attend to the securing of proper newspaper reports of the meetings and assist the Secretary.

4. No special meeting of the Academy shall be held without a notice of the same having been sent to the address of each member at least fifteen days before such meeting.

5. No bill against the Academy shall be paid without an order signed by the President and countersigned by the Secretary.

6. Members who shall allow their dues to remain unpaid for two years, having been annually notified of their arrearage by the Treasurer, shall have their names stricken from the roll.

7. Ten members shall constitute a quorum for the transaction of business.

AN ACT TO PROVIDE FOR THE PUBLICATION OF THE REPORTS AND PAPERS OF THE INDIANA ACADEMY OF SCIENCE.

[Approved March 11, 1895.]

Whereas, The Indiana Academy of Science, a chartered scientific association, has embodied in its constitution a provision that it will, upon the request of the Governor, or of the several departments of the State government, through the Governor, and through its council as an advisory board, assist in the direction and execution of any investigation within its province, without pecuniary gain to the Academy, provided only that the necessary expenses of such investigation are borne by the State; and,

WHEREAS, The reports of the meetings of said Academy, with the several papers read before it, have very great educational, industrial and economic value, and should be preserved in permanent form: and

WHEREAS, The Constitution of the State makes it the duty of the General Assembly to encourage by all suitable means intellectual, scientific and agricultural improvement; therefore,

SECTION 1. *Be it enacted by the General Assembly of the State of Indiana*, That hereafter the annual reports of the meetings of the Indiana Academy of Science, beginning with the report for the year 1894, including all papers of scientific or economic value, presented at such meetings, after they shall have been edited and prepared for publication as hereinafter provided, shall be published by and under the direction of the Commissioners of Public Printing and Binding.

SEC. 2. Said reports shall be edited and prepared for publication without expense to the State, by a corps of editors to be selected and appointed by the Indiana Academy of Science, who shall not, by reason of such service, have any claim against the State for compensation. The form, style of binding, paper, typography and manner and extent of illustration of such reports shall be determined by the editors, subject to the approval of the Commissioners of Public Printing and Stationery. Not less than 1,500 nor more than 3,000 copies of each of said reports shall be published, the size of the edition within said limits to be determined by the concurrent action of the editors and the Commissioners of Public Printing and Stationery: *Provided*, That not to exceed six hundred dollars ($600) shall be expended for such publication in any one year, and not to extend beyond 1896: *Provided*, That no sums shall be deemed to be appropriated for the year 1894.

SEC. 3. All except three hundred copies of each volume of said reports shall be placed in the custody of the State Librarian, who shall furnish one copy thereof to each public library in the State, one copy to each university, college or normal school in the State, one copy to each high school in the State having a library, which shall make application therefor, and one copy to such other institutions, societies or persons as may be designated by the

Academy through its editors or its council. The remaining three hundred copies shall be turned over to the Academy to be disposed of as it may determine. In order to provide for the preservation of the same it shall be the duty of the Custodian of the State House to provide and place at the disposal of the Academy one of the unoccupied rooms of the State House, to be designated as the office of the Academy of Science, wherein said copies of said reports belonging to the Academy, together with the original manuscripts, drawings, etc., thereof can be safely kept, and he shall also equip the same with the necessary shelving and furniture.

SEC. 4. An emergency is hereby declared to exist for the immediate taking effect of this act, and it shall therefore take effect and be in force from and after its passage.

APPROPRIATION FOR 1913-1914.

The appropriation for the publication of the proceedings of the Academy during the years 1913 and 1914 was increased by the Legislature in the General Appropriation bill, approved March 9, 1909. That portion of the law fixing the amount of the appropriation for the Academy is herewith given in full:

For the Academy of Science: For the printing of the proceedings of the Indiana Academy of Science twelve hundred dollars: *Provided*, That any unexpended balance in 1913 shall be available in 1914, and that any unexpended balance in 1914 shall be available in 1915.

AN ACT FOR THE PROTECTION OF BIRDS, THEIR NESTS AND EGGS.

SEC. 602. Whoever kills, traps or has in his possession any wild bird, or whoever sells or offers the same for sale, or whoever destroys the nest or eggs of any wild bird, shall be deemed guilty of a misdemeanor and upon conviction thereof shall be fined not less than ten dollars nor more than twenty-five dollars: *Provided*, That the provisions of this section shall not apply to the following named game birds: The Anatidae, commonly called swans, geese, brant, river and sea duck; the Rallidae, commonly called rails, coots, mud-hens, gallinules; the Limicolae, commonly called shore birds, surf birds, plover, snipe, woodcock, sandpipers, tattlers and curlew; the Gallinae, commonly called wild turkeys, grouse, prairie chickens, quails and pheasants; nor to English or European house sparrows, crows, hawks or other birds of prey. Nor shall this section apply to persons taking birds, their nests or eggs, for scientific purposes, under permit, as provided in the next section.

SEC. 603. Permits may be granted by the Commissioner of Fisheries and Game to any properly accredited person, permitting the holder thereof to collect birds, their nests or eggs for strictly scientific purposes. In order to obtain such permit the applicant for the same must present to such Commissioner written testimonials from two well-known scientific men certifying to the good character and fitness of such applicant to be entrusted with such privilege, and pay to such Commissioner one dollar therefor and file with him a properly executed bond in the sum of two hundred dollars, payable to the State of Indiana, conditioned that he will obey the terms of such permit, and signed by at least two responsible citizens of the State as sureties. The bond may be forfeited, and the permit revoked upon proof to the satisfaction of such Commissioner that the holder of such permit has killed any bird or taken the nest or eggs of any bird for any other purpose than that named in this section.

PUBLIC OFFENSES—HUNTING WILD BIRDS—PENALTY.

[Approved March 13, 1913.]

SECTION 1. *Be it enacted by the General Assembly of the State of Indiana*, That section six (6) of the above entitled act be amended to read as follows: Section 6. That section six hundred two (602) of the above entitled act be amended to read as follows: Section 602. It shall be unlawful for any person to kill, trap or possess any wild bird, or to purchase or offer the same for sale, or to destroy the nest or eggs of any wild bird, except as otherwise provided in this section. But this section shall not apply to the following named game birds: The Anatidæ, commonly called swans, geese, brant, river and sea duck; the Rallidæ, commonly known as rails, coots, mud-hens and gallinules; the Limicolæ, commonly known as shore birds, plovers, surf birds, snipe, woodcock, sandpipers, tattlers and curlews; the Gallinæ, commonly called wild turkeys, grouse, prairie chickens, quails, and pheasants; nor to English or European house sparrows, blackbirds, crows, hawks or other birds of prey. Nor shall this section apply to any person taking birds or their nests or eggs for scientific purposes under permit as provided in the next section. Any person violating the provisions of this section shall, on conviction, be fined not less than ten dollars ($10.00) nor more than fifty dollars ($50.00).

Indiana Academy of Science.

Officers, 1913–1914.

President,
Severance Burrage.

Vice-President,
A. L. Foley.

Secretary,
Andrew J. Bigney.

Assistant Secretary,
H. E. Enders.

Press Secretary,
Frank B. Wade.

Treasurer,
W. A. Cogshall.

Editor,
H. E. Barnard.

Executive Committee:

Arthur, J. C.,
Bigney, A. J.,
Blatchley, W. S.,
Bodine, Donaldson,
Branner, J. C.,
Burrage, Severance,
Butler, Amos W.,
Cogshall, W. A.,
Coulter, John M.,
Coulter, Stanley,
Culbertson, Glenn,
Dryer, Chas. R.,
Eigenmann, C. H.,
Evans, P. N.,
Dennis, D. W.,
Foley, A. L.,
Hay, O. P.,
Hessler, Robert,
John, J. P. D.,
Jordan, D. S.,
Mees, Carl L.,
Moenkhaus, W. J.,
Mottier, David M.,
Mendenhall, T. C.,
Naylor, Joseph P.,
Noyes, W. A.,
Stuart, Milo H.,
Wade, F. B.,
Waldo, C. A.,
Wiley, H. W.,
Williamson, E. B.,
Wright, John S.,

Curators:

Botany	J. C. Arthur.
Entomology	W. S. Blatchley.
Herpetology, Mammalogy, Ornithology	A. W. Butler.
Ichthyology	H. C. Eigenmann.

Committees Academy of Science, 1914.

Program.

John S. Wright, Indianapolis
Chas. Stoltz, South Bend
W. M. Blanchard, Greencastle

Membership.

F. M. Andrews, Bloomington
A. M. Kenyon, Lafayette
Fred Miller, Indianapolis

Nominations.

Donaldson Bodine, Crawfordsville
J. W. Beede, Bloomington
Edwin Morrison, Richmond

Auditing.

John C. Dean, Indianapolis
L. J. Rettger, Terre Haute

State Library.

W. S. Blatchley, Indianapolis
Stanley Coulter, Lafayette
Amos W. Butler, Indianapolis

Restriction of Weeds and Diseases.

J. C. Arthur, Lafayette
Robert Hessler, Logansport
J. N. Hurty, Indianapolis
Stanley Coulter, Lafayette
D. M. Mottier, Bloomington

Biological Survey.

C. C. Deam, Bluffton
Will Scott, Bloomington
Geo. N. Hoffer, Lafayette
U. O. Cox, Terre Haute
J. A. Nieuwland, Notre Dame

Academy to State.

R. W. McBride, Indianapolis
Glenn Culbertson, Hanover
H. E. Barnard, Indianapolis
Amos W. Butler, Indianapolis
W. W. Woolen, Indianapolis

Distribution of Proceedings.

A. J. Bigney, Moores Hill
Amos W. Butler, Indianapolis
P. N. Evans, Lafayette
D. M. Mottier, Bloomington
John S. Wright, Indianapolis

Publication of Proceedings.

H. E. Barnard, Editor, Indianapolis
C. M. Hilliard, Lafayette
F. B. Wade, Indianapolis
C. R. Dryer, Terre Haute
M. K. Haggerty, Bloomington

OFFICERS OF THE INDIANA ACADEMY OF SCIENCE.

Years.	President.	Secretary.	Asst. Secretary.	Press Secretary.	Treasurer.
1885–1886	David S. Jordan	Amos W. Butler			O. P. Jenkins.
1886–1887	John M. Coulter	Amos W. Butler			O. P. Jenkins.
1887–1888	J. P. D. John	Amos W. Butler			O. P. Jenkins.
1888–1889	John C. Branner	Amos W. Butler			O. P. Jenkins.
1889–1890	T. C. Mendenhall	Amos W. Butler			O. P. Jenkins.
1890–1891	O. P. Hay	Amos W. Butler			O. P. Jenkins.
1891–1892	J. L. Campbell	Amos W. Butler			C. A. Waldo.
1892–1893	J. C. Arthur	Amos W. Butler	Stanley Coulter W. W. Norman		C. A. Waldo.
1893–1894	W. A. Noyes	C. A. Waldo	W. W. Norman		W. P. Shannon.
1894–1895	A. W. Butler	John S. Wright	A. J. Bigney		W. P. Shannon.
1895–1896	Stanley Coulter	John S. Wright	A. J. Bigney		W. P. Shannon.
1896–1897	Thomas Gray	John S. Wright	A. J. Bigney		W. P. Shannon.
1897–1898	C. A. Waldo	John S. Wright	A. J. Bigney	Geo. W. Benton	J. T. Scovell.
1898–1899	C. H. Eigenmann	John S. Wright	E. A. Schultze	Geo. W. Benton	J. T. Scovell.
1899–1900	D. W. Dennis	John S. Wright	E. A. Schultze	Geo. W. Benton	J. T. Scovell.
1900–1901	M. B. Thomas	John S. Wright	E. A. Schultze	Geo. W. Benton	J. T. Scovell.
1901–1902	Harvey W. Wiley	John S. Wright	Donaldson Bodine.	Geo. W. Benton	J. T. Scovell.
1902–1902	W. S. Blatchley	John S. Wright	Donaldson Bodine.	G. A. Abbott	W. A. McBeth.
1903–1904	C. L. Mees	John S. Wright	J. H. Ransom	G. A. Abbott	W. A. McBeth.
1904–1905	John S. Wright	Lynn B. McMullen	J. H. Ransom	G. A. Abbott	W. A. McBeth.
1905–1906	Robert Hessler	Lynn B. McMullen	J. H. Ransom	Charles R. Clark	W. A. McBeth.
1906–1907	D. M. Mottier	Lynn B. McMullen	J. H. Ransom	G. A. Abbott	W. A. McBeth.
1907–1908	Glenn Culbertson	J. H. Ransom	A. J. Bigney	G. A. Abbott	W. A. McBeth.
1908–1909	A. L. Foley	J. H. Ransom	A. J. Bigney	G. A. Abbott	W. A. McBeth.
1909–1910	P. N. Evans	Geo. W. Benton	A. J. Bigney	John W. Woodhams.	W. J. Moenkhaus.
1910–1911	C. R. Dryer	A. J. Bigney	E. B. Williamson	Milo H. Stuart	W. J. Moenkhaus.
1911–1912	J. P. Naylor	A. J. Bigney	E. B. Williamson	Milo H. Stuart	W. J. Moenkhaus.
1912–1913	Donaldson Bodine	A. J. Bigney	C. M. Smith	F. B. Wade	W. J. Moenkhaus.
1913–1914	Severance Burrage	A. J. Bigney	H. E. Enders	F. B. Wade	W. A. Cogshall.

MEMBERS.*

FELLOWS.

††Abbott, G. A., Grand Forks, N. Dak. ....†1908
Professor of Chemistry, University of North Dakota.
Chemistry.

Aley, Robert J., Orono, Me. 1898
President of University of Maine.
Mathematics and General Science.

Anderson, H. W., 1 Mills Place, Crawfordsville, Ind. 1912
Professor of Botany, Wabash College.
Botany.

Andrews, F. M., 744 E. Third St., Bloomington, Ind. 1911
Assistant Professor of Botany, Indiana University.
Botany.

Arthur, Joseph C., 915 Columbia St., Lafayette, Ind. 1894
Professor of Vegetable Physiology and Pathology, Purdue University.
Botany.

Barnard, H. E., Room 20, State House, Indianapolis, Ind. 1910
Chemist to Indiana State Board of Health.
Chemistry, Sanitary Science, Pure Foods.

Beede, Joshua W., cor. Wall and Atwater Sts., Bloomington, Ind. 1906
Associate Professor of Geology, Indiana University.
Stratigraphic Geology, Physiography.

Benton, George W., 100 Washington Square, New York, N. Y. 1896
With the American Book Company.

*Every effort has been made to obtain the correct address and occupation of each member, and to learn what line of science he is interested in. The first line contains the name and address; the second line the occupation; the third line the branch of science in which he is interested. The omission of an address indicates that mail addressed to the last printed address was returned as uncalled for. Information as to the present address of members so indicated is requested by the secretary. The custom of dividing the list of members has been followed.

† Date of election.

†† Non-resident.

Bigney, Andrew J., Moores Hill, Ind. 1897
Vice-President and Professor of Biology and Geology, Moores Hill College.
Biology and Geology.

Bitting, Catharine Golden, Washington, D. C. 1895
Microscopic Expert, Pure Food, National Canners Laboratory.
Botany.

Blatchley, W. S., 1558 Park Ave., Indianapolis, Ind. 1893
Naturalist.
Botany, Entomology and Geology.

Bodine, Donaldson, Four Mills Place, Crawfordsville, Ind. 1899
Professor of Geology and Zoology, Wabash College.
Entomology and Geology.

Breeze, Fred J., care American Book Company, New York, N. Y. 1910
With the American Book Company.
Geography.

Bruner, Harry Lane, 324 S. Ritter Ave., Indianapolis, Ind. 1899
Professor of Biology, Butler College.
Comparative Anatomy, Zoology.

Burrage, Severance, care Eli Lilly Co., Indianapolis, Ind. 1898
Charge of Biological Laboratory, Eli Lilly Co.
Bacteriology, Sanitary Science.

Butler, Amos W., 52 Downey, Ave., Irvington, Ind. 1893
Secretary, Indiana Board of State Charities.
Vertebrate Zoology, Anthropology, Sociology.

Cogshall, Wilbur A., 423 S. Fess Ave., Bloomington, Ind. 1906
Associate Professor of Astronomy, Indiana University.
Astronomy and Physics.

Cook, Mel T., New Brunswick, N. J. 1902
Professor of Plant Pathology, Rutgers College.
Botany, Plant Pathology, Entomology.

Coulter, John M., care University of Chicago, Chicago, Ill. 1893
Head Department of Botany, Chicago University.
Botany.

Coulter, Stanley, 213 S. Ninth St., Lafayette, Ind. 1893
Dean School of Science, Purdue University.
Botany, Forestry.

Cox, Ulysses O., P. O. Box 81, Terre Haute, Ind. 1908
Head Department Zoology and Botany, Indiana State Normal.
Botany, Zoology.

Culbertson, Glenn, Hanover, Ind. 1899
Chair Geology, Physics and Astronomy, Hanover College.
Geology.

Cumings, Edgar Roscoe, 327 E. Second St., Bloomington, Ind. 1906
Professor of Geology, Indiana University.
Geology, Paleontology.

Davisson, Schuyler Colfax, Bloomington, Ind. 1908
Professor of Mathematics, Indiana University.
Mathematics.

Deam, Charles C., Bluffton, Ind. 1910
Druggist.
Botany.

Dennis, David Worth, Richmond, Ind. 1895
Professor of Biology, Earlham College.
Biology.

Dryer, Charles R., 35 Gilbert Ave., Terre Haute, Ind. 1897
Professor of Geography and Geology, Indiana State Normal.
Geography, Geology.

Eigenmann, Carl H., 630 Atwater St., Bloomington, Ind. 1893
Professor Zoology, Dean of Graduate School, Indiana University.
Embryology, Degeneration, Heredity, Evolution and Distribution of American Fish.

Enders, Howard Edwin, 105 Quincy St., Lafayette, Ind. 1912
Associate Professor of Zoology, Purdue University.
Zoology.

Evans, Percy Norton, Lafayette, Ind. 1901
Director of Chemical Laboratory, Purdue University.
Chemistry.

Foley, Arthur L., Bloomington, Ind. 1897
Head Department of Physics, Indiana University.
Physics.

Golden, M. J., Lafayette, Ind. 1899
Director of Laboratories of Practical Mechanics, Purdue University.
Mechanics.

††Goss, William Freeman M., Urbana, Ill. 1893
Dean of College of Engineering, University of Illinois.

Haggerty, M. E., Bloomington, Ind. 1913

Hathaway, Arthur S., 2206 N. Tenth St., Terre Haute, Ind. 1895
Professor of Mathematics, Rose Polytechnic Institute.
Mathematics, Physics.

Hessler, Robert, Logansport, Ind. 1899
Physician.
Biology.

Hilliard, C. M., Lafayette, Ind. 1913

Hoffer, Geo. N., West Lafayette, Ind. 1913

Hurty, J. N., Indianapolis, Ind. 1910
Secretary, Indiana State Board of Health.
Sanitary Science, Vital Statistics, Eugenics.

†Huston, H. A., New York City 1893

Kern, Frank D., State College, Pa. 1912
Professor of Botany, Pennsylvania State College.
Botany.

Lyons, Robert E., 630 E. Third St., Bloomington, Ind. 1896
Head of Department of Chemistry, Indiana University.
Organic and Biological Chemistry.

McBeth, William A., 1905 N. Eighth St., Terre Haute, Ind. 1904
Assistant Professor Geography, Indiana State Normal.
Geography, Geology, Scientific Agriculture.

†Marsters, V. F., Santiago, Chile 1893

Mees, C. L., Terre Haute, Ind. 1894
President of Rose Polytechnic Institute.

†Miller, John Anthony, Swarthmore, Pa. 1904
Professor of Mathematics and Astronomy, Swarthmore College.
Astronomy, Mathematics.

Moenkhaus, William J., 501 Fess Ave., Bloomington, Ind. 1901
Professor of Physiology, Indiana University.
Physiology.

Moore, Richard B., Denver, Colo. 1893
With U. S. Bureau of Mines.
Chemistry, Radio-activity.

Mottier, David M., 215 Forest Place, Bloomington, Ind. 1893
Professor of Botany, Indiana University.
Morphology, Cytology.

Naylor, J. P., Greencastle, Ind. 1903
Professor of Physics, Depauw University.
Physics, Mathematics.

†Noyes, William Albert, Urbana, Ill. 1893
Director of Chemical Laboratory, University of Illinois.
Chemistry.

Pohlman, Augustus G., 1100 E. Second St., Bloomington, Ind. 1911
Professor of Anatomy, Indiana University.
Embryology, Comparative Anatomy.

Ramsey, Rolla R., 615 E. Third St., Bloomington, Ind. 1906
Associate Professor of Physics, Indiana University.
Physics.

Ransom, James H., 323 University St., West Lafayette, Ind. 1902
Professor of General Chemistry, Purdue University.
General Chemistry, Organic Chemistry, Teaching.

Rettger, Louis J., 31 Gilbert Ave., Terre Haute, Ind. 1896
Professor of Physiology, Indiana State Normal.
Animal Physiology.

Rothrock, David A., Bloomington, Ind. 1906
Professor of Mathematics, Indiana University.
Mathematics.

Scott, Will, 731 Atwater St., Bloomington, Ind. 1911
Assistant Professor of Zoology, Indiana University.
Zoology, Lake Problems.

Shannon, Charles W., Norman, Okla. 1912
With Oklahoma State Geological Survey.
Soil Survey, Botany.

Smith, Albert, 1022 Seventh St., West Lafayette. 1908
Professor of Structural Engineering.
Physics, Mechanics.

††Smith, Alexander, care Columbia University, New York, N. Y. 1893
Head of Department of Chemistry, Columbia University.
Chemistry.

Smith, Charles Marquis, 910 S. Ninth St., Lafayette, Ind. 1912
Professor of Physics, Purdue University.
Physics.

Stone Winthrop E., Lafayette, Ind. 1893
President of Purdue University.
Chemistry.

††Swain, Joseph, Swarthmore, Pa. 1898
President of Swarthmore College.
Science of Administration.

Van Hook, James M., 639 N. College Ave., Bloomington, Ind. 1911
Assistant Professor of Botany, Indiana University.
Botany.

††Waldo, Clarence A., care Washington University, St. Louis, Mo. 1893
Thayer Professor Mathematics and Applied Mechanics, Washington University.
Mathematics, Mechanics, Geology and Mineralogy.

††Webster, F. M., Kensington, Md. 1894
Entomologist, U. S. Department of Agriculture, Washington, D. C.
Entomology.

Westlund, Jacob, 439 Salisbury St., West Lafayette, Ind. 1904
Professor of Mathematics, Purdue University.
Mathematics.

Wiley, Harvey W., Cosmos Club, Washington, D. C. 1895
Professor of Agricultural Chemistry, George Washington University.
Biological and Agricultural Chemistry.

Woollen, William Watson, Indianapolis, Ind. 1908
Lawyer.
Birds and Nature Study.

Wright, John S., care Eli Lilly Co., Indianapolis, Ind. 1894
Manager of Advertising Department, Eli Lilly Co.
Botany.

NON-RESIDENT MEMBERS.

Ashley, George H., Washington, D. C.

Branner, John Casper, Stanford University, California.
Vice-President of Stanford University, and Professor of Geology.
Geology.

Brannon, Melvin A., 207 Chestnut St., Grand Forks, N. D.
Professor of Botany.
Plant Breeding.

Campbell, D. H., Stanford University, California.
Professor of Botany, Stanford University.
Botany.

Clark, Howard Walton, U. S. Biological Station, Fairport, Iowa.
Scientific Assistant, U. S. Bureau of Fisheries.
Botany, Zoology.

Dorner, H. B., Urbana, Illinois.
Assistant Professor of Floriculture.
Botany, Floriculture.

Duff, A. Wilmer, 43 Harvard St., Worcester, Mass.
Professor of Physics, Worcester Polytechnic Institute.
Physics.

Evermann, Barton Warren, Bureau of Fisheries, Washington, D. C.
Chief, Alaska Fisheries Service
Zoology.

Fiske, W. A.

Garrett, Chas. W., Room 718, Pennsylvania Station, Pittsburgh, Pa.
Librarian, Pennsylvania Lines West of Pittsburgh.
Entomology, Sanitary Sciences.

Gilbert, Charles H., Stanford Universty, California.
Professor of Zoology, Stanford University.
Ichthyology.

Greene, Charles Wilson, 814 Virginia Ave., Columbia, Mo.
Professor of Physiology and Pharmacology, University of Missour
Physiology, Zoology.

Hargitt, Chas. W., 909 Walnut Ave., Syracuse, N. Y.
Professor of Zoology, Syracuse University.
Hygiene, Embryology, Eugenics, Animal Behavior.

Hay, Oliver Perry, U. S. National Museum, Washington, D. C.
Research Associate, Carnegie Institution of Washington.
Vertebrate Paleontology, especially that of the Pleistocene Epoch.

Hughes, Edward, Stockton, California.

Jenkins, Oliver P., Stanford University, California.
Professor of Physiology, Stanford University.
Physiology, Histology.

Jordan, David Starr, Stanford University, California.
President of Stanford University.
Fish, Eugenics, Botany, Evolution.

Kingsley, J. S., Tufts College, Massachusetts.
Professor of Zoology, Tufts College.
Zoology.

Knipp, Charles T., 913 W. Nevada St., Urbana, Illinois.
Assistant Professor of Physics, University of Illinois.
Physics, Discharge of Electricity thru Gases.

MacDougal, Daniel Trembly, Tucson, Arizona.
Director, Department of Botanical Research, Carnegie Institute, Washington, D. C.
Botany.

McMullen, Lynn Banks, State Normal School, Valley City, North Dakota.
Head Science Department, State Normal School.
Physics, Chemistry.

Mendenhall, Thomas Corwin, Ravenna, Ohio.
Retired.
Physics, "Engineering," Mathematics, Astronomy.

Newsom, J. F., Palo Alto, California.
Mining Engineer.

Purdue, Albert Homer, State Geological Survey, Nashville, Tenn.
State Geologist of Tennessee.
Geology.

Reagan, A. B., Nett Lake School, Nett Lake, Minnesota.
Superintendent and Special Distribution Agent, Indian Service.
Geology, Paleontology, Ethnology.

Slonaker, James Rollin, 334 Kingsley Ave., Palo Alto, California.
Assistant Professor of Physiology, Stanford University.
Physiology, Zoology.

Springer, Alfred, 312 East 2d St., Cincinnati, Ohio.
Chemist.
Chemistry.

ACTIVE MEMBERS.

Allen, William Ray, Bloomington, Ind.

Allison, Evelyn, Lafayette, Ind.
Care Agricultural Experiment Station.
Botany.

Baine, H. Foster, 420 Market St., San Francisco, Cal.
Editor, Mining and Scientific Press.

Baker, Walter D., N. Illinois St. Indianapolis, Ind.
Care Waldcraft Co.
Chemistry.

Baker, Walter M., Amboy.
Superintendent of Schools.
Mathematics and Physics.

Banker, Howard J., 306 Hanna St., Greencastle.
Professor of Biology, DePauw University.
Botany.

Barcus, H. H., Indianapolis.
Instructor, Mathematics, Shortridge High School.

Barr, Harry L., Waveland.
Student.
Botany and Forestry.

Barrett, Edward, Indianapolis.
State Geologist.
Geology, Soil Survey.

Bates, W. H., 306 Russell St., West Lafayette
Associate Professor, Mathematics.

Bell, Guido, 431 E. Ohio St., Indianapolis.
Physician.

Bellamy, Ray, Worcester, Mass.

Bennett, Lee F., 825 Laporte Ave., Valparaiso.
Professor of Geology and Zoology, Valparaiso University.
Geology, Zoology.

Bishop, Harry Eldridge, 1706 College Ave., Indianapolis.
Food Chemist, Indiana State Board of Health.

Blanchard, William M., 1008 S. College Ave., Greencastle.
Professor of Chemistry, DePauw University.
Organic Chemistry.

Bond, Charles S., 112 N. Tenth St. Richmond.
Physician.
Biology, Bacteriology, Physical Diagnosis and Photomicrography.

Bourke, A. Adolphus, 1103 Cottage Ave., Columbus.
Instructor, Physics, Zoology and Geography.
Botany, Physics.

Brossmann, Charles, 1616 Merchants Bank Bldg., Indianapolis.
Consulting Engineer.
Water Supply, Sewage Disposal, Sanitary Engineering, etc.

Brown, James, 5372 E. Washington St., Indianapolis.
Professor of Chemistry, Butler College.
Chemistry.

Brown, Hugh E., Bloomington, Ind.

Bruce, Edwin M., 2401 North Ninth St., Terre Haute.
Assistant Professor of Physics and Chemistry, Indiana State Normal.
Chemistry, Physics.

Bryan, William Lowe, Bloomington.
President, Indiana University.
Psychology.

Bybee, Halbert P., Bloomington.
Graduate Student, Indiana University.
Geology.

Canis, Edward N., 2221 Park Ave., Indianapolis.
Officeman with William B. Burford.
Botany, Psychology.

Carmichael, R. D., Bloomington.
Assistant Professor of Mathematics, Indiana University.
Mathematics.

Caswell, Albert E., Lafayette.
Instructor in Physics, Purdue University.
Physics and Applied Mathematics.

Chansler, Elias J., Bicknell.
Farmer.
Ornithology and Mammals.

Clarke, Elton Russell, Indianapolis.

Clark, Jediah H., 126 East Fourth St., Connersville.
Physician.
Medicine.

Conner, S. D., West Lafayette.

Cox, William Clifford.

Crowell, Melvin E., 648 E. Monroe St., Franklin.
Dean of Franklin College.
Chemistry and Physics.

Cutter, George, Broad Branch Road, Washington, D. C.
Retired Manufacturer of Electrical Supplies.
Conchology.

Daniels, Lorenzo E., Rolling Prairie.
Retired Farmer.
Conchology.

Davs, Melvin K., Anderson.
Instructor, Anderson High School.
Physiography, Geology, Climatology.

Deppe, C. R., Franklin.

Dietz, Harry F., 108 W. Twenty-eighth St., Indianapolis.
Deputy State Entomologist.
Entomology, Eugenics, Parasitology, Plant Pathology.

Dolan, Jos. P., Syracuse.

Drew, David Abbott, 817 East Second St., Bloomington.
Instructor in Mechanics and Astronomy.
Astronomy, Mechanics, Mathematics and Applied Mathematics.

DuBois, Henry, Bloomington, Ind.

Duden, Hans A., 5050 E. Washington St., Indianapolis.
Analytical Chemist.
Chemistry.

Dutcher, J. B., Bloomington.
Assistant Professor of Physics, Indiana University.
Physics.

Earp, Samuel E., 24½ Kentucky Ave., Indianapolis.
Physician.

Easley, Mary, Bloomington, Ind.

Edmonston, Clarence E., Bloomington.
Graduate Student, Physiology, Indiana University.
Physiology.

Ellis, Max Mapes, Boulder, Colo.
Instructor in Biology, University of Colorado.
Biology, Entomology.

Evans, Samuel G., 1452 Upper Second St., Evansville.
Merchant.
Botany, Ornithology.

Ewers, James E., Terre Haute.
Instructor in High School.
Geology.

Felver, William P., 325½ Market St., Logansport.
Railroad Clerk.
Geology, Chemistry.

Fisher, Martin L., Lafayette.
Professor of Crop Production, Purdue University.
Agriculture, Soils and Crops, Birds, Botany.

Frier, George M., Lafayette.
Assistant Superintendent, Agricultural Experiment Station, Purdue University.
Botany, Zoology, Entomology, Ornithology, Geology.

Fuller, Frederick D., 213 Russell St., West Lafayette.
Chief Deputy State Chemist, Purdue Experiment Station.
Chemistry, Microscopy.

Funk, Austin, 401 Spring St., Jeffersonville.
Physician.
Diseases of Eye, Ear, Nose and Throat.

Galloway, Jesse James, Bloomington.
Instruction, Indiana University.
Geology, Paleontology.

Gates, Florence A., 416 Irving St., Toledo, Ohio.
Teacher of Botany.
Botany and Zoology.

Gillum, Robert G., Terre Haute, Ind.

Glenn, E. R., 535 North Walnut St., Bloomington.
Instructor in Physics, Bloomington High School.
Physics.

Gottlieb, Frederic W., Morristown.
Care Museum of Natural History. Assistant Curator, Moores Hill College.
Archaeology, Ethnology.

Grantham, Guy E., 437 Vine St., West Lafayette.
Instructor in Physics, Purdue University.

Greene, Frank C., Missouri Bureau of Geology and Mines, Rolla, Mo.
Geologist.
Geology.

Grimes, Earl J., Russellville.
Care U. S. Soil Survey
Botany, Soil Survey.

Harding, C. Francis, 111 Fowler Ave., West Lafayette.
Professor of Electrical Engineering, Purdue University.
Mathematics, Physics, Chemistry.

Harman, Mary T., 611 Laramie St., Manhattan, Kansas.
Instructor in Zoology, Kansas State Agricultural College.
Zoology.

Harvey, R. B., Indianapolis.

Heimburger, Harry V., 701 West Washington St., Urbana, Ill.
Assistant in Zoology, University of Illinois.

Hendricks, Victor K., 855 Benton Ave., Springfield, Mo.
Assistant Chief Engineer, St. L. & S. F. R. R.
Civil Engineering and Wood Preservation.

Hennel, Cora, Bloomington, Ind.

Hennel, Edith A., Bloomington, Ind.

Hetherington, John P., 418 Fourth St., Logansport.
Physician.
Medicine, Surgery, X-Ray, Electro-Therapeutics.

Hinman, J. J., Jr., University of Iowa, Iowa City, Ia.
Chemist, Dept. Public Health and Hygiene.
Chemistry.

Hole, Allen D., Richmond.
Instructor, Earlham College.

Hubbard, Lucius M., South Bend.
Lawyer.

Hufford, Mason E., Bloomington, Ind.

Hutton, Joseph Gladden, Brookings, South Dakota.
Associate Professor of Agronomy, State College.
Agronomy, Geology.

Hyde, Roscoe Raymond, Terre Haute.
Assistant Professor, Physiology and Zology, Indiana State Normal.
Zoology, Physiology, Bacteriology.

Ibison, Harry M., Marion.
Instructor in Science, Marion High School.

Jackson, D. E., St. Louis, Mo.
Assistant Professor, Pharmacology, Washington University.

Johnson, A. G., Madison, Wisconsin.

Jones, Wm. J., Jr., Lafayette.
State Chemist, Professor of Agriculture and Chemistry, Purdue University.
Chemistry, and general subjects relating to agriculture.

Kenyon, Alfred Monroe, 315 University St., West Lafayette.
Professor of Mathematics, Purdue University.
Mathematics.

von KleinSmid, R. B., Tucson, Ariz.,
President University of Ariz.

Liebers, Paul J., 1104 Southeastern Ave., Indianapolis.

Ludwig, C. A., 210 Waldron St., West Lafayette, Ind.
Assistant in Botany, Purdue University.
Botany, Agriculture.

Ludy, L. V., 229 University St., Lafayette.
Professor, Experimental Engineering, Purdue University.
Experimental Engineering in Steam and Gas.

Mason, T. E., Bloomington.
Graduate Student, Mathematics, Indiana University.
Mathematics.

McBride, Robert W., 1239 State Life Building, Indianapolis.
Lawyer.

McEwan, Mrs. Eula Davis, Bloomington, Ind.

McClellan, John H., Gary, Ind.

McCulloch, T. S., Charlestown.

Mance, Grover C., Bloomington, Ind.

Markle, M. S., Richmond.

Middletown, A. R., West Lafayette.
Professor of Chemistry, Purdue University.
Chemistry.

Miller, Fred A., 534 E. Twenty-ninth St., Indianapolis.
Botanist for Eli Lilly Co.
Botany, Plant Breeding.

Montgomery, Hugh T., South Bend.
Physician.
Geology.

Moore, George T., St. Louis, Mo.
Director, Missouri Botanical Garden.
Botany.

Morrison, Edwin, 80 S. W. Seventh St., Richmond.
Professor of Physics, Earlham College.
Physics and Chemistry.

Morrison, Harold, Indianapolis, Ind.

Mowrer, Frank Karlsten, Interlaken, New York.
Cooperative work with Cornell University.
Biology, Plant Breeding.

Muncie, F. W.

Myers, B. D., 321 N. Washington St., Bloomington.
Professor of Anatomy, Indiana University.

Nieuwland, J. A., The University, Notre Dame, Ind.
Professor, Botany. Editor Midland Naturalist.
Systematic Botany, Plant Histology, Organic Chemistry.

North, Cecil C., Greencastle.

Northnagel, Mildred, Gary, Ind.

O'Neal, Claude E., Bloomington.
Graduate Student, Botany, Indiana University.
Botany.

Orton, Clayton R., State College, Pennsylvania.
Assistant Professor of Botany, Pennsylvania State College.
Phytopathology, Botany, Mycology, Bacteriology.

Osner, G. A., Ithaca, New York.
Care Agricultural College.

Owen, D. A., 200 South State St., Franklin.
Professor of Biology. (Retired.)
Biology.

Owens, Charles E., Corvallis, Oregon.
Instructor in Botany, Oregon Agricultural College.
Botany.

Payne, Dr. F., Bloomington, Ind.

Petry, Edward Jacob, 267 Wood St., West Lafayette.
Instructor in Agriculture.
Botany, Plant Breeding, Plant Pathology, Bio-Chemistry.

Phillips, Cyrus G., Moores Hill.

Pickett, Fermen L., Bloomington.
Botany Critic, Indiana University Training School.
Botany, Forestry, Agriculture.

Pipal, F. J., 11 S. Salisbury St., West Lafayette.

Price, James A., Fort Wayne.

Ramsey, Earl E., Bloomington.
Principal High School.

Shriver, Dr. Will, Indianapolis, Ind.
Director, State Laboratory of Hygiene.

Shockel, Barnard, Professor, Terre Haute, Ind.

Schultze, E. A., Laurel.
Fruit Grower.
Bacteriology, Fungi.

Silvey, Oscar W., 437 Vine St., West Lafayette.
Instructor in Physics.
Physics.

Smith, Chas. Piper, College Park Md.
Associate Professor, Botany, Maryland Agricultural College.
Botany.

Smith, Essie Alma, R. F. D. 6, Bloomington.

Smith, E. R., Indianapolis.
Horticulturist.

Snodgrass, Robert, Crawfordsville, Ind.

Spitzer, George, Lafayette.
Dairy Chemist, Purdue University.
Chemistry.

Steele, B. L., Pullman, Washington.
Associate Professor of Physics, State College, Washington.

Steinley, Leonard, Bloomington, Ind.

Stoltz, Charles, 530 N. Lafayette St., South Bend.
Physician.

Stoddard, J. M.

Stuart, M. H., 3223 N. New Jersey St., Indianapolis.
Principal, Manual Training High School.
Physical and Biological Science.

Sturmer, J. W., 119 E. Madison Ave., Collingswood, N. J.
Dean, Department of Pharmacy, Medico-Chirurgical College of Philadelphia.
Chemistry, Botany.

Taylor, Joseph C., Logansport.
Wholesale merchant.

Thompson, Albert W., Owensville.
Merchant.
Geology.

Thompson, Clem O., Salem.
Principal High School.

Thornburn, A. D., Indianapolis.
Care Pitman-Moore Co.
Chemistry.

Trueblood, Iro C. (Miss), 205 Spring Ave., Greencastle.
Teacher of Botany, Zoology, High School.
Botany, Zoology, Physiography, Agriculture.

Tucker, W. M., 841 Third St., Chico, California.
Principal High School.
Geology.

Turner, William P., Lafayette.
Professor of Practical Mechanics, Purdue University.

Vallance, Chas. A., Indianapolis.
Instructor, Manual Training High School.
Chemistry.

Voorhees, Herbert S., 2814 Hoagland Ave., Fort Wayne.
Instructor in Chemistry and Botany, Fort Wayne High School.
Chemistry and Botany.

Wade, Frank Bertram, 1039 W. Twenty-seventh St., Indianapolis.
Head of Chemistry Department, Shortridge High School.
Chemistry, Physics, Geology and Mineralogy.

Walters, Arthur L., Indianapolis.

Warren, Don Cameron, Bloomington, Ind.

Waterman, Luther D., Indianapolis.
Physician.

Webster, L. B., Terre Haute, Ind.

Weatherwax, Paul, Bloomington, Ind.

Weems, M. L., 102 Garfield Ave., Valparaiso.
Professor of Botany.
Botany and Human Physiology.

Weir, Daniel T., Indianapolis.
Supervising Principal, care School office.
School Work.

Weyant, James E., Indianapolis.
Teacher of Physics, Shortridge High School.
Physics.

Wheeler, Virges, Montmorenci.

Wiancko, Alfred T., Lafayette.
Chief in Soils and Crops, Purdue University.
Agronomy.

Williams, Kenneth P., Bloomington.
Instructor in Mathematics, Indiana University.
Mathematics, Astronomy.

Williamson, E. B. Bluffton.
Cashier, The Wells County Bank.
Dragonflies.

Wilson, Charles E., Bloomington.
Graduate Student, Zoology, Indiana University.
Zoology.

Wood, Harry W., 84 North Ritter Ave., Indianapolis.
Teacher, Manual Training High School.

Woodburn, Wm. L., 902 Asbury Ave., Evanston, Ill.
Instructor in Botany, Northwestern University.
Botany and Bacteriology.

Woodhams, John H., care Houghton Mifflin Co., Chicago, Ill.
Traveling Salesman.
Mathematics.

Wootery, Ruth, Bloomington, Ind.

Yocum, H. B., Crawfordsville.

Young, Gilbert A., 725 Highland Ave., Lafayette.
Head of Department of Mechanical Engineering, Purdue University.

Zehring, William Arthur, 303 Russell St., West Lafayette.
Assistant Professor of Mathematics, Purdue University.
Mathematics.

Zeleny, Charles, University of Illinois, Urbana, Ill.
Associate Professor of Zoology.
Zoology.

Znfall, C. J., Indianapolis, Ind.

Fellows	70
Members, Active	162
Members, Non-resident	27
Total	259

INDIANA ACADEMY OF SCIENCE

IN JOINT SESSION WITH THE

INDIANA CONSERVATION ASSOCIATION

WHEREAS, We have learned of the death of Mrs. Fairbanks, the wife of Hon. Charles W. Fairbanks, who was to have participated in this meeting, and the value of whose service in the cause of Conservation is well known: Therefore be it

Resolved, That we hereby express our sympathy with him and his family in this time of bereavement, and our regret at his unavoidable absence from our meetings, and direct that a copy of this resolution be sent to him, and that it be spread upon the minutes of the respective organizations.

A. W. BUTLER,
For the Indiana Academy of Science.

SEVERANCE BURRAGE,
For the Indiana Conservation Association.

Minutes of Spring Meeting.

CRAWFORDSVILLE, INDIANA,

MAY 15 16 AND 17, 1913.

The 1913 spring meeting of the Academy was held at Crawfordsville and the Shades May 15 to 17.

The scientific program consisted of a lecture Thursday, May 15, 8 p. m., by Professor G. Frederick Wright, of Oberlin, on "Thirty Years' Progress in Glacial Geology." The lecture was an attractive and instructive presentation of an interesting subject and was much enjoyed by those present.

Friday, May 1, was taken up with an excursion to the Shades of Deatn. This was of especial interest to geologists, botanists, and zoologists, but the natural grandeur of the place and the outing were appreciated by all. At noon the local committee served lunch at the Shades Hotel without cost to the members. Following the lunch a short business session was held, about forty members being present. The following were elected to membership: Charles H. Baldwin, Indianapolis; Francis Daniels and H. F. Ashby, Crawfordsville, and E. L. Marcrum, Waveland. There was some discussion of the matter of the Donaldson Farm, which was to have been left to the State as a park but which has been in uncertain control on account of legal complications. It was moved that "It is the sense of this Academy that the Donaldson Farm should become the property of Indiana University, that the Academy use its influence to that end, and that the President of the Academy and Dr. C. H. Eigenmann constitute a committee to prepare a suitable memoral to present to the proper authorities." This was carried unanimously. It was moved that the thanks of the Academy be extended to Professor Wright for his lecture. Carried by a rising vote. President Bodine presided.

Friday evening after returning to Crawfordsville a very enjoyable dinner was served at the Crawford House, at 8:30, by the Academy without cost to the members. The dinner was followed by informal talks. Mr.

Amos Butler acting as toastmaster and responses being made by Messrs. Cogshall, Bodine, Macbeth, Kern, Culbertson, Barrett, Enders, J. S. Wright, Stoltz, Morrison and Eigenmann. Various items of interest relating to the trip to the Shades were brought out by the speakers.

Saturday morning May 17, was taken up by field trips along Rock River (Sugar Creek) to the crinoid beds and other places of interest. Many members also took advantage of the opportunity to visit the Gen. Lew Wallace place.

Frank D. Kern,
Secretary, *pro tem.*

Minutes of the Twenty-Ninth Annual Meeting

INDIANA ACADEMY OF SCIENCE.

Claypool Hotel, Indianapolis, Indiana.

October 24, 1913.

The Executive Committee of the Indiana Academy of Science met in Parlor T and was called to order by the President, Donaldson Bodine of Crawfordsville. The following members were present: Donaldson Bodine, A. W. Butler, Severance Burrage, W. A. Cogshall, W. S. Blatchley, J. W. Beede, D. M. Mottier, G. Culbertson, C. R. Dryer, C. C. Deam, R. W. McBride, C. H. Eigenmann and A. J. Bigney.

The minutes of the Executive Committee of 1912 were read and approved.

The reports of the standing committees were then taken up. The program committee, J. W. Beede, chairman, reported the work completed as indicated by the printed program, with several additional papers.

The Treasurer, W. J. Moenkhaus, having gone abroad, left his work in charge of A. G. Pohlman, but he, not being able to be present, delegated his power to W. A. Cogshall, who reported as follows:

Balance from 1912	$273.38
Dues	148.00
Total	$421.38
Expenditures	166.60
Balance	$254.78

On motion W. A. Coggshall was appointed Treasurer *pro tem.*

The following auditing committee was appointed: Severance Burrage, C. R. Dryer, J. W. Beede.

The Editor, C. C. Deam, reported that the work had been completed and the copy was in the hands of the printer.

The nominating committee was appointed as follows: A. W. Butler, W. A. Cogshall, G. Culbertson.

The President stated he had received a letter from an Austrian scientist applying for a certain correspondence position in the Academy. Since such a position does not exist in our Academy the Secretary was directed to reply to that effect.

A letter was read from Dr. Stultz, of South Bend, inviting the Academy to hold its spring meeting in that city. It was referred to the program committee.

President Bodine suggested that the standing committees be appointed by the incoming president. After some discussion a motion was made and carried that the incoming president appoint his committees except those necessary for carrying on the business of the Academy, such as auditing, nominating, etc.

Judge McBride, of the committee on relations of Academy to the State, reported that they had succeeded in keeping the appropriation at $1,200.

On motion Mr. Butler was appointed to act with a committee from the Conservation Association to draft suitable resolutions on the death of Mrs. Fairbanks, a copy to be sent to Hon. C. W. Fairbanks and a copy spread on the minutes.

On motion the Secretary was ordered to purchase a new secretary book and to have the old one bound.

On motion the Secretary and A. W. Butler were appointed to ask the State Librarian for permission to deposit the records of the Academy in his safe for security.

Adjournment.

A. J. Bigney, Secretary.

Donaldson Bodine, President.

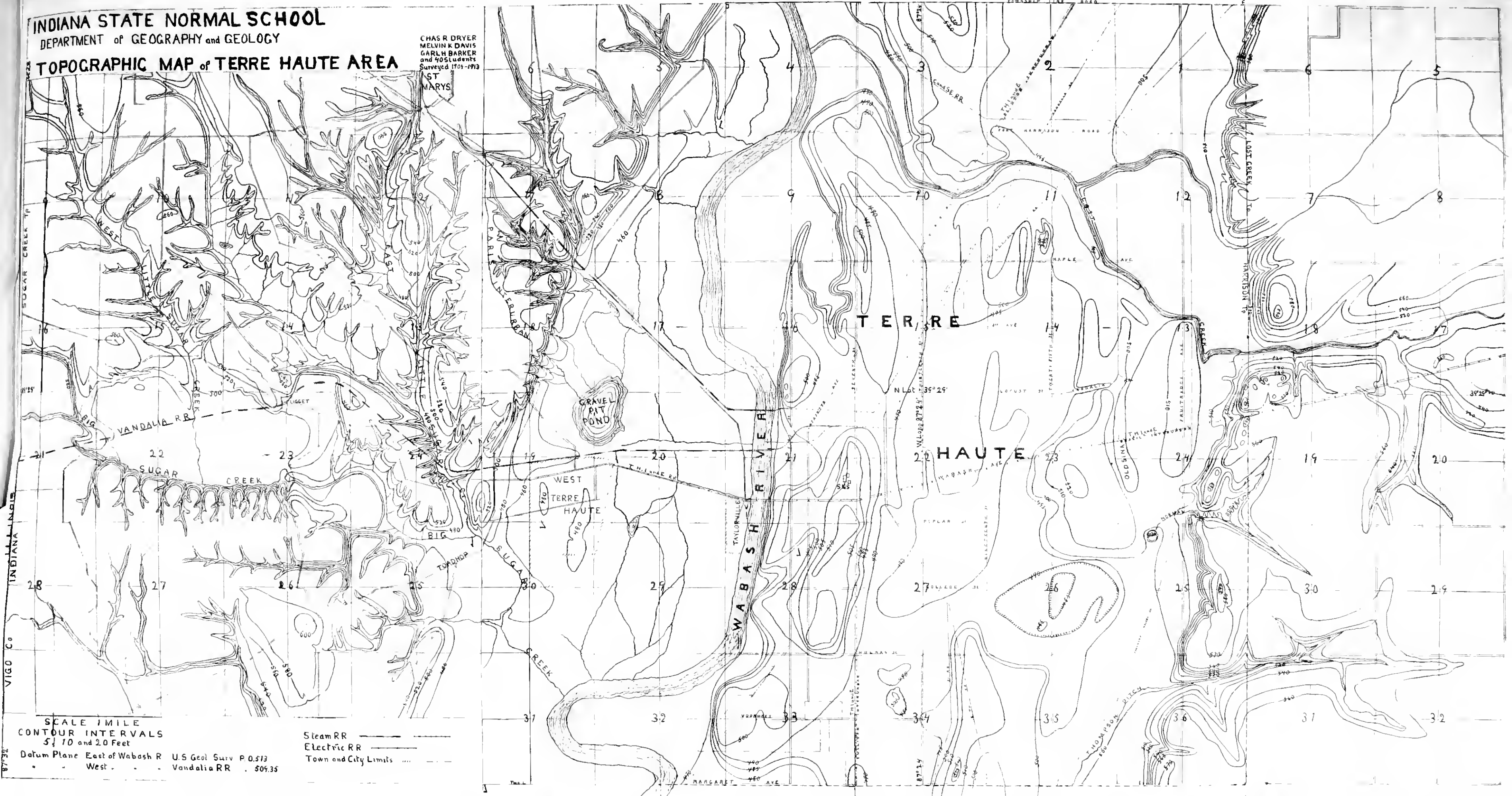
Palm Room, Claypool Hotel.

October 24, 1913.

The Indiana Academy of Science met in general session at 1:30 p. m. and was called to order by the President, Donaldson Bodine.

Business items were first taken up. J. W. Beede, of the Program Committee, reported work completed as printed.

Severance Burrage of the Auditing Committee reported the books of the Treasurer correct.


INDIANA STATE NORMAL SCHOOL
DEPARTMENT of GEOGRAPHY and GEOLOGY
TOPOGRAPHIC MAP of TERRE HAUTE AREA
CHAS R DRYER
MELVIN K DAVIS
CARL H BARKER
and 40 Students
Surveyed 1903-1913
ST MARYS
TERRE HAUTE
WEST TERRE HAUTE
WABASH RIVER
GRAVEL PIT POND
SUGAR CREEK
BIG SUGAR CREEK
WEST LITTLE SUGAR CREEK
EAST LITTLE SUGAR CREEK
LOST CREEK
VANDALIA RR
TAYLORVILLE
TOADHOP
THOMPSON DITCH
SUGAR CREEK Tp
HARRISON Tp
LOST CREEK Tp
INDIANA
VIGO Co
MAPLE AVE
WABASH AVE
MARGARET AVE
N Lat 39°29'
SCALE 1 MILE
CONTOUR INTERVALS
5, 10 and 20 Feet
Datum Plane East of Wabash R U.S Geol Surv P.O. 513
" " West . . . Vandalia RR . 504.35
Steam RR
Electric RR
Town and City Limits

The Editor, C. C. Deam, made a complete report of his work, and stated that the copy was in the hands of the state printer.

E. R. Cumings, of the Membership Committee, reported the following names for membership: Dr. Will Shimer, State House, Indianapolis; Elton Russell Clarke, Indianapolis; Harold Morrison, Indianapolis; Robert Snodgrass, Crawfordsville; Leonard Steimley, Bloomington; Dr. F. Payne, Bloomington; Ruth Wootery, Bloomington; Cora Hennel, Bloomington; Edith A. Hennel, Bloomington; C. J. Zufall, Indianapolis; Arthur L. Walters, Indianapolis; Mason E. Hufford, Bloomington; Henry DuBois, Bloomington; Hugh E. Brown, Bloomington; Mary Easley, Bloomington; John H. McClellan, Gary; R. B. Harvey, Indianapolis; L. B. Webster, Terre Haute; Don Cameron Warren, Bloomington; Paul Weatherwax, Bloomington; Prof. Bernard Shockel, Terre Haute; Grover C. Mance, Bloomington; Mrs. Enia Davis McEwan, Bloomington; Robert G. Gillum, Terre Haute; Mildred Northnagel, Gary; William Ray Allen, Bloomington.

On motion the persons named were elected members.

The Treasurer *pro tem.*, W. A. Cogshall, reported as follows.

Balance from 1912	$273.38
Dues	148.00
Total	421.38
Expenditures	166.60
Balance	$254.78

Dr. C. H. Eigenmann made a brief report of the expedition of Messrs. Henn and Wilson to Colombia that went out under his direction.

Dr. H. J. Banker reported that he had collected 268 pages of data on the scientific literature in the libraries in the State. Many difficulties had been encountered but progress had been made. He stated that he had incurred an expense of $18.75 in this work.

On motion the Academy ordered the Treasurer to pay this bill and extend to Dr. Banker the thanks of the Academy for his efficient work. The committee was continued.

On motion the papers of the Conservation Association were ordered published in the Proceedings of the Academy.

The regular program was then taken up, beginning with President Bodine's address.

PROGRAM.

FRIDAY AFTERNOON, 1:30.

SECTIONAL MEETINGS.

Section A. Biology.

Section B. Miscellaneous.

Boiling and Condensing Points of Alcohol- Water Mixtures.....P. N. Evans

Additional Notes on an Almost Extinct Native Disease. Trembles...... ....Robert Hessler

Race Suicide..Robert Hessler

A Psychologist's Investigation in the Field of Crime Among Adolescents ....R. B. von KleinSmid

Agricultural Work in Southern Indiana.....................C. C. Phillips

Some Remarkable Wells in Bean Blossom Valley, Monroe County...... ....J. W. Beede

On the General Solution and so-called Special Solutions of Linear, Non-homogeneous, Partial Differential Equations...........H. L. Steimley

A Modified Permeameter...............Edwin Morrison and B. D. Morris

FRIDAY EVENING, 6.

Members of the Academy and Conservation Association so inclined will have dinner together at tables in the Claypool Hotel.

FRIDAY EVENING, 7:45.

Business session of the Academy of Science.

Election of Officers, etc.

PROGRAM.

The germination of *Arisaema draconlinus*. Lantern.........F. L. Pickett

The Prothallium of *Camptosorus rhizophyllus*. Lantern......F. L. Pickett

Irish Potato Scab as Affected by Fertilizers Containing Sulphates and Chlorides. Lantern..................................S. D. Conner

Newly Discovered Phenomena Connected with the Electric Discharge in Air. Lantern...A. L. Foley

JOINT CONFERENCE ON CONSERVATION.

SATURDAY, 8:30 TO 12:30.

Water Conservation.

A Sanitary Survey of Indiana Rivers.................Jay Cravens, C. E.

The relations of the Lakes of Northern Indiana to Problems of Flood Control..Will Scott

(The papers on flood damage and control are listed under the regular program of the Indiana Academy of Science.)

Forest Conservation.

First Steps in Indiana Forestry........................Stanley Coulter
Taxation of Forest Lands..............................H. W. Anderson
Forests and Floods....................................F. M. Andrews

Conservation of Human Life.

County Tuberculosis Hospital as a Factor in the Conservation of Human Life...James Y. Welborn
Playgrounds and Recreation Centers as Factors in the Conservation of Human Life...W. A. Gekler
Public Toilet Facilities, Drinking Fountains and Public Spitting in Relation to the Conservation of Human Life..............C. M. Hilliard

Mineral Resources.

Possible Dangers from Drilling for Oil and Gas in Coal Measures..... ....Edward Barrett
Power Economy and the Utilization of Waste in the Quarry Industry.. ....G. C. Mance

In the evening session the Membership Committee reported the following persons for election as Fellows of the Academy: George N. Hoffer, West Lafayette; C. M. Hilliard, Lafayette; M. E. Haggerty, Bloomington.

The Committee on Nominations reported the following for officers for the ensuing year:

President—Severance Burrage, Indianapolis.
Vice-President—A. L. Foley, Bloomington.
Secretary—A. J. Bigney, Moores Hill.
Assistant Secretary—H. E. Enders, Lafayette.
Press Secretary—F. B. Wade, Indianapolis.
Treasurer—W. A. Cogshall, Bloomington.
Editor—H. E. Barnard, Indianapolis.

On motion they were elected as reported.

The program was then completed.

Adjournment.

A. J. Bigney, Secretary.

Donaldson Bodine, President.

President's Address: The Work of the Indiana Academy of Science

Donaldson Bodine.

Not the least among the agencies that make for the betterment of a state are such organizations as the Indiana Conservation Association and the Indiana Academy of Science. Their officers and members receive no salary, they attend the meetings at their own expense and there formally and informally discuss together problems which have to do with the development of the commonwealth. Doubtless the greatest immediate gain comes to the individual who takes advantage of the opportunity for fellowship and the mutual interchange of thought and opinion, but through the individual the state also reaps its reward. It is as true in science as in morals that the level of the state is determined by the level of the individuals who compose the larger body. The primitive law of life is competition —a competitive struggle for existence and advancement. The work of Darwin, and more especially that of his followers, has given sufficient emphasis to the importance and universal application of this law; but even in the lower realms of life, we find the beginnings of a higher law, cooperation—a mutual aid in the struggle. Kessler, Kropotkin, and others have shown the equal if not greater importance of this later principle and have called attention to the fact that in all groups of animals those who have developed this mutual aid in the largest degree have shown the greatest progress. In social evolution also the greatest advances have come since competition has given way to, or at least has been modified by, cooperation, and the greatest teacher the world has known founded his plan for the salvation of the individual and the race upon the principle of mutual service. This mutual service should be the watchword of the members of the Academy.

The constitution of the Academy provides that the President shall deliver an address on the morning of one of the days of the meeting at the expiration of his term of office, and in obedience to that provision and in conformity with the idea of true conservation, which means the best, most intelligent and therefore the most efficient use of resources, I beg to bring to your attention some questions which I believe to be of vital importance to the Academy and to its greatest efficiency as a state organization. This is an age of organization, and associations of various sorts are rapidly multiplying. Everyone must feel the burden of the demands of societies, local, state and national, upon his time, attention and means; and to secure and maintain the loyalty and devotion of its members, any society must prove its value in substantial returns. It has been my privilege to belong to the Academy since my advent into Hoosierdom, and nearly two decades of membership have given me a high appreciation of its value. I offer no excuse, therefore, for bringing to your attention some features of the work of the Academy and in asking your consideration of some suggestions which may be of service in making it of still greater usefulness to its members.

Societies, like individuals, must be undergoing a continuous development, unless indeed they are moribund. They must be adapted to the needs and demands of the times and from time to time readjustments are imperative if a vigorous life is to be maintained. Not too infrequently, then, should we pause to take stock of our present condition and consider ways and means by which greater effectiveness can be secured. A few years ago one of our distinguished past presidents, Dr. Jordan, said that the fight for the recognition of science in the educational field and in the world at large was a potent factor in binding together the members of the Academy in a common cause. Times have changed. No longer is it necessary for the man of science to assert his rights. The theoretic chemistry of yesterday is at the foundation of modern industry; the "plaything" of the physicist of yesterday, today lights the world and puts distant peoples into instant communication; the marvels of the biologist's microscope and culture tubes have become the dependence of the modern world for the maintenance of its life and health, and the public has become well-nigh too credulous of the powers of science. The old field of battle has been won, but there are other and greater promised lands of usefulness which must be entered and possessed, and the new conquests require new adjustments and new weapons.

Section 2 of Article I of the constitution sets forth the purposes of the Academy as follows: "The objects of this Academy shall be scientific research and the diffusion of knowledge concerning the various departments of science, to promote intercourse between men engaged in scientific work, especially in Indiana; to assist by investigation and discussion in developing and making known the material, educational and other resources and riches of the State; to arrange and prepare for publication such reports of investigations and discussions as may further the aims and objects of the Academy as set forth in these articles."

The first provision for the encouragement of research and the diffusion of knowledge concerning the various departments of science is an important one. Examination of the printed volumes of the Proceedings will disclose a long list of original contributions and reports of investigations of the natural resources of our state and of the development of various phases of scientific progress. The record is one of which we may well be proud. Many of the papers have been an inspiration to those who heard their presentation, and they remain an invaluable, permanent record of current problems or of conditions long since passed away. Still it is worth while to raise the question whether it may not be possible to increase the value and interest of the papers presented at our regular meetings by making them part of well considered and carefully prepared programs.

In connection with this problem there appears a serious defect in the practice which obtains in the organization of the committees upon which the Academy must depend for the direction of its work. The constitution provides that "The President shall at each annual meeting appoint two members to be a committee which shall prepare the programs and have charge of the arrangements for the meetings for one year." Current practice so interprets this provision that the retiring president chooses this and other committees which must work with the newly elected officers. This I consider a seriously unfortunate usage. Under such conditions there is no reason to anticipate the same sense of common interest and responsibility for the work of officers and committees as would obtain if the acting president had the appointment of his own committees. As an illustration I may cite the fact that one year within the writer's knowledge the chairman of the program committee, which so far as the immediate interests of the Academy are concerned is the most important committee, was not even informed of his appointment till so late as to make arrangements for the spring meeting altogether impracticable. Had the acting president selected his own committees there certainly would have been a closer cooperation and a fuller sense of responsibility and therefore more efficient service. This statement is made not in adverse criticism of either officers or committees, but of the unwise practice of the Academy. Conmittees are the organs of a society, and without their efficient action even an enthusiastic membership can avail but little. In the interest of a closer cooperation and better service I would commend to the Academy a change in its practice to the end that the incoming president may choose and appoint the committees with which he is to work and for whose action he is in large measure responsible.

May I also add a word here to emphasize the fact that it is a matter of vital importance to the Academy that each committee should organize promptly and carry on its work with some energy. Except during its regular meetings the Academy is a discrete body and must therefore delegate the performance of its necessary work to special or standing committees and must rely upon them for its proper and timely accomplishment. In the case of the standing committees, some of the members are carried over from year to year and are therefore somewhat familiar with the work they are expected to do. On the other hand the president is elected for one year and comes to the office with no special knowledge of the organization of the Academy or of the immediate duties of his office. In addition to this, the membership being state-wide in its distribution, there are few opportunities for personal conference in planning or carrying on the work. It is practically necessary, then, for the chairmen to take the initiative and to assume the responsibility to the president and the Academy for the efficient performance of the work devolving upon their several committees.

If the work of the committees be neglected or indifferently performed, the Academy suffers and has little opportunity to repair the failure. Fortunately, members are loyal and try to render excellent service. The chief difficulty comes from a failure to realize the time-consuming nature of the accomplishment of work through correspondence and the delays incident to widely separated residence of different members of committees. Every committee, therefore, should organize at once and make early preparation for their work.

The committee of most immediate importance to the Academy is the program committee and it is so fundamental that I may be pardoned a comment or two regarding its work. Personally I do not believe it is sufficient that this committee simply issue a call for contributions. Plans for a definite program should be made at once, and by personal invitation and correspondence the cooperation of members should be secured in carrying it out. This year's program affords an illustration of this plan, and I believe will prove its value. A definite idea should be developed as to the principal feature of the program, and the participation of individual members should be secured to treat of its various phases lying within the range of their several fields of work. This involves much labor, but the results will justify the effort, and I am sure the committee will be willing to give the necessary time and energy to the accomplishment of the plan. The writer does not believe that the papers form the most important part of the work of the Academy, but it goes without saying that a well-planned, attractive program is of first importance in gaining attendance and interest at the meetings, and without these all other ends will suffer defeat.

One result of the specialization of today is the narrowing of the interests of workers to smaller and smaller limits within the fields of their special activities. I quote in part from the address of Dr. John M. Coulter to the Academy on the occasion of the celebration of its twenty-fifth anniversary. There is "a tendency to become narrow in our vision and lose our perspective of the whole field not only of science but also of education. You will find that as scientific men become less and less interested in other fields of work, as they grind their own grooves deeper and deeper, they become less and less effective as teachers and less and less influential with their students. You will find men with broad outlook, clear and wide vision, men with sympathy—men can only get these things by coming in contact with larger fields than their own—are the men who win with students." So spoke one of Indiana's most effective teachers, and we must all be quite in accord with his opinion. Since we recognize this tendency, I would point out that a program which by its general interest and excellence will provoke thought and discussion in other than immediate individual fields of activity would be of inestimable value in the work of the Academy for its members. To this end may we not expect and demand the hearty cooperation of officers and committees and a ready and enthusiastic support from the whole membership?

One other consideration in connection with the regular programs is worth a passing mention. Modern photography and improved projection apparatus afford an important addition to the means of clear and interesting presentation of results of work, and in connection with this visual method I venture to suggest that more attention be given to the exhibition of specimens, apparatus, or preparations. The greater part of our members are teachers or are in some way closely identified with educational work, and the display of apparatus or preparations that have proven helpful in actual use would be of great practical value. Such displays have become one of the most acceptable features of the meetings of the sections of the American Association and of its affiliated societies and with our smaller and more intimate membership they might well prove of equal or greater value. Reference is not made here to the elaborate display of a single worker so much as to the exhibition of a number of less pretentious bits of apparatus or ingenious devices or illustrative specimens. For example, one scarcely ever visits a laboratory for the first time without seeing some ingenious device that has been worked out to meet a real need. Usually the same need is found elsewhere, and the display of the device at such a meeting as ours would command an appreciative welcome and be both suggestive and helpful.

The most important function of the Academy lies outside of the regular program, though in a large measure the latter conditions its success. I refer to the social side of the meetings—the intercourse of members for personal association and inspiration. The testimony of all older members agrees upon this as the pleasantest and most profitable feature of the Academy. During the business or teaching year we are largely isolated from each other. Sometimes a want of sympathy with or even distrust of the work of others arises from a lack of personal acquaintance and a knowledge of what they are doing. President Wilson has said that "Unless the hearts of men are bound together, the policies of men will fail; because the only thing that makes classes in a great nation is that they do not understand that their interests are identical." Personal acquaintance will do more than any other one thing to bring about a common good fellowship and mutual appreciation which will insure that the other objects of the Academy will flourish through stimulus to thought and work and wider usefulness. The political boundaries of a state may not serve best as limits to a scientific organization, but at least they do serve to bind together into a practical working unit for the purpose of acquaintance, friendship, and cordial relations the scientific workers of a limited geographical community. This alone is an all-sufficient justification for the existence of our state organization.

Man is a social being, and nothing else is so potent in his development as personal contact with his fellows. Wagner has made much of isolation as a factor in evolution. Jordan insists upon its necessity if animals are to maintain themselves and develop into a species. This isolation, however, is not that of the individual, but of a society. Isolation of the individual kills; of the society, vivifies. Segregation, with its consequent freedom from intimate contact with distracting forces and especially with its consequent interaction of varying kinds and degrees of like tendencies and interests, is of paramount importance in the development of the individual. This kind of segregation is just what our organization can and should accomplish. As members we are each interested in some particular field of work and too many of us find it difficult to keep in touch with the broad fields of which ours is but a part. No other agency can do so much to help us here as the personal contact which our meetings make possible. During the last two decades the pendulum has swung too far in the direction of intense specialization to the exclusion of the broader training, and already clearer minds are calling us back to the fact that science is one great field, and that to succeed in any part, one must have a broad view and a fair knowledge of the whole. The distinguished president of the British Association laid emphasis upon this in his address upon "Continuity" at the Birmingham meeting last month. President Van Hise says that for the training of a geologist there must be intimate knowledge of at least two basal sciences with a broad knowledge in other fields. "No man," says he, "may hope for the highest success who does not continue special studies and broadening studies to the end of his career. Besides the broad training in language which is essential in every field, there must be an intensive training in chemistry, physics, mineralogy, and biology." In other words the study of geology alone cannot make a competent geologist. Professor Bessey, whose word always commands the thoughtful attention of all teachers and students in America, contends that the fundamental training of a botanist may well be limited in the special botanical field to three years of university work, so that time and energy may be spared to the acquisition of the broader foundation necessary for subsequent specialization. With such a wide training the student is able to take up his special work with an intelligence and understanding that is impossible to one trained in a narrower fashion. In his presidential address to the Academy three years ago Dr. Evans said: "He is a poor chemist, who is only a chemist." Further testimony from experts in the scientific and educational fields could be cited, but I believe we all agree as to the value of broad training and the maintenance of broad interests along with any degree of specialization that may be attained. In view of this belief may I repeat that the personal interchange of ideas and the comradeship that our meetings afford can do much to nourish and keep alive this wider interest in different fields that all too readily becomes deadened by the isolation of the individual in his own work. In this service the Academy has a peculiar advantage over associations organized to promote some particular purpose. Its interests are broad, its members are recruited from widely varying fields, and yet all are bound together by their common interest in scientific work. In this respect no other organization has quite so much to offer to its members. The working out of the problem involves grave difficulties, but I believe there should be some way of putting larger emphasis upon the social side of the meetings. If possible the program committee should make some provision for greater opportunity for social intercourse. Short recesses in the regular sessions might be of service. The examination and discussion of exhibits such as previously suggested would be admirable for the purpose and would be not less effective than more elaborately planned occasions which are likely to become more or less formal and thus miss their real object. A greater cordiality on the part of the older members toward the younger, especially those who have recently joined the ranks of the Academy, would count for much. We should be of one large family and not stand too much upon formality.

In this connection let me remark that the Academy is not living up to its privileges. It should have a much larger membership. Indiana has many scientists engaged in industrial work. Pure and applied science, if we may use as still tenable that distinction of Huxley's, go hand in hand and we should do well if we could enlist in the service of the Academy many of the workers in the fields of the practical application of science. There should be some systematic effort by the membership committee to seek out these men and to show them the advantages of a connection with the Academy. In this work the committee must have the hearty cooperation of every member. It should be possible to enlist in our service the members of the various state departments of science who are doing valiant service in promoting the welfare of the people through work in agriculture, entomology, forestry, geology, health, hygiene, and sanitation. They would greatly help the Academy and in turn would unquestionably be well repaid by the advantages of membership.

In connection with the social side of the work of the Academy, one other feature needs special mention. Conversation with the various members has shown that too little is known of the regular spring meetings. Comparatively few attend, but of those who do it is the common testimony that they are both most enjoyable and profitable. May I urge their claim upon your attendance? They are held in a different place each year and are in the nature of field excursions. This plan offers two great advantages. It gives occasion for members to visit different parts of the state and in association with others, some of whom are familiar with the territory, to become acquainted with the characteristic features of the locality. Through a series of years opportunity is given to acquire a personal knowledge of the more interesting and representative parts of the state which one scarcely would or could attain by individual travel or excursions. Field trips of this sort also afford the very best opportunities for gaining mutual acquaintance and for interchange of ideas and discussion. As one who has rarely missed a spring meeting and then only with regret and by reason of necessity, let me urge upon all the pleasure and advantages of attendance. That many other demands upon time and attention, especially at that time of the year, are pressing is recognized, but the value of such meetings will well repay the sacrifice of trouble and expense, and it is hoped that many who have not as yet attended these excursions into the field will in the near future find it possible to take part in them. I have endeavored to outline some ways in which immediate work may be done in the interests of enlarging the usefulness of the Academy. I am convinced that such work should be undertaken and have therefore turned from a more attractive theme as the subject of my address because it seemed to me a proper time and occasion to call attention to the necessity of some changes if we are to maintain and increase our membership and to serve it efficiently and well. With opportunity comes responsibility; and responsibility well discharged, brings yet larger opportunity. With an increased and united membership we could take an important part in the educational work of our state which, on its scientific side, needs direction and encouragement.

In closing allow me to propose one definite undertaking which I believe the Academy should give careful consideration. The end to be gained we would all welcome, and the effort toward its attainment would in itself be of value and incidentally bring other happy results. It seems to me that the Academy of Science is the proper body to urge a movement toward the establishment as part of our educational system of an adequate organization of a state museum for the collection, exhibition and preservation of our fauna and flora, our geological and archaeological history, and our natural resources. Such a museum would become the center of the scientific work of the state and the depository of the materials brought together by the state surveys. I do not mean to advocate a museum in the old sense of the word, to be a mere custodian of rare or curious specimens and records, but an organized department which shall exhibit our natural resources and point out the possibilities of their development in the interests of the people. Such a museum would fill a large place in the educational system of the state.

The rise of the museum in the city, state, and nation is the latest phase in the educational evolution of our day. It is only necessary to point to the work of such institutions as The National Museum at Washington, The New York State Museum at Albany, The Museum of Natural History at New York, The Carnegie Museum at Pittsburgh, and The Field Museum at Chicago, to prove its value in modern life. Its method of teaching is direct and impressive and it is the only method that is able to reach many of the people of a community. "The truest measure of civilization and of intelligence in the government of a state," I quote from an address of Professor Henry Fairfield Osborn, "is the support of its institutions of science, for the science of our time in its truest sense is not the opinion or prejudices, the strength or weakness of its votaries; it is the sum of our knowledge of nature with its infinite applications to state welfare, to state progress, and to the distribution of human happiness." In the development of this side of our educational system Indiana—we must admit it with regret—is far behind other and neighboring states. New York State is the leader and has evolved an ideal organization. Beginning in 1836 with the establishment of an official Natural History Survey, she has made successive and progressive changes until in 1894 a consolidation under the State Department of Education placed the museum at the head of all the scientific interests of the state. It directs all surveys, archeological, botanical, entomological, geological, paleontological, topographical, and zoological, and with the consolidation has come a great gain. It has succeeded not only in building up a museum worthy of a great state, but it has also taken a place in the educational work which no other organization could fill equally well. By means of instructive exhibits it has become a great teaching force, and through its traveling collections and the furnishing of materials and specimens to schools and societies it has widened its sphere of usefulness till it reaches every part of the state and has the sympathy and active support of a wide constituency.

Our own state in 1869 organized a Department of Geology and Natural History and much good work has been accomplished. The energies of the department have been largely confined to investigations in the geological field, however, and its official title has been changed to The Department of Geology and Natural Resources. Little has been done in other fields and practically nothing in an educational way to gain the interest and support of the people of the state as a whole. It has been unable, therefore, to obtain adequate financial support from the state or to enlist the cooperation of other departments and organizations which should assist in building up an institution of which we might be proud and which would take a large place in the educational system of the state. Indiana now has a number of state departments or boards for the control or prosecution of work in various fields of pure or applied science, but for the most part they are independent in organization and work and there is lacking that cooperation and solidarity we should expect and without which the highest effectiveness cannot be attained. Let me say again that this statement of fact is not made in the spirit of criticism of the officers or personnel of any department; the purpose is simply to call attention to the situation as it exists and to point out the desirability of a change in the organization to bring about a condition more fitting to present conditions and therefore more advantageous to all departments and to their work for the state. I believe it would be wise and proper for the Academy, together with the different scientific departments and boards of the state, to consider some plan for the consolidation of the scientific agencies of the state which would render their work more effective and more extensive and thus gain the sympathy of the people and the necessary increased financial and other material support from the legislature. What is everybody's business is nobody's business, but some body or some organization should make it its business at least to consider some method of encouraging and forwarding the organized scientific activities of the stae, and by reason of its character and standing the Academy of Science might well lead the way. For such action the third purpose of the organization as laid down in the constitution provides abundant warrant, and it is the belief of the speaker that through such action the Academy would render large and lasting service to the state.

Wabash Studies. IV: The Flood of March, 1913, at Terre Haute.

Charles R. Dryer.

The natural channel of the Wabash at Terre Haute is 700 feet wide and 15 feet deep, low water standing at 446 feet A. T. The flood plain which becomes a channel at high water is 460 feet A. T. and from 9,000 to 13,000 feet wide. The bluff on the west rises to about 550 feet and the terrace on the east to 490 feet. An island terrace, a mile long and a quarter of a mile wide, rising to 480 feet, stands in the flood plain near the west side.

The city of Terre Haute occupies the terrace along the east bank of the Wabash, 45 to 65 feet above low water and 30 to 50 feet above the flood plain. West Terre Haute (population 6,000) stands on the island terrace 10 to 20 feet above the flood plain. Taylorville, a slum district (population 600), is built on the flood plain at the west bank of the river. Toadhop (population 200) is a workmen's village in the flood plain where Sugar Creek breaks through the west bluff.

The grade of the Big Four Railroad, fifteen feet high, crosses the flood plain diagonally to the northwest, but has an opening midway 200 or 300 feet wide, crossed by a trestle. The grade of the Vandalia Railroad, of equal height, crosses the plain at right angles without a break except an underpass about fifteen feet wide for the Paris interurban line near the west end. The Wabash avenue grade to West Terre Haute parallels the Vandalia and forms a complete dam, paved with brick. Each of these roads crosses the river by a steel bridge about 700 feet long resting on four or five piers.

On March 24, 1913, the river gauge stood at 17 feet and the water was out of the channel, flooding Taylorville. On March 27th the river had risen to 31.25 feet (477 feet A. T.), where it stood for about fourteen hours. Taylorville and Toadhop were submerged and the waters occupied West Terre Haute except two small islands. The railroad grades were washed out for about half a mile and water a foot deep poured over the whole length of the Wabash-avenue grade, forming a waterfall about two feet high upon the interurban track on the south side. A bayou which cuts into the terrace on the northwestern edge of Terre Haute was flooded and about sixty houses were covered or floated away. The flood still lacked thirteen feet of reaching the lowest levels of the Terre Haute terrace, but threatened or reached the basements of several public utility stations along its river edge. The water-works pumping station did not suspend operation, although the filtering plant was unusable. The station which furnishes city light and power for car lines was protected by a temporary levee and out of business but a few hours. The gas works shut down fourteen hours.

Terre Haute was without railroad communication for about a week, but mail and passengers were transferred two miles by boat. One of the peculiar and interesting marks left by the flood was the spreading out of the gravel from the broken Vandalia grade into a great fan, which buried many houses in West Terre Haute up to the second story in gravel. The railroad and street grades acted as so many dams to compel the flood water to pass through the normal channel 700 feet wide. If they had been provided with adequate openings high water would have been several feet lower, the grades would have been left intact and West Terre Haute uncovered by water or gravel. During midsummer low water the discovery was made that the piers of the Wabash-avenue bridge had been seriously undermined and they had to be strengthened with concrete. The discharge of flood water under the bridges has been estimated at 300 times as great as the normal, a contingency for which the bridge engineers had not provided.

The Flood of March, 1913, Along the Ohio River and Its Tributaries in Southeastern Indiana.

Glenn Culbertson.

Upon investigation it was found that the floods of the tributaries of the Ohio River in southeastern Indiana, resulting from the unusual rainfall of March 23-27, 1913, were not so remarkable as those of the streams of central Indiana and Ohio.

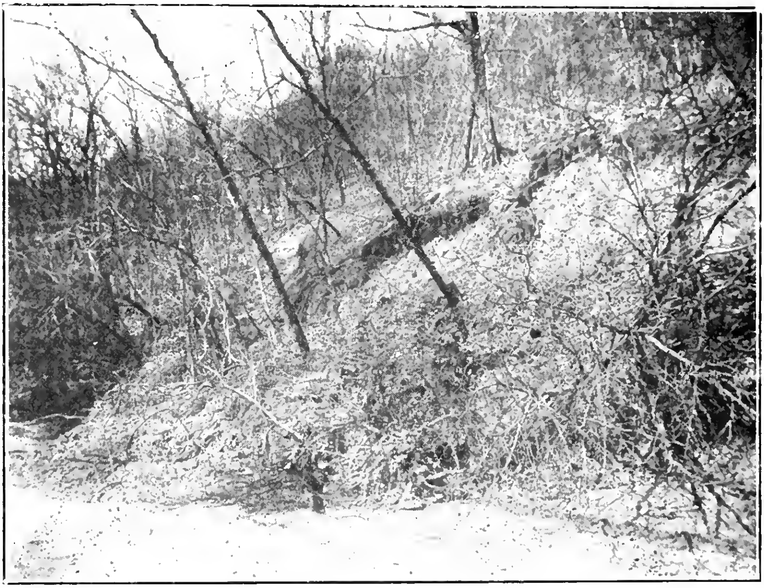
Two reasons may be given for this. The first is that the precipitation in the basins of the tributaries of the Ohio in southeastern Indiana during the above period did not exceed seven or seven and a half inches, except in very small areas. In the basin of the tributaries of the east and west forks of White River the rainfall in places reached nine or more inches during the same period. The second reason is, that while the precipitation was excessive, yet the heaviest showers of two or three inches, coming within a period of a few hours, were sufficiently separated in time to permit the "immediate runoff" to pass into the larger streams and on to the Ohio River. This was done the more readily inasmuch as the gradients of the tributaries of the Ohio in this region are very high. In these streams a period of a few hours only is needed to carry off an excess of water that in the more level parts of central and northern Indiana would require almost as many days.

Two or three excessive rainfalls of this period added greatly to the destructive erosion of the steep hillsides, where unprotected by forest growth or other vegetation. The soil of these slopes, loosened by the winter's frost and in too many cases entirely without protection, was swept away by the hundreds and thousands of tons. Along with the finer materials much gravel and small stones were deposited over the valuable bottom lands along the larger streams, adding greatly to this destructive work which has taken place during every great flood since the forests were removed from the hills.

The flood of the Ohio River during early April, resulting from the rains of March, was not the greatest known, being exceeded by that of

1884. That of March, 1913, however, was noted especially in two respects, viz: the remarkable rapidity of its rise, and the very great quantity of sediment carried.

From ten days to two weeks are usually required for the Ohio River to reach a flood stage such as that of March, 1913, but in that case such was the rapidity of the rise, that flood stage was reached in four or five days. Because of the unusually rapid rise there was a destruction of movable property much greater than ordinarily occurs.



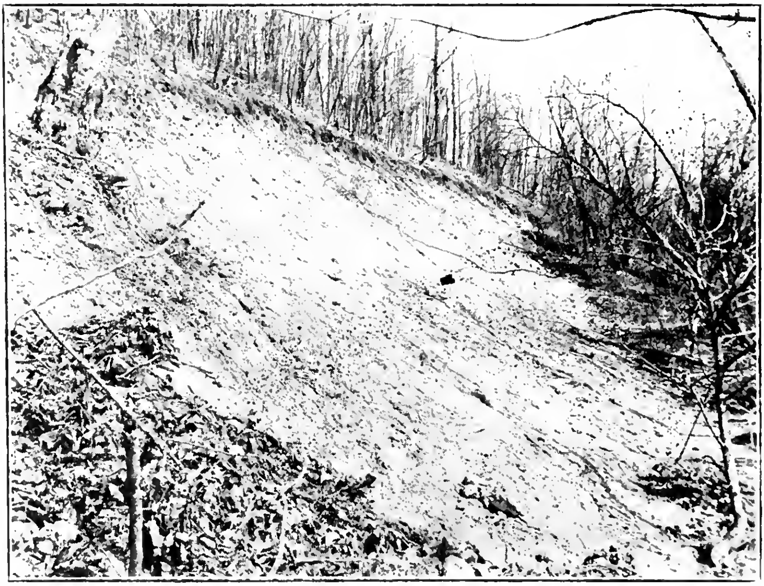
Slide Covering Madison and Hanover Pike.

The deposits left on the bottom lands of the Ohio by the floods of last March were by far the greatest known. In many places the silt or mud was laid down to the depth of six, eight, and even twelve inches. The immediate effect of this deposit was the complete destruction of all wheat and alfalfa growing in the bottoms below high water mark, where covered with flood waters for several days. In many of the Ohio bottoms alfalfa is one of the most valuable crops and its destruction was a serious loss to the farmers. Where the soil could be broken and cultivated all the bottom lands, whether previously sown to wheat or alfalfa, were plowed and planted in corn. Where the deposits were eight to twelve inches, however, and in some cases even of less depth, it was found to be impossible to get the soil in condition for a crop in 1913, a winter's freezing and thawing being necessary to produce the proper texture in the soil for the cultivation and production of a crop. The materials, soil and silt, left by the 1913 flood, like all those of more recent years, are found to be not nearly so fertile as were the deposits of the past, when much of the basin of the Ohio was still largely forested.

Landslide on Steep Hillside Upon Which Tobacco Had Been Grown. This Picture Shows a Great Mass of Soil, etc., Heaped Up Below the Break.

The most important results of the very unusual precipitation of last March, on the steep slopes of the Ohio and its tributaries in southeastern Indiana, from a geological standpoint and probably from an economic also, was the very great number and size of the landslides. Those occurring as a result of the rains of last March were tenfold more numerous than those following any heavy rains of the past. Every few hundred yards along the slopes facing the Ohio and its larger tributaries, these slides occurred.

In some places great cracks extending for several hundreds of feet were formed in the earth, and the soil moved a few feet only. In other places hundreds of tons of soil broke away to the depth of from three to five or six feet, and moved to more gentle slopes below, leaving a great tangle of soil, roots, branches and trunks of small trees in huge mounds. Valuable tobacco or other lands were rendered unfit for cultivation, or roadways were so completely covered that the use of dynamite alone could remove the material and open the roads for traffic.

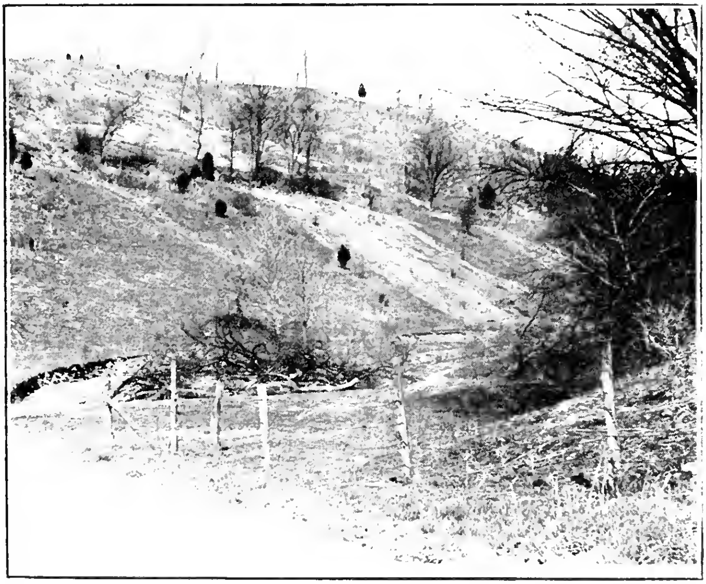


Slide Covering One-half Acre on a Slope Covered with Growth of Small Trees.

In other cases the slides began well up the slopes and continued to the bottom of the valley, carrying hundreds of tons of rocks, soil, and vegetable debris. The slides were fully as frequent on the forested slopes where the larger trees had been removed, and only shrubs and small trees remained, as on the hillsides covered with blue grass. In a few cases it was noticed that a black walnut or a white oak, although not more than a foot in diameter, was able to hold the soil even in the midst of a comparatively large landslide. The large tap roots of these trees extended far below the materials loosened, and hence held their positions and the soil embraced by them.

Very much more extensive than the slides themselves was the creep of the hillside soils. The effect of the creep was the removal of thousands of tons of soil on a single slope to the distance of a few inches or a foot or so down the slope.

The one great lesson taught by the excessive rainfall of March, 1913, so far as the steep slopes of southeastern Indiana are concerned, is that



Extensive Slide on a Steep Slope Covered with Blue Grass Sod.

the only adequate protection against disastrous soil loss is in the reforestation of such localities with the larger varieties of trees. The planting of such trees as the black walnut and the white oak and others with very large tap roots is especially desirable.

The Wabash River Flood of 1913, at Lafayette, Ind.

R. L. Sackett.

The principal factors affecting the flood discharge of rivers in cubic feet per second per square mile are:

The duration and intensity of rainfall.

The topography of the watershed.

The geology of the watershed.

Temperature and condition of the soil and surface.

Presence of lakes.

Slope and general character of the channel.

Data has not yet been collected so carefully and for long enough periods to permit predicting flood stages with any accuracy.

Tiefenbacher gives the following estimate of the flood discharge of European streams in cubic feet per second (See Ency. Brit., Eleventh Ed., Vol. XIV, p. 77):

In flat country 8.7 to 12.5 cubic feet second per square mile.

In hilly country 17.5 to 22.5 cubic feet second per square mile.

In moderately mountainous districts 36.2 to 45.0 cubic feet second per square mile.

In very mountainous districts 50 to 75 cubic feet second per square mile.

Various formulas have been proposed to express the maximum flood flow such as

O'Connell proposed, Q equals $K\sqrt{M}$ where K varies "from 0.43 for small rivers draining meadow land" to 67.5 for the Danube.

Q is the discharge in cubic feet per second.

M is the area in square miles.

Fanning proposed, Q equals 200 M for New England Rivers.

Dredge gives, Q equal $1300 \frac{M}{L^{\frac{2}{3}}}$ where L is the length of the catchment area in miles.

Kuichling plotted available data and derived the following formulas:

$$Q = \left(\frac{44000}{M + 170} + 20.\right) M. \text{ for floods exceeded occasionally;}$$

$$\text{and } Q + \left(\frac{127000}{M + 370} + 7.4\right) M, \text{ for floods exceeded rarely.}$$

In U. S. Geolog. Survey Bulletin No. 147.

$$Q = \left(\frac{46790}{M + 320} + 15\right) M. \text{ is proposed.}$$

Many other formulas have been proposed and are given in a paper by Mr. Fuller in the Trans. Amer. Soc. C. E., Vol. XXXIX, p. 1063.

When applied to the Wabash they give widely varying results because none of them was made for the topographical and meteorological conditions which characterize our floods.

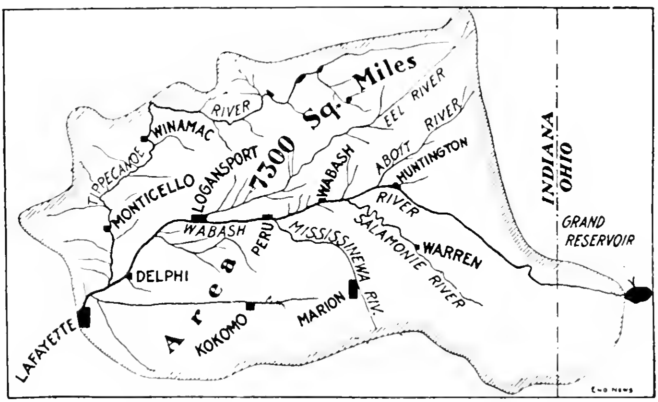


Fig. 1. Drainage Area of the Wabash River above Lafayette, Ind.

The following extract from an article by the author in Engineering News, April 24, 1913, will explain the conditions causing and accompanying this flood.

A series of heavy rains, extending over the entire drainage area of the Wabash River, commenced March 21 and continued at intervals until March 26, raising the river to unprecedented heights, causing the loss of many lives and the destruction of several million dollars of property.

Previous floods which did much damage occurred June 11, 1858, August

5, 1878, February 17, 1883, and March 15, 1907. The flood of 1913 reached a mark 22 inches higher than the record of 1883 at Lafayette, Ind., and exceeded all records at Peru and Logansport by as high as 8 feet. The flood of 1883 was produced at Lafayette by an ice jam which formed about a mile below the city. The damage done was due to slack water, while the present flood caused the partial destruction of three large steel bridges by extraordinary erosion of the river bottom in the restricted sections.

One student lost his life in an attempt to rescue men marooned on the Brown-street levee, when the latter washed out on the west of them and the bridge fell on the east of them. High water closed the gas works, the two water-works pumping stations, the city heating and lighting plant and many industries; one light and power plant continued in operation although its condensers and pumps were under 7 feet of water.

The drainage area with its tributaries above Lafayette, as shown in Fig. 1, includes an area of about 7,300 square miles, of which 400 are in Ohio. The whole of this area is in a glaciated area, the depth gradually decreasing east of this point until near Logansport, Ind., the bed of the river is in rock. East of that point the deposit varies in thickness.

The drainage area is practically clear of forests and under cultivation. The average fall of the river is about 18 inches per mile here and increases in the upper portions. There are numerous islands and sand bars which form and are swept away in periods of high water. The soil wash is high and the loss therefrom is a matter of great moment. The high turbidity is, of course, a factor in the erosive action which is so characteristic of the rivers of the Mississippi Valley.

The elevation of the head waters above M. H. T., New York harbor, is about 1,000 feet; at Huntington, 699 feet; at Logansport, 583 and at Lafayette, 500 for low water.

Rainfall data preliminary to the hydrograph, Fig. 3, are given in Table I.

TABLE I. RAINFALL DATA OVER WABASH RIVER DRAINAGE AREA.

(Measured by Experiment Station at Purdue University.)

Date	Inches.
Average annual precipitation	50
Greatest annual precipitation, 1909	55
Greatest monthly precipitation June, 1902	11 37
Greatest precipitation in twenty-four hours, August 12, 1912	4.30
Rainfall for March, 1913	7 05

The hydrograph shows a remarkable relationship between rainfall and runoff for a watershed of this area—7,300 square miles. From March 1 to

March 20 inclusive, only 0.94 inches of rain fell. From Fig. 3 it is apparent that according to the government rain gage at Purdue, and a private gage, about 1 inch of water fell preceding the 23d, enough to thoroughly saturate the soil. On the 23d, 1.75 inches of rain fell; another inch on the 24th; 1.35 on the 25th-26th and snow on the 26th, which did not immediately melt. While there are no other rain gages on the watershed above this point from which records were obtainable, it is quite probable that the diagram represents average conditions. (See Table in *Engineering News*, April 3, 1913, p. 381.)

The daily maximum temperature during the flood period is also shown on Fig. 3. While there had been no snow the saturated condition of the ground, which was free from frost, the temperature and the distribution of rainfall caused the highest known stage of the river.

Gagings of the Wabash River here have been made by students at Purdue University for several years and by the Weather Bureau and U. S. Geological Survey.

From these we find the following greatest annual discharge:

Date.	*Max. for Year in Cu. Ft. per Sec.*
1904, March 27	70,000 (estimated.)
1907, March 15	41,500
1908, March 7	57,000
1909, February 25	44,000
1910, January 19	49,000
1911, January 29	31,000
1912, March 20	45,900
1913, March 26*	95,400 (including flow over levee.)

From the above data it is evident that the flood of 1913 was greater than any other recent one.

The maximum flood rate at Lafayette was less than 20 cubic feet per second per square mile. For Logansport, the flood of 1904 gave less than 20 cubic feet per second per square mile.

These are low rates and as the rainfall did not average as great as has been recorded for equal areas otherwheres it was not a flood which would occur only once in a hundred years, but may be expected more frequently than that.

*Note. A more extended investigation of the flood gagings indicates that the maximum discharge may have reached 130,000 cubic feet per second.

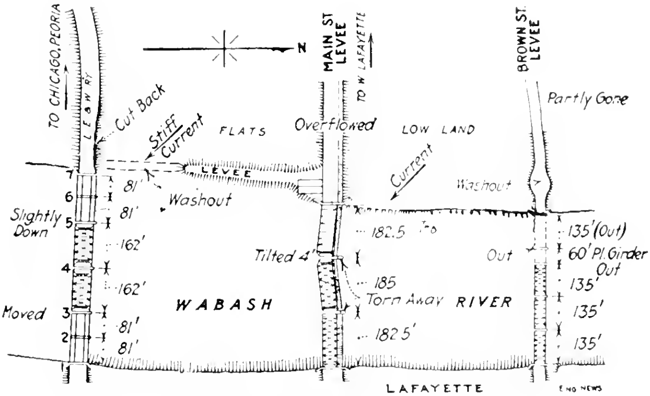


Fig. 2. The Three Bridges Across the Wabash at Lafayette.

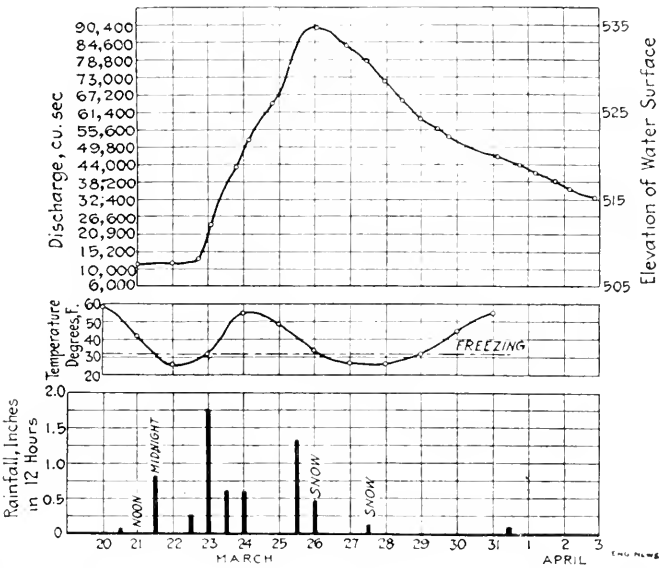


Fig. 3. Hydrograph of the Wabash River, Lafayette, Ind., March 20–April 2, 1913.

From the data so far available for floods in the Ohio River Valley, Fuller proposes as the maximum 24 hour flow:

Q equals 150 M, where M is the catchment area in square miles and Q is total cubic feet per second.

As a result the maximum expected flood flow here would be 180,000 cubic feet per second.

The average flood is given as, Q equals 75 M, which equals the recorded discharge of last March.

Another method of discussing the question of future floods is by their expected frequency. For those eastern streams where data has been collected for some time it appears that a flood of twice the average flood discharge may be expected about once in 40 years.

The Selective Action of Gentian Violet in Bacteriological Analysis.

C. M. Hilliard.

In 1912 Churchman[1] reported a new differential test for the *Schizomycetes*, depending upon the selective bactericidal action of gentian violet. The action of this stain in high dilution upon various organisms planted in media containing the dye was found to correspond closely to the Gram staining reaction, the forms inhibited—"violet positive"—being in the majority of cases forms that retain the stain; those growing—"violet negative"—usually being strains that decolorize when treated by the Gram method. His actual results on 318 different strains of bacteria are shown in the following table:

318 Strains.	Gram positive.	Violet positive.	Violet negative.
	182	165 (90%)	17 (10%)
	Gram negative.		
	136	15 (11%)	121 (89%)

The characteristic behavior of bacteria cultivated in the presence of the dye in high dilution (1:100,000) is "so constant and clear cut that it must be regarded as a fundamental biological characteristic." The Gram stain has ever been an unsatisfactory test with certain groups of organisms, especially the Coccaceæ. Differences in the age of the cultures, time of application of the various reagents, and the temperature may influence the result. It is sometimes extremely difficult to interpret the result of the stain as, some individual cells will retain the stain and others in the same field or even in the same chain as contiguous cells will have decolorized. As an instance of discrepancy in interpretation of results we may cite Kligler's work[2] who by the same method (Churchman's) recorded 13 of 17 strains of saprophytic cocci as certainly Gram negative, while four stained uncertainly, as opposed to Churchman's recording of all 17 strains as Gram positive. In my own work on 240 strains of streptococci I found 21 to stain irregularly and occasionally successive stains of the same culture at different times would give totally

[1] Jour. of Exp. Med., Vol. XVI, No. 2, p. 221.

[2] Jour. of Exp. Med., Vol. XVII, No. 6, p. 653.

opposite results. The violet reaction is in striking contrast to this "notoriously uncertain" staining test and though not assuming to be a parallel or substitute test, it is a valuable differential reaction.

Work on various other staining agents has shown many to exhibit a definite selective inhibitive action. The Conradi-Drigalski medium for isolation of *B. typhosus* from water, stools, etc., has as its basis the restraining action of the crystal violet towards various cocci and bacilli, without influencing at all the growth of the typhoid-colon group. Krumwiede[3] and Pratt[4] and Churchman[5] have made observations on the growth of bacteria on media containing various closely related aniline dyes and have found their action to correspond closely to that of the gentian violet. Smith[6] has shown the violet test to be specific for certain of the phytopathological bacteria.

Aside from the significance of this test as a classificatory feature of great value it might be expected to have some practical application in sanitary bacteriological analysis, as most of the intestinal bacteria that we presume indicate pollution by sewage are Gram negative and, therefore, with few exceptions, are violet negative. Many of the common saprophytic bacteria found normally in water and in milk are Gram positive and so would in the majority of cases fail to grow in the presence of the stain. Churchman in his work on the collection at the American Museum of Natural History found the following organisms to be Gram negative and with two exceptions also violet negative:

3 strains of *B. coli communis*.
5 strains of *B. coli communior*.
5 strains of *B. paracoli*.
2 strains of *B. coli varietas*.
14 strains of *B. typhosus*.
18 strains of *B. paratyphosus*.
5 strains of *Vibrio cholera*.
3 strains of *B. dysenteriæ*.
5 strains of *B. enteritidis*.
3 strains of *B. cloaca*.

Curiously enough *B. welchii* and *B. sporogenes*, both Gram positive, proved to be violet negative. *Subtilis, mycoides, megatherium, liodermos, mesentericus* and many of the saprophytic cocci are violet positive.

[3] Ztschr. of Hyg., Vol. XXXIX, p. 283.
[4] Proc. N. Y. Path. Soc., Vol. XIII, p. 43.
[5] Jour. Exp. Med., Vol. XVII, No. 4, p. 373.
[6] Phytopathology, Vol. II, No. 5, p. 213.

A priori, then, we might expect that the addition of gentian violet to our culture media in proper dilution would result in eliminating many saprophytic bacteria, still permitting those forms of sewage origin to flourish. If we used a sugar medium and added litmus we could still further emphasize the colon group, as these are acid-forming organisms. The violet stain partly masks the coloration of the litmus indicator, but not sufficiently to make the picture of acid fermentation uncertain.

My work to date has not been extensive enough to warrant any definite conclusions, but it is at least suggestive. I have analysed various samples of water taken chiefly from the Wabash River, which is rather highly polluted at Lafayette. Duplicate plates of proper dilutions have been made of litmus-lactose agar and litmus-lactose-violet agar, the latter being the same as the former with the exception of the addition of a standardized loop full of gentian violet solution to the agar tube just before pouring. The plates have been examined after 24 hours incubation at 37° C. The total number of organisms growing, the total number of red colonies—acidifers—and the presumptive coli colonies growing on the two media have been recorded. The suspected coli growths have been "fished" and planted in lactose-peptone-bile for confirmation and almost without exception the fermentation of this media has checked the presumptive colony growth.

The colonies on the violet plates appear somewhat smaller and the acid production is less distinct. The stain is picked up by the cells so that the colonies appear, especially the sub-surface colonies, as distinctly purple growths. Viewed under the microscope the cells show a light purple color, indicating vital staining.

So far I have found pretty generally what was expected, viz., that the total count is materially reduced on the violet plates but that the number of red colonies, and especially of coli, are approximately the same on the two media. It has been found possible to plate a larger sample of water and to intensify the picture of presumptive pollution by the use of the violet. A few typical examples of actual tests will illustrate this:

Sample.	*Media.*	*Total counts.*	*Total red.*	*Coli.*
Wabash (polluted).	L. L. A.	15,000	5,000	3,000
	L. L. V. A.	8,000	6,000	6,000
Wabash....... ..	L. L. A.	10,000	1,800	600
	L. L. V. A.	3,100	1,100	500

Sample.	*Media.*	*Total counts.*	*Total red.*	*Coli.*
Wabash....	L. L. A.	3,500	2,000	700
	L. L. V. A.	1,500	1,300	600
Wabash .	L. L. A.	8,700	2,600	1,600
	L. L. V. A.	4,200	2,000	1,550
Tap (driven wells) .	L. L. A.	16	0	0
	L. L. V. A.	0	0	0

The last test noted in the above table suggests that the ratio of the count on lactose agar with and without the violet present may be a valuable diagnostic feature. Polluted waters show about 50 per cent. reduction of the total count on violet media, while unpolluted water containing more of the saprophytic violet positive organisms show a much greater reduction; 100 per cent. in the case of the tap water at Lafayette. Gram stains of centrifuged specimens of fresh sewage shows the ratio of Gram positive to Gram negative cells to be anywhere from 1:5 to 1:100. This does not check the 50 per cent, reduction very closely but many factors of a variable nature enter into the two tests. The significant point is that the majority of sewage organisms are Gram negative and therefore may be expected to be violet negative.

Further work is being done to determine the quantitative relations of pure strains of typhoid and coli studied by this method and to test the effect of attenuation of these forms in relation to the violet when held in suspension in water under various conditions of temperature, light, etc. So far the results seem to indicate that sojourn of a week or more has no selective inhibitive effect; in fact, the violet media seems to be favored by the organisms after this treatment.

One interesting point has been brought out by this latter study. In working with several strains of coli suspended in water, variation in counts on the two media—lactose agar plus violet, and without the violet—was so great that I decided to test the individual strains. I found one, No. 41 received from the American Museum of Natural History and thoroughly tested by myself, to be absolutely inhibited by the violet stain. A study of the culture showed it to be a motile, Gram negative bacillus, fermenting bile rather weakly, not liquefying gelatin after ten days, and giving other characteristics typical of coli. Churchman and Michael[7] have described work on

[7] Jour. Exp. Med., Vol. XVI, No. 6, p. 822.

B. enteritidis where one form, indistinguishable from the others by any morphological, cultural or agglutination characters was singled out nevertheless by this delicate affinity of the violet dye. The observation, he states, is an isolated one, but my experience with this colon culture seems to confirm the fineness of this selective affinity.

Although my work is too meagre to warrant any definite conclusions, yet it seems to be suggestive, at least, of the value of selective bactericidal or bacteriostatic dyes as valuable adjuncts in sanitary bacteriological analysis.

An Epidemic of Diarrhœa, Presumably Milk Borne.

P. A. Tetrault.

MILK-BORNE EPIDEMICS IN GENERAL.

Milk-borne epidemics, as a rule, show certain characteristics which distinguish them from all other epidemics.

1. A very sudden outbreak and a gradual decline.
2. The first cases appear among milk users.
3. The severity of the outbreak depends on the distribution of the infected milk and the amount of infection present in the milk.
4. The length of the epidemic varies with the period of incubation of the disease, the length of time the milk is infected, and contagiousness of the disease.
5. Secondary cases very often occur.

THE DUBLIN EPIDEMIC.

On August 5, 1913, there broke out in Dublin, N. H., an epidemic of diarrhœa exhibiting all of these above-named characteristics. At first the outbreak was localized along one milk route, but soon became general and spread throughout the entire community. During the first few days of the epidemic there was a sudden rise in the number of cases reported and the total jumped from a few cases to thirty-one, all of which were in households taking milk from this one milkman.

The Dublin Chemical and Bacteriological Laboratory had been making routine bacteriological tests of all the milk sold in Dublin. On August 4th the milk from this particular barn was found to be infected with *B. coli*. Up to this time the total count had been very low, with absence of coli and streptococci. Immediately a survey of the barn and surroundings was made and the following data collected:

Two members of the family had had diarrhœa on the evening of August 3d. One of these persons handled the milk in the milk room.

An open privy, which had been overlooked up to this time, was discovered in the horse stable immediately adjoining the milk room. Flies were in great abundance, and it was admitted by a member of the family that they were frequently found in the milk room.

The milk continued to show coli until August 8th, when it cleared up entirely.

THE NATURE OF THE DISEASE.

The disease showed a very rapid onset accompanied by pain, high temperature, nausea and vomiting. Diarrhœa always followed. Secondary cases were numerous, especially among children.

THE SPREAD OF THE EPIDEMIC.

Until about August 12th, all cases occurred along the suspected milk route. Over 60 per cent. of these milk users were infected. On that date one of the neighbors of an infected household came down with the disease. From then on the contagion spread from one family to another, probably through contagion, until nearly every home in the community had or had had the disease.

Nothing was done to investigate the causes, although the State Board of Health was asked to look over the situation.

It might be said, to eliminate as many probable causes as possible, that the town of Dublin does not have a common water supply. Most of the water comes from driven wells or from the lake. Dublin is a summer resort and everything is done to keep the town in as sanitary a condition as possible.

CONCLUSION.

The epidemiology of this outbreak has not been studied carefully enough to permit us to draw any positive conclusions. I have tried to show the relation of the epidemic to the milk infected with coli. The evidences seem to incriminate the milk, although a positive diagnosis of a milk-borne epidemic cannot be reached from the data at hand.

On the Vertical Distribution of the Plankton in Winona Lake.

Glenwood Henry.

During the summer of 1912, while studying at the Biological Station of Indiana University, I undertook to make a quantitative determination of the vertical distribution of the plankton in Winona Lake. A study was also made of the significant physical and chemical conditions associated with it. The lake was mapped by A. A. Norris ('02), and some of its physical features were considered by Juday ('03).

Winona Lake is a small temperate lake of the deeper type. Its maximum length is 1.4 miles. Its maximum width is 1.2 miles and its maximum depth is 81 feet. It is large enough to present all of the usual plankton problems and small enough to make their study at critical times easily possible. All forms taken were determined, at least generically, and their abundance estimated. The exact quantitative work was limited to the eleven genera and groups, *Ceratium*, *Tribonema*, *Anabaena*, *Diaptomus*, *Fragilaria*, *Microcystis*, *Lyngbya*, *Cyclops*, *Nauplii*, *Cladocera*, and *Rotifera*. The *Cladocera* were represented by the following forms: *Daphnia hyalina*, *Daphnia pulex*, *Daphnia retrocurva*, *Chydorus*, *Bosmina*, *Pleuroxus procurvatus*. The following *Rotifera* were identified: *Anuraea cochlearis*, *Anuræa aculeata*, *Notholca longispina*, *Brachionus pala*, and *Hexarthra polyptera*. Weekly catches, July 11th to August 13th, were taken of the eleven forms at ten levels, ranging from surface to 23 meters. The temperature, also the amount of dissolved oxygen, carbon dioxide, and carbonates were determined for the different depths.

I desire to express my thanks to Dr. Will Scott, acting director of the Station, for the many courtesies and helpful suggestions extended to me in the collection of the data for this paper. Scott Edwards made the temperature observation and G. N. Hoffer determined the dissolved gases. To these gentlemen I am under obligation for permission to use these data.

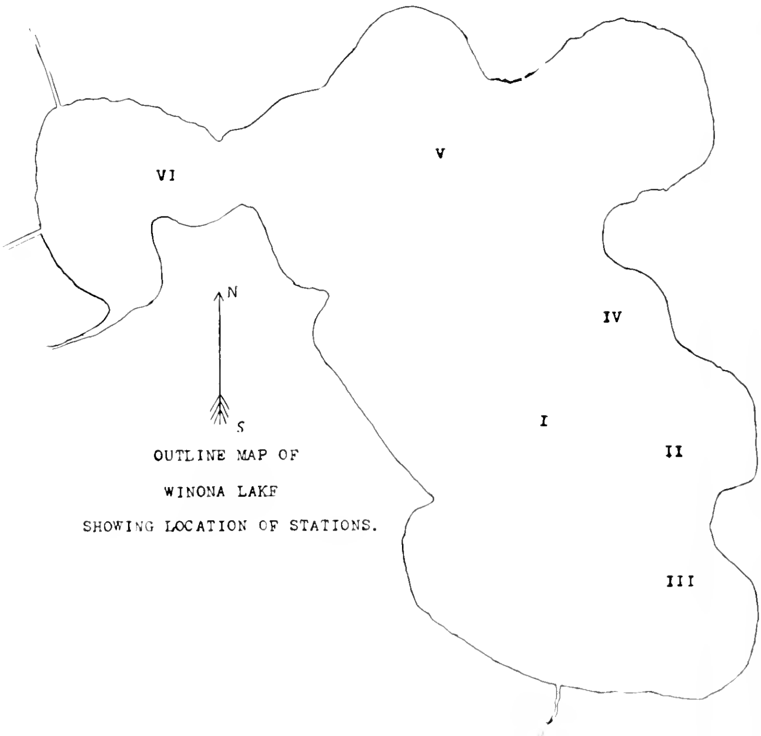
Physical Conditions.

Turbidity.

The turbidity of the lake was determined by means of a Secchi's disk. The water was clearest on July 24th, when the disk disappeared at 4 m. The minimum depth, 2.7 m., occurred several times during the summer.

Temperature.

Temperature readings were made by means of a thermophone, and were taken simultaneously with the plankton catches. The temperature of the surface water, during the summer, varied from 21° to 26° C. At the bottom of the lake, only a slight variation ranging from 8.3° C. to 9° C. occurred. The thermocline was about 6 or 7 m. in thickness. The epilimnion was 5.5 m. thick on July 1st; by the middle of August it had descended to 14.5 m. This descent of the thermocline was associated with the high wind and cloudy days of the latter part of August. The average vertical readings are given in the accompanying temperature graph. They were taken in the deepest part of the lake at various times during the day.



OUTLINE MAP OF
WINONA LAKE
SHOWING LOCATION OF STATIONS.

Weather.

The summer of 1912 exhibited very unsettled weather conditions in the vicinity of the lake. Strong winds prevailed much of the time, especially during the month of August, and heavy rains often raised the surface of the lake several inches above its normal level. The winds, which were generally accompanied by cloudy weather, blew the surface of the water into waves of considerable magnitude for a small lake, and caused a piling up of the surface water on the leeward side. Detailed records cannot be given because the only anemometer available was adapted to winds of low velocity only, which rendered it useless during the high winds which prevailed.

Dissolved Gases.

A study of the dissolved gases revealed the fact that there was sufficient carbon dioxide present for photosynthesis, and that oxygen was present in sufficient quantities to support animal life at all depths. At the surface of the lake there were 5 c. c. of dissolved oxygen per liter; in the upper layer of the epilimnion there were 4.25 c. c. present; in the middle of the thermocline 2.35 c. c., and at the bottom of the lake there was 1.5 c. c. of dissolved oxygen per liter of water.

The carbon dioxide increased from .8 c. c. at the surface to 8.75 c. c. at the bottom. It increased from 2.5 c. c. to 5.5 c. c. from the top to the bottom of the thermocline.

METHOD USED IN PLANKTON CATCHES.

Six stations, position of which are indicated on the outline map, were established. They were located in positions which best showed the effect of the wind upon the plankton. The depths of the staions varied from 7.5 to 23 m. The catches for this report were mostly made at Station 1, depth 23 m., the other stations being used as a check upon the results obtained at that station. Weekly catches were made by the use of a brass pump, known in the trade as "The Barnes Hydroject Pump," a three-fourths inch garden hose, and a plankton net, the straining part of which was made of No. 20 Dufour bolting cloth. These weekly catches were taken respectively at the surface, 1 m., 2 m., 4 m., 6 m., 8 m., 10 m., 14 m., 20 m., and 23 m. The quantity of water, 10.4 liters, strained for each catch, was the amount produced by 50 strokes of the pump. The ordinary counting method was used to determine the number of organisms. In most cases 20 per cent. of the material was counted, but all individuals of forms readily recognized by the naked eye were counted.

PLANKTON DISTRIBUTION IN REFERENCE TO THE EPILIMNION, THERMOCLINE, AND HYPOLIMNION.

Seventy-four and six-tenths per cent. of the plankton inhabited the epilimnion. The per cent. of the eleven forms studied quantitatively are: *Rotifera* 87.4, *Lyngbya* 80.7, *Ceratium* 88.6, *Microcystis* 76.5, *Anabaena* 84.8, *Tribonema* 64.3, *Nauplii* 60.5, *Diaptomus* 71.2, *Fragilaria* 76.7, *Cyclops* 38.8, *Cladocera* 31.6.

Seventy-three and three-tenths per cent. of the phytoplankton and 83.3 per cent. of the zooplankton inhabited the epilimnion.

The thermocline contained 21.8 per cent. of the plankton of the lake. The following synopsis gives the per cent. of each of the eleven forms: *Diaptomus* 23.8, *Fragilaria* 19.5, *Cyclops* 34.4, *Cladocera* 40.7, *Tribonema* 26.6, *Nauplii* 18.7, *Microcystis* 20.3, *Anabaena* 14.4, *Ceratium* 10.3, *Lyngbya* 18, *Rotifera* 10.8. Of the zooplankton 12.3 per cent., and of the phytoplankton 22.6 per cent. lived in the thermocline.

The hypolimnion contained 3.5 per cent. of the plankton, 4.3 per cent. of the zooplankton, and 3.4 per cent. of the phytoplankton. The per cent. of each form in the hypolimnion was: *Cladocera* 27.7, *Cyclops* 26.7, *Fragilaria* 3.5, *Nauptii* 20.8, *Diaptomus* 5, *Anabaena* .8, *Tribonema* 9.1, *Microcystis* 3.2, *Lyngbya* 1.1, *Rotifera* 1.7, *Ceratium* 1.1.

At 23 m. there were more forms per liter than at 20 m. This was probably due to the presence of some dead organisms that by the loss of activity had sunk to the bottom. The end of the hose at 23 m. was very close to the bottom.

THE EFFECTS OF PHYSICAL FACTORS UPON DISTRIBUTION.

The large per cent. of plankton in the epilimnion was due to the presence of sunlight and plenty of food. In the upper half (best lighted part) of this stratum, there was sufficient carbon dioxide to permit rapid photosynthesis. Apstein ('96) found light to be the most important factor in explaining the presence of fifty-six times as much plankton from 0-2 m. as in the remainder of the water. That direct sunlight has a repelling effect upon some plankton, was demonstrated by the fact that 53 per cent. inhabited the first two meters, while only 12 per cent. lived at the surface, *i. e.*, in the surface meter. Other factors enter into the explanation of the prolific life in the epilimnion. Many organisms were too heavy to sink into the cold heavy waters of the thermocline. Juday in his work on the Wisconsin

Lakes, determined that the vast amount of algæ collecting at the top of the thermocline, at certain times, so increased the process of photosynthesis, that 300 per cent. oxygen saturation occurred. It is also to be remembered that the lowering of the thermocline in August increased the depth of the epilimnion one meter.

Four factors must be taken into consideration in accounting for the rapid decrease of organisms below the epilimnion: First, the lower temperature (20° C. at the top of the thermocline and 9.6° C. at the bottom during July, 21.1° C. and 10.7° C. respectively being the average temperatures for August); second, the decrease in the amount of oxygen from 4.25 c. c. per liter of water at six meters to 2.50 c. c. at the bottom of the thermocline; third, the decrease in the amount of food; and, fourth, the limited amount of sunlight.

In the hypolimnion the physical conditions were so uniform that the plankton was very evenly distributed in this stratum.

SEASONAL DISTRIBUTION OF THE PLANKTON.

Six weeks is too short a time to obtain results of much value concerning seasonal distribution. However, the data collected indicate the following facts: The plankton, as a whole, increased in amount in August. *Ceratium*, *Fragilaria*, *Microcystis*, and *Lyngbya* increased gradually to August 13th, the date of the last observation. *Diaptomus* reached its maximum August 1st; *Nauplii* and *Anabaena* on August 8th. The *Cladocera* and *Rotifera* increased rather suddenly in August and were most numerous on the date of the last collection.

THE EFFECTS OF WIND UPON DISTRIBUTION.

As mentioned earlier in this paper, six stations were established to determine whether or not the plankton of the whole lake at a given level was homogeneous at all times. Repeated catches at different stations under ordinary conditions indicate that the plankton at the different levels was uniform.

SUMMARY.

Oxygen sufficient for respiration occurs at all levels of the lake, and probably is not a limiting factor.

Carbon dioxide was present in sufficient quantities for photosynthesis.

The epilimnion contained 74.6 per cent. of the plankton, the thermocline 21.8 per cent. and the hypolimnion 3.5 per cent.

Plankton was more abundant in August than in July.

So far as these observations go, wind has no appreciable effect upon the distribution of the plankton.

EXPLANATION OF FIGURES.

Figures 1 to 15, inclusive, indicate the distribution of the organisms.

The numbers at the bottom indicate the date.

Figure 16 shows graphically the amount of dissolved gases at different depths.

Figure 17 indicates the maximum, minimum, and average temperatures.

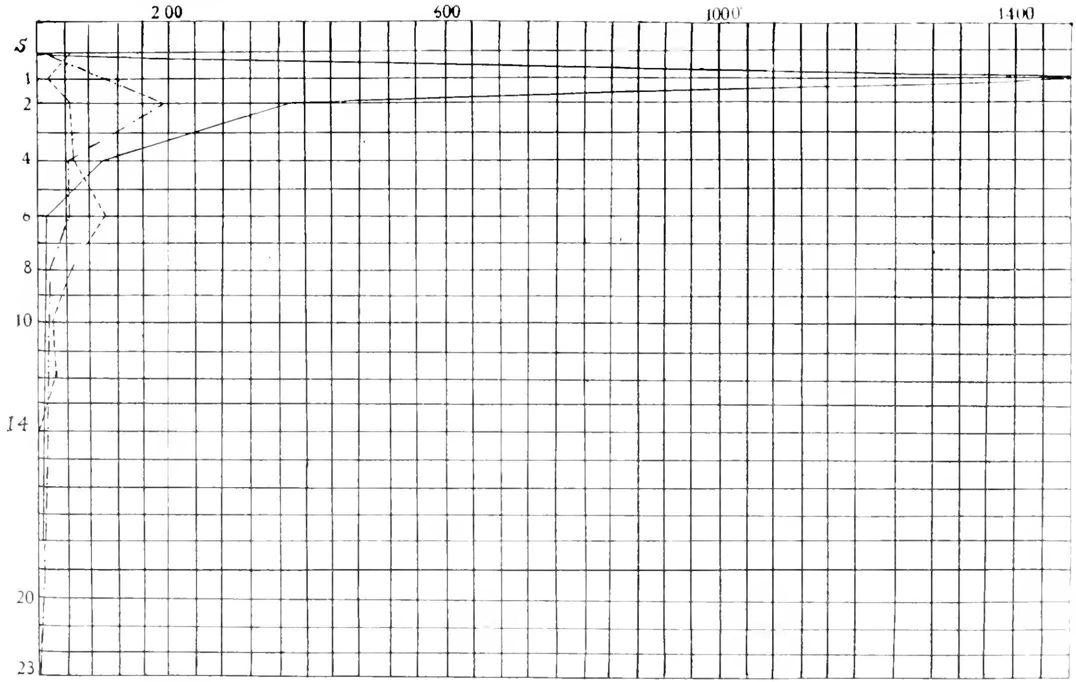
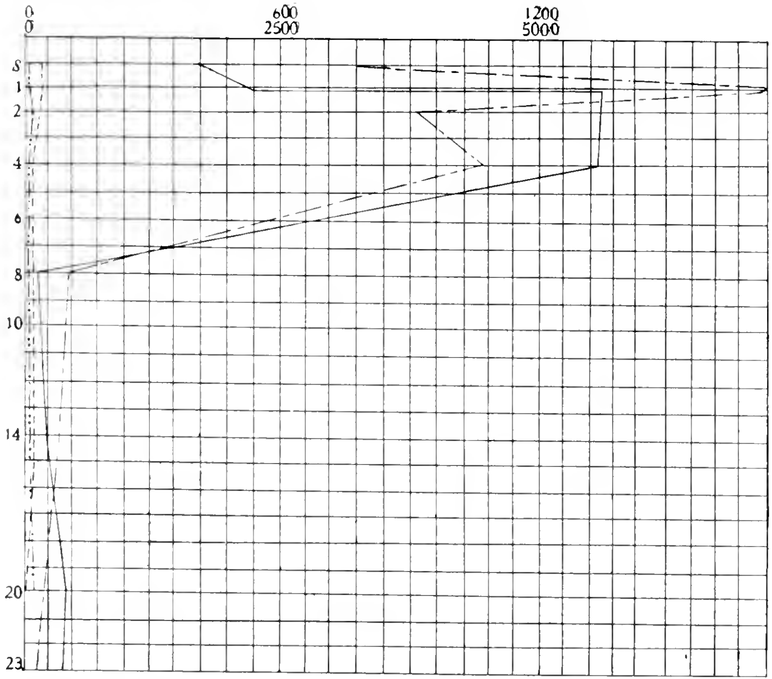


Fig.1.--- Ceratium.
7-11.
8-1.
8-13.



G1
Fig.2.--- Fragilaria and Microcystis.
Fragilaria. 7-11.
Fragilaria. 8-13.
Microcystis.7-11.
Microcystis.8-13.

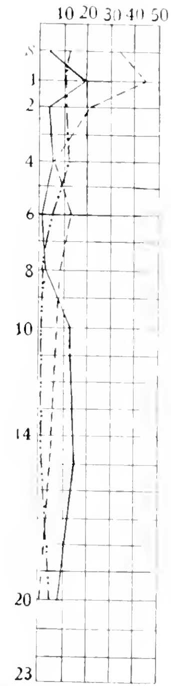


Fig.3.--Nauplii.
7-11.
8-1.
8-13.

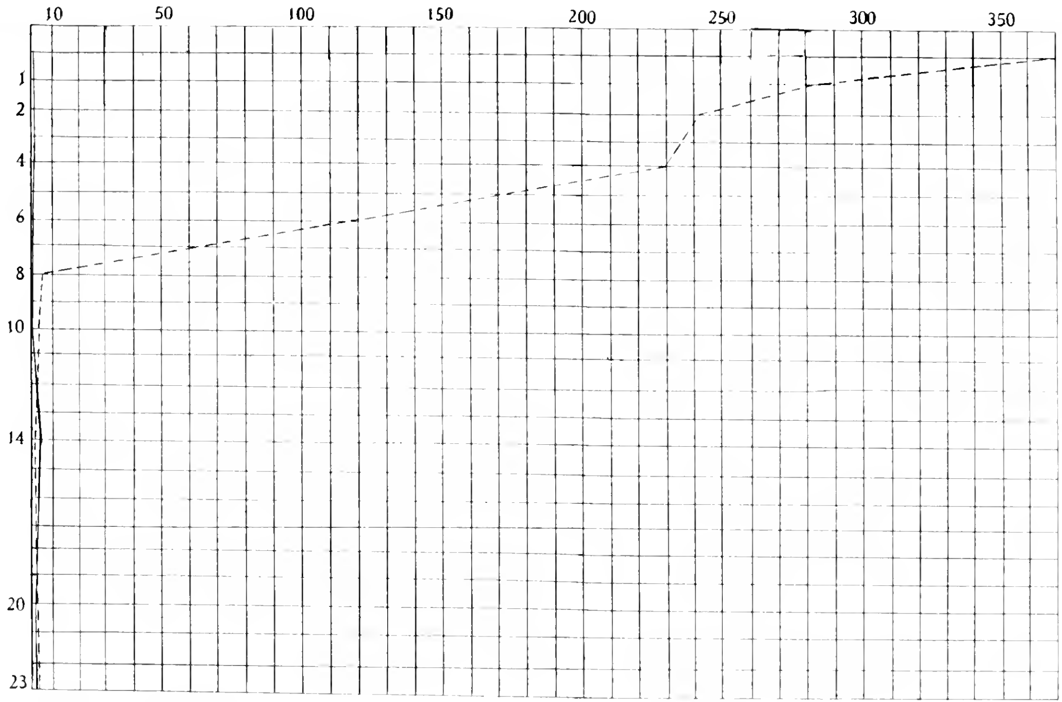


Fig.4.--- Anabaena.
7-11. ________
8-8. - - - - - - -

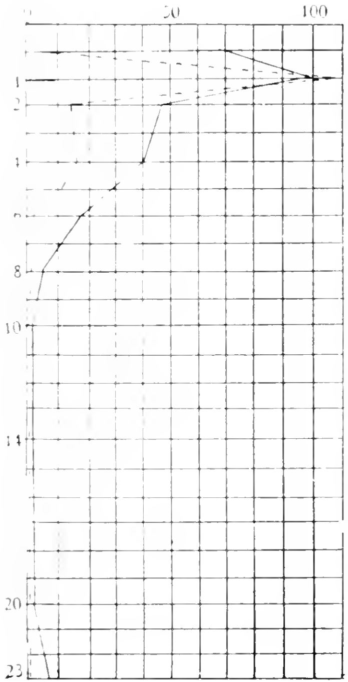


Fig.5.--- Lyngbya.
7-11.
8-13.

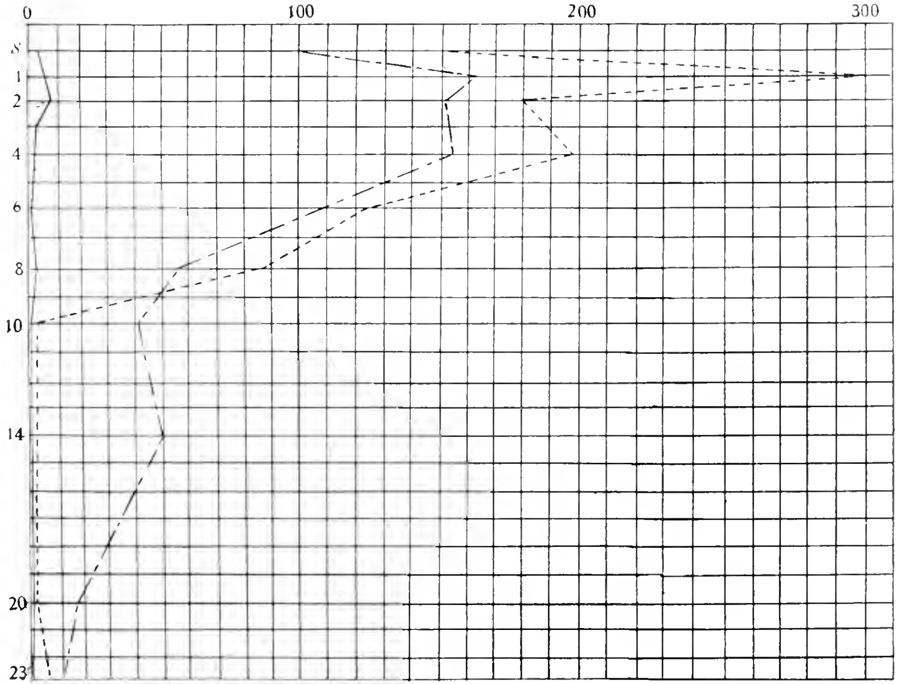


Fig.6.---Tribonema.
7-11.
8-8.
8-13.

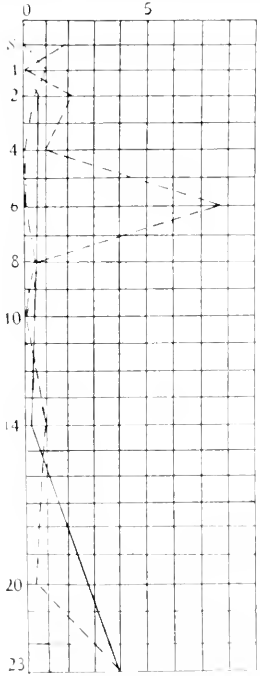


Fig.7.--- Cladocera.
7-11. —··—··—··—
8-8. — — — — — —
8-13. ————————

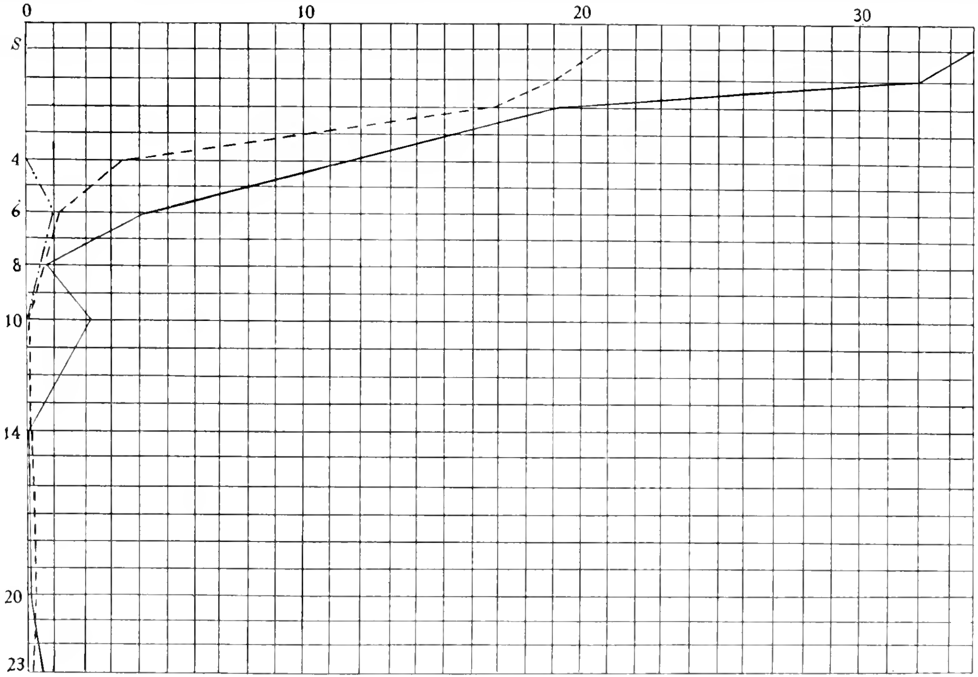


Fig.8.--- Rotifera.
7-11. —·—··— —
8-8. — — — — — — —
8-13. ————————

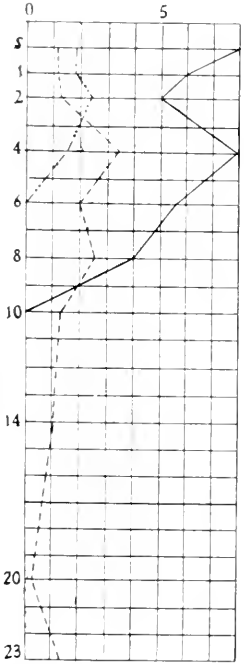


Fig.9.--- Diaptomus.
7-11.— — —
8-8. - - - - - - -
8-13.————

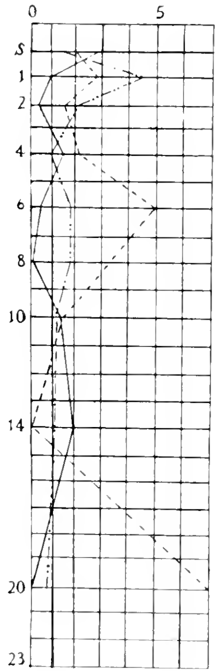


Fig.10.--- Cyclops.
7-11.— — — —
8-8. - - - - - - - -
7-18.————

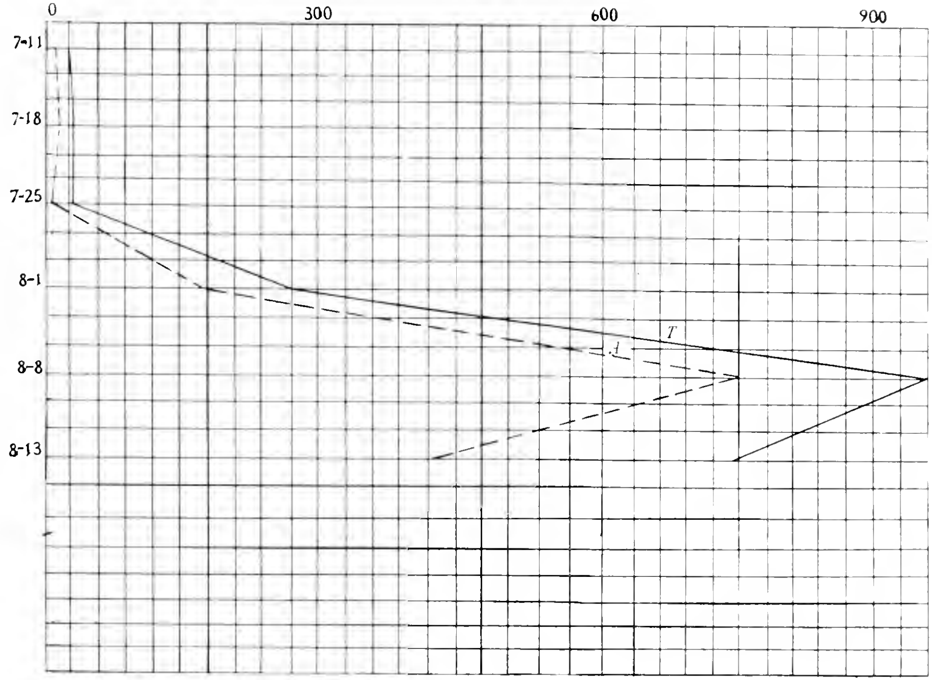


Fig.11.---Tribonema and Anabaena.
Tribonema.——Anabaena.- - - - -

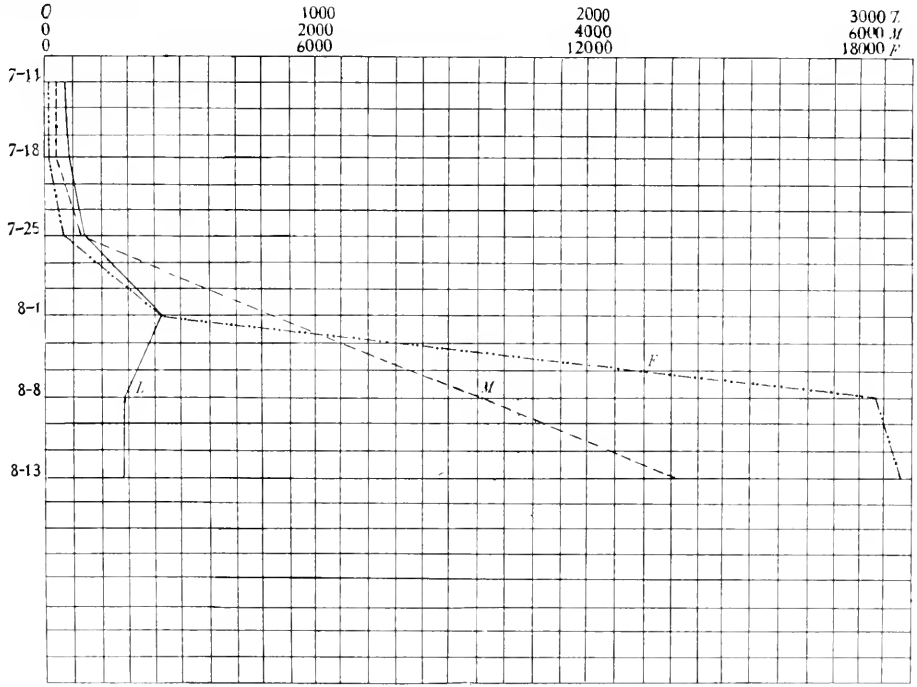


Fig.12.---Fragilaria,Microcystis,and Lyngbya.
Fragilaria —·—Microcystis----Lyngbya——

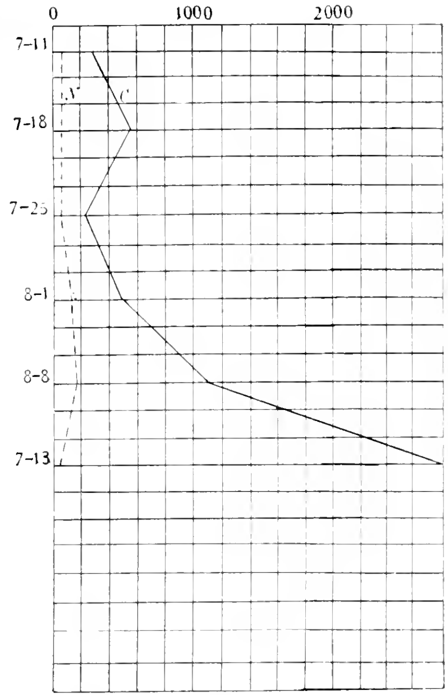


Fig.13.--- Ceratium and Nauplii.
Ceratium.—— Nauplii.------

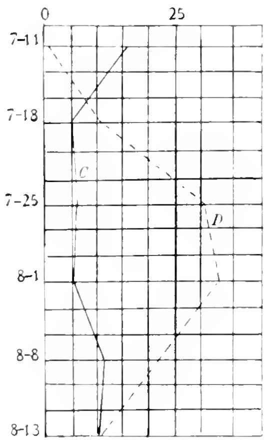


Fig.14.-Diaptomus--Cyclops
Diaptomus.----Cyclops.——

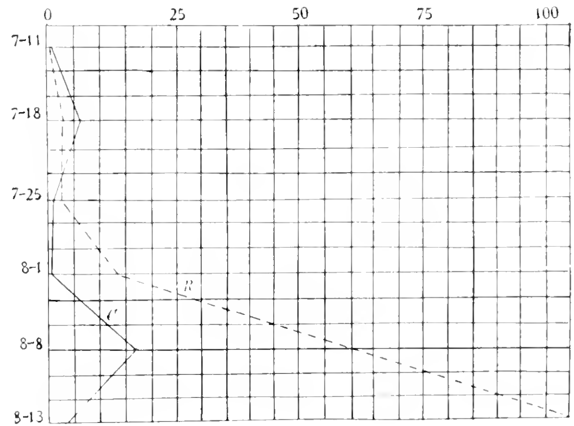


Fig.15.--- Cladocera and Rotifera.
Cladocera.———Rotifera.-----

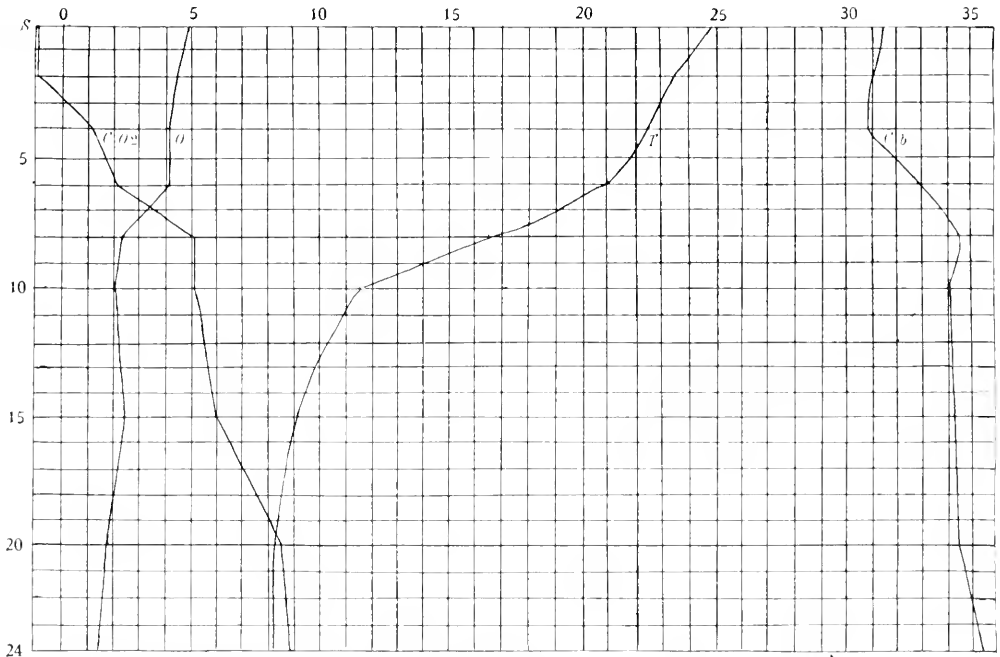


Fig. 16. *Chemical* chart of Winona Lake, Aug. 21, 12. (By George N. Hoffer)
Scale, 1 Vertical space = 1 meter. CO
CO_2 = read in cc per liter.
O = " " " "
T = " " *Centigrade*
Cb = " " grams per liter.

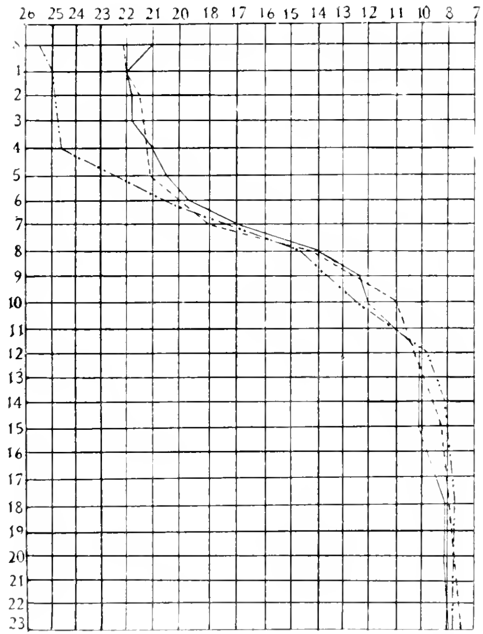


Fig 17 Seasonal Temperature Graph.
Horizontal spaces=degrees of temperature C
Vertical spaces=depth in meters.
Average temperature ————
Maximum temperature — — — — —
Minimum temperature —..—..—

A Simple Apparatus for the Study of Phototropic Responses in Seedlings.

Geo. N. Hoffer.

The purpose of this apparatus is to determine the minimum quantity of light, acting as a lateral stimulus, that will produce a curvature response in seedlings of various kinds as well as some of the fungi, such as *Phycomyces* and *Pilobolus*.

Any kind of light may be used, but in the comparative studies I use direct sunlight. The quantity of light is regulated by opening and closing an iris diaphragm with various-sized apertures for definite lengths of time.

The apparatus is made from a microscope carrying case. As shown in the photograph, Fig. 1, the outside attachments are the drawtube and rack and pinion of a microscope removed from the base and attached to one side of the box. The tube works through a hole in the side of the box. The opening is made light proof by a velvet collar, Fig. III, VC, glued to the rim and held to the tube of the scope by rubber bands.

Into another hole is fitted a hemispheric, revolving iris diaphragm, Fig III, I. This is on the adjacent side of the box close to the microscope and on the same level with the objective of the microscope. A mirror is attached to the box to reflect light directly into it through the iris and onto the plant. A micrometer eyepiece in the microscope is the index by which all of the readings are made. The illumination for the readings is supplied by the light which passes through the bottle, Fig. III, K, into a solid glass rod, SG, and conducted by the rod to within a half inch of the plane in which the plant is held and ends directly opposite to the objective of the microscope. This glass rod should be approximately one-half of an inch in diameter so as to present a field of sufficient size.

The bottle contains a saturated solution of bichromate of potassium in water. This solution is to absorb the active blue-violet rays of light. The glass rod is covered with black tape, Fig. III, T, and the opening into the box through which the rod extends is sealed against the admission of light by a velvet collar. A black cardboard collar, Fig. III, BC, slips over the bottle and rests upon the platform below the bottle. A piece of white cardboard on the platform serves as a reflector for the light entering the bottle. It is this dull red light which is carried to the objective of the microscope and used to make the readings. This light enters only when making the readings and has not, in the number of cases tried, produced any stimulus that would effect the experiment and alter the response to the normal light stimulus. However, I have yet to try experiments on Phalaris.

The internal construction of the box, Fig. II, consists merely of a vertical rod on which works a burette clamp. The rod is so placed that a test tube containing the plant under study can be adjusted easily into position opposite both the iris and the objective of the microscope. The door of the box is fitted with strips of velvet so as to make it light proof.

To use the apparatus, seedlings are grown in soil, sawdust, etc., in test tubes in the dark room. These culture tubes should always be held in a vertical position while being adjusted in the box for study. The box is "loaded" in the dark room and the plants placed so as to be in the field of the microscope. The iris is closed and the door of the box is locked. The plant is then brought into focus using the illumination secured by raising the collar, BC, to a sufficient height and thus permitting the reflected light to enter the bottle from below. Readings are taken at intervals of several minutes before opening the iris in order to be certain that no geotropic stimuli other than the normal are acting. When no readings are being taken the collar rests upon the platform.

The plant is then laterally stimulated by opening the iris to any desired size for a definite length of time. The mirror reflects the light through the iris onto the plant.

The microscope is kept covered at all times with a photographer's focusing cloth. All of the readings are made under this cloth. This prevents any light from passing through the microscope and being focused onto the plant.

To record the results a graphic record may be made, using the ordinates to denote the extent of curvature in spaces on the micrometer eyepiece, and the abscissas to denote the time of stimulation, or presentation period, the latent period, and the length of time for the completion of the response. Figure IV illustrates such a record:

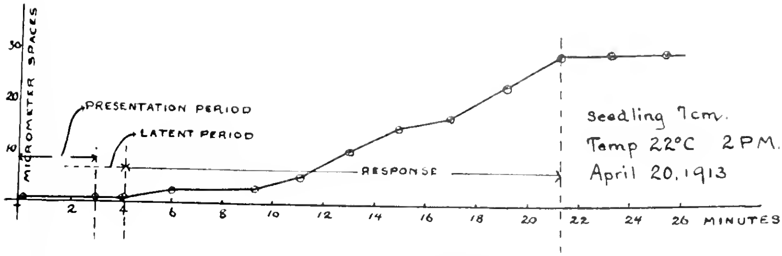


Fig. IV. Study of *Avena sativa.*

The ventilation of the box is unimportant for the short periods required for each study. A wet sponge placed inside of the box serves to keep the air moist. The temperature of the apparatus can also be recorded and all tests made under equitemperatures.

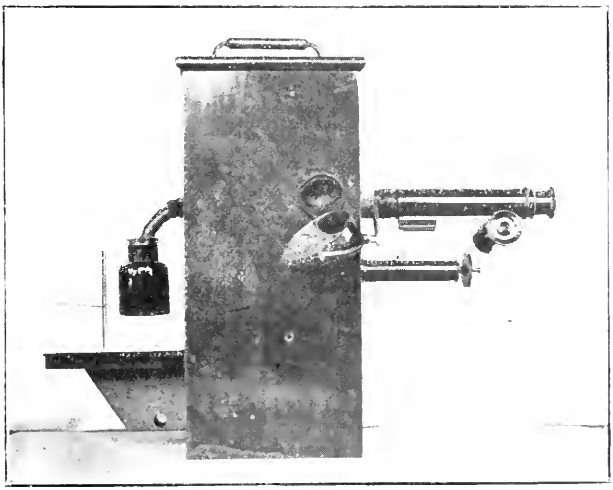


Fig. I. External View of Apparatus.

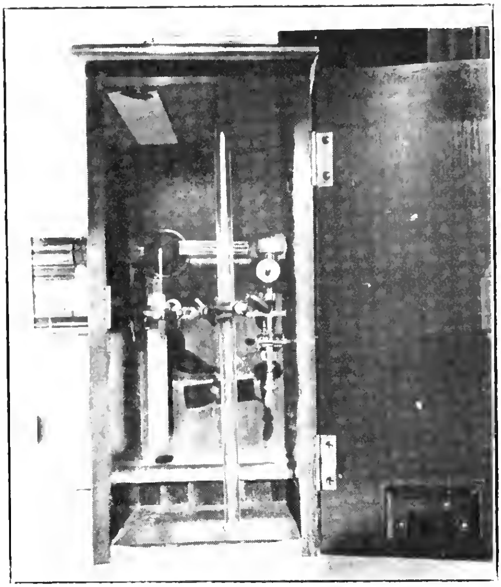


Fig. II. Internal View of Apparatus.

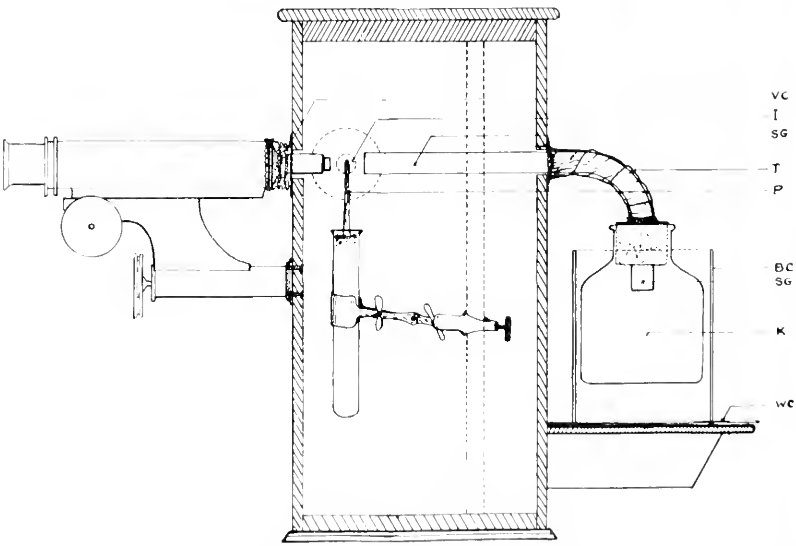


Fig. III. Cross section of the apparatus to show the position of the plant and its relation to the microscope and the glass rod; VC, velvet collar sealing the aperture through which the microscope works; I, the iris diaphragm; SG, the glass rod; T, tape covering the glass rod to make it light proof; P, the plant, BC, the collar which slips over the bottle; K, the bottle containing the saturated solution of bichromate of potassium; WC, the white cardboard to reflect light into bottle.

A Test of Indiana Varieties of Wheat Seed for Fungous Infection.

Geo. N. Hoffer.

"Indiana grows annually more than 2,500,000 acres of wheat. The average yield for the past ten years has been 15.1 bushels per acre."—Cir. No. 23, Purdue University Agr. Exp. Sta.

The economic significance of any factor which plays a part in causing a decrease in the quantity of the yield, even though this decrease may be represented by a fractional part of one per cent. of the yield, is considerable. The mere presence, then, of internally infecting fungi in the wheat seed studied in the laboratory may be indicative of very important problems in the field.

In Bulletin No. 203 of the Ohio Agricultural Experiment Station, T. F. Manns has described a method for detecting fungi internally infecting wheat and other small grain. The method in brief, consists in sterilizing the outside of the grain by means of a solution of corrosive sublimate in 50 per cent. alcohol and then placing the seeds in sterile petri dishes on agar-agar. This allows germination of the plant embryo when viable. Cultures or growths of the fungi surviving internally in the seed develop at the same time. The fungi in these cultures can then be identified.

The results of laboratory tests at the Ohio station "show an amazing amount of disease transmission in seed wheat as well as the proof of scab infection by both germinating and dead wheat kernels." A study of field conditions showed "that many seedling wheat plants were killed by the scab fungus *(Fusarium roseum)* conveyed in the seed or retained by the soil." This verified the laboratory conclusions.

In the report of the botanist of the North Dakota Agricultural Experiment Station for 1911, Dr. H. L. Bolley concludes from the results of numerous tests of seeds that "our experiments, taken as a whole, tend to prove definitely that the soil is not often materially depleted, but that the deterioration in yield and quality of grain is more specifically to be assigned to troubles caused by internal seed infection and soil infection."

The genera of fungi which Bolley regards as being of pathogenic interest are *Colletotrichum*, *Fusarium*, *Helminthosporium*, and possibly *Macrosporium*.

In Circular No. 3 of the Purdue University Experiment Station the statement is made that "the average (yield of wheat) on the station farm for the past twenty-five years has been 28.04 bushels per acre." This is nearly thirteen bushels above the average for the state.

The question naturally arises, knowing the results obtained elsewhere by studies of the internally infecting fungi of seed wheat, whether Indiana varieties taken at random from a single locality may be similarly infected?

Following the method used by T. F. Manns, thirty-four different varieties of wheat seed were tested by me. I shall summarize briefly the results of the test and hold them tentatively against further studies on both the wheat plants and seed.

Of the thirty-four varieties, fourteen were free from fungi of any kind. Thirteen of the varieties were found to be infected with a *Fusarium*. Four of the varieties showed an internal *Macrosporium*, and three varieties showed both a *Fusarium* and *Macrosporium* infection.

The meagerness of these data, however, precludes the formation of any definite conclusions, but does indicate a fertile field for study.

Pyropolyporus Everhartii (Ellis & Gall.) Murrill as a Wound Parasite.

Geo. N. Hoffer.

During the fall of 1912 and the spring of this year many observations of various species of oaks infected with *Pyropolyporus Everhartii* were made by my class in forest pathology working in the vicinity of Lafayette, Indiana. The finds from the first were very interesting because of considerable deformation of trees of *Quercus imbricaria* Mich.

The fungus is reported in Bulletin No. 149 of the Bureau of Plant Industry. Here it is described as a wound parasite on *Quercus marylandica* Muench., blackjack oak. Murrill describes the fungus as attacking living trunks of *Quercus nigra* and *Fagus* species. In a recent communication G. G. Hedgecock tells me that the fungus is very common in the lower Mississippi valley. In Phytopathology, Vol. 2, No. 2, Mr. Hedgecock records the hosts for this fungus. The list includes all of the oak species upon which I found the fungus with the exception of *Quercus alba* L. This species is a new host in this locality.

Plate I shows a number of sporophores from three different hosts. Plate II shows the bole of a *Quercus imbricaria* badly deformed. Large knotty growths have developed and, in the centers of these, sporophores have formed. Plate III shows a sporophore developing on a living tree of *Quercus velutina* Lamarck. Plate IV shows a stub of a killed tree of *Quercus alba* L.

The other species upon which the fungus has been found in this vicinity are *Quercus rubra* L. and *Quercus macrocarpa* Michaux. The effect on these trees has been generally the killing of branches of the trees.

The distribution of the fungus within the state has not been worked out. It has been observed by me in Kosciusko County during the past summer. The species upon which I found it in this locality was *Quercus velutina* Lam. It was frequently found on both dead and living trees. Examinations of some of the dead trees showed no signs of borer attacks.

From these observations I believe that the fungus may be of considerable economic importance within the state.

The photographs from which the plates have been made were taken by P. H. Teal, class of 1913, Purdue. Mr. Teal made a study of the fungi affecting the oaks in this country as his thesis subject.

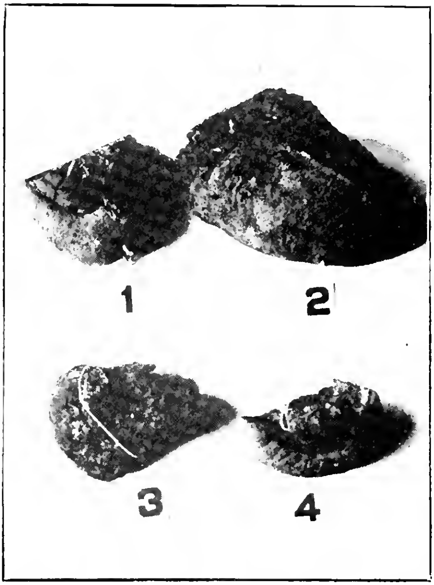


Plate I. Sporophores (1 and 2) from Quercus imbricaria; (3) from Quercus rubra; (4) from Quercus velutina.

Plate II. Tree of Quercus imbricaria Attacked by Fungus.

Plate III. Sporophores on Quercus velutina.

Plate IV. Stub of Quercus alba with Fungus.

The Mosses of Monroe County, Indiana, II.

Mildred Nothnagel and F. L. Pickett.

At the winter meeting of the Indiana Academy of Science in 1912 the authors presented a list of the mosses of Monroe County, made up principally of fall-fruiting forms. That list appears in the Proceedings for 1912, pp. 69-75. In the spring of 1913 the collection and identification of the mosses in the neighborhood of Bloomington was resumed. The following list is the result of that work and includes fourteen new species, among which are representatives of one family and three genera not represented in the previous list.

Material has been prepared, as described in the former paper, and left in the herbarium of the Botanical Department of Indiana University. Full notes of habitat, time and locality of collection, as well as of condition of the specimens, are on file to make the material of value for comparison. In this, as in the previous list, the numbers in parenthesis after each specie indicate the accession numbers in the herbarium.

In this list some species are included which were in the former list. This has been done to indicate noteworthy differences in time of fruiting, or of habitat, and to show the herbarium numbers of such species as were not given numbers in the first list.

To those interested in making permanent collections, the following plan for preparing microscopic slides of species for convenient reference and examination may be of use. The dissections of leaves from different parts of a plant as well as peristome, operculum and calyptra, are mounted in a 10 per cent. glycerin solution in water for examination. If satisfactory, the slide, with the specimens well covered with the dilute glycerin, is carefully protected from the dust until the glycerin is concentrated. Then a cover glass on which a small piece of glycerin-jelly has been melted is carefully placed on the previously warmed slide. Such mounts are very convenient for quick reference, and are quite firm if covers at least 22 mm. by 32 mm. are used. In the writers' collections the quick reference to such preparations is further facilitated by giving the slides the same accession numbers as the regular herbarium specimens.

Doubtful specimens have been sent to Dr. A. J. Grout of Brooklyn for identification, and due notice given in the list.

Order. BRYALES.

Suborder NEMATODONTEÆ.

Family *Polytrichaceæ.*

Polytrichum Commune L. (105).

P. Ohioense R. & C. (106).

Suborder ARTHRODONTEÆ.

Family *Fissidentaceæ.*

Fissidens taxifolius (L.) Hedw. (77). Determined by Dr. Grout.

Mature spores in late fall and winter. Dark green mats on clay, Huckleberry ravine. Common.

Family *Dicranaceæ.*

Ditrichum pallidum (Schreb.) Hampe. (111). Mature spores in May. Dense yellow-green tufts on clay, dry wooded hillsides, common.

Family *Grimmiaceæ.*

Grimmia apocarpa (L.) Hedw. (70). Mature spores in March and April. On limestone slabs and cliffs forming almost black cushions, abundant.

Family *Tortulaceæ.*

Weisia viridula (L.) Hedw. (72). Mature spores in April, abundant.

Barbula unguiculata (Huds.) Hedw. (103). Spores mature from late fall to early spring.

Family *Funariaceæ.*

Funaria flavicans Mx. (79). Mature spores in April. Rare.

F. hygrometrica (L) Sibth. (101). Mature spores in May. Common.

Physcomitrium immersum Sulliv. (122).

Family *Bryaceæ.*

Bryum capillare L. (112). Mature spores in July. Occasional on wooded hillsides.

B. intermedium Brid. (108). Mature spores in May. On limestone wall of Oolitic Stone Mills Company's reservoir.

Mnium affine Rand. (83). Determined by Dr. Grout. Mature spores in April. On damp soil in Huckleberry Ravine. Not common.

M. rostratum Schrad. (92). Sterile. Rare, on very damp rocks or in running water.

Family *Hypnaceæ.*

Amblystegium fluviatile (Sw.) B. & S. (98). Mature spores in May. Light green tufts in running water; common, but rarely found fruiting.

A. kochii B. & S. (80). Mature spores in April. Common. Indiana University campus.

A. orthocladon (P. B.) Kindb. (107). Mature spores in May. On stones in running water, common.

A. varium (Hedw.) Lindb. (81, 99). Thin, loose mats with light green branches; on soil; common. Mature spores in April.

Family *Leucodontaceæ.*

Forsstroemia trichomitria (Hedw.) Lindb. (119). High on living *Juglans cinerea* near I. U. water-works reservoir. Mature spores from late summer to midwinter.

Indiana University Botanical Laboratory.

Ecological Notes on Certain White River Algæ.

Paul Weatherwax.

During the summer of 1913, while assisting in a sanitary survey* of the West Fork of White River, the writer took advantage of the opportunity to make a study of the algæ in the stream. The work was begun at Martinsville, Ind., near the close of June, and ended at Mt. Carmel, Ill., about the middle of September, more or less hurried investigations being made along the river near several of the larger towns.

Only such forms were considered as were present in quantities sufficient to be conspicuous to the unaided eye, no attempt being made to secure specimens by filtration. The striking condition was the general scarcity of algæ, especially along the lower part of the river.

For four or five miles in the neighborhood of Martinsville the shallow parts of the river were choked with a growth of *Cladophora glomerata* Kg. and *Hydrodictyon utriculatum* Roth.; and large masses composed of species of Oscillatoria, Desmids, and Diatoms were continually floating down the river. This material had evidently been broken loose from where it had grown further up the river or some of its tributaries, for it did not continue in a growing condition but eventually broke up and disappeared. The Cladophora gradually became less noticeable in the deeper water a few miles below Martinsville and was afterwards seen only occasionally and in small quantities. The Hydrodictyon was in well-defined locations in water that was comparatively quiet, and, although it was rapidly reproducing, and the young nets were seen floating even far below Spencer, it apparently did not find suitable conditions for growth far below Martinsville. Spirogyra, Mesocarpus, and Zygnema were found in small quantities in a few places, but they were not fruiting and usually showed signs of disintegration. Numerous species of Diatoms were present in the shallower places all along the river.

* This survey was conducted by the Indiana State Board of Health Water Laboratory. To State Water Chemist, Jay A. Craven, I am much indebted for some of the data and other information that have led to the publication of this paper.

The scarcity of algae can best be explained by considering the nature of the river itself. Along the lower part of the West Fork and the entire course after the two branches unite the river follows a meandering course through a loose, sandy soil; and, by a gradual process of cutting the bank on one side and piling up sandbars on the other, it is continually changing its course. Then, along the straight parts of the stream the banks are generally steep, and there is little shallow water. When we consider at the same time that the current is comparatively swift, it is seen that only when the river is at its lowest stage are conditions at all favorable for the growth of algae. Moreover, the conditions just preceding these investigations had been the worst possible, for the exceptional flood of the preceding spring had made such changes in the river bed that several years will be required to bring the plant life of the stream back to a normal condition.

The abrupt disappearance of algal growth just below Martinsville was accompanied by an improved sanitary condition of the water. These two conditions were due, in part, to a series of long, deep stretches of quiet water which acted as septic basins for the polluted water and were also too deep for algae. It is probable, too, that the algae above these deep parts aided materially in purifying the water by releasing large amounts of oxygen which went into solution and hastened the putrefaction of organic matter.

Aphanomyces phycophilus De Bary.

Paul Weatherwax.

While some experiments were being made with algae about the first of March, 1913, it was noticed that some Spirogyra that had been kept for ten days in distilled water had been attacked by a fungus. Attention was at once given to this parasite, which was rapidly destroying the alga. In about a week it was producing oospores, thus making possible its identification as *Aphanomyces phycophilus* De Bary.

This fungus, which is one of the few parasitic forms of the Saprolegniaceae, was first described by De Bary in 1860, and as late as 1892 Humphrey * noted that it had not yet been reported from America. Since then, as far as we have been able to learn, no one has mentioned finding it in this country. **

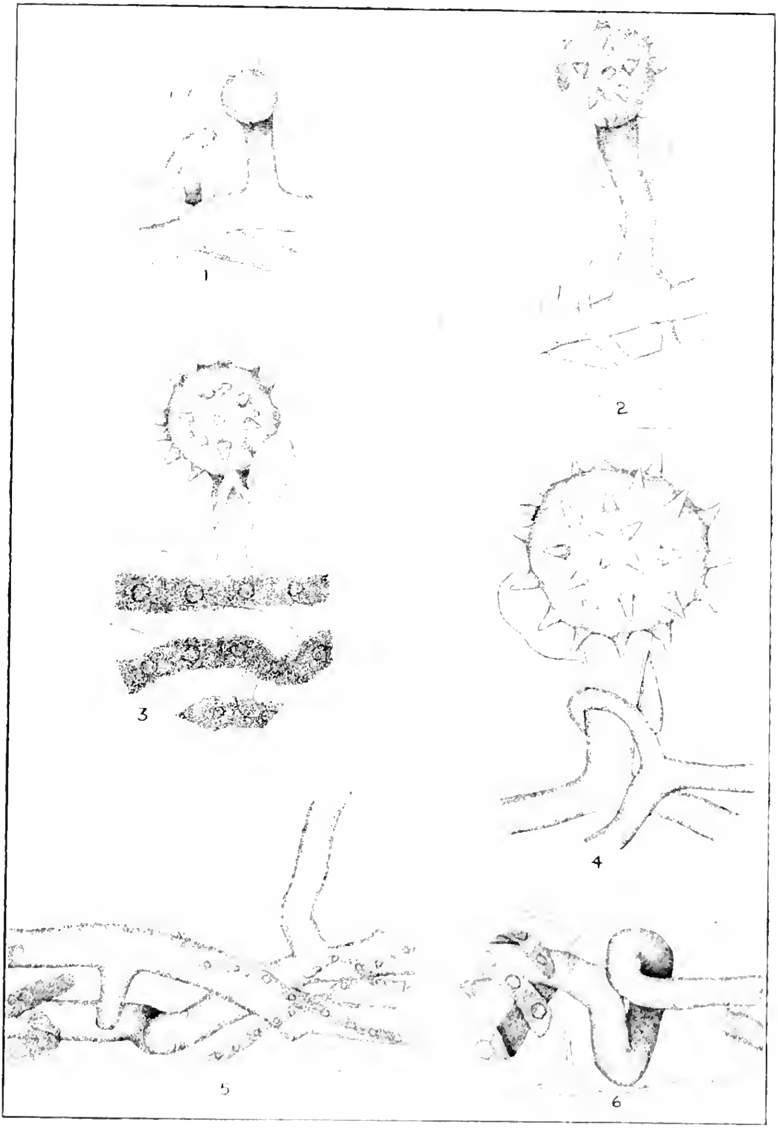
It is clear that the plant is a parasite, and, in this instance, it seemed confined to the one species of host. As well as could be determined from the sterile filaments the host was *Spirogyra dubia* Kg. Scattered filaments of other species of Spirogyra in the same vessel were not attacked, and all attempts to inoculate other species failed.

The mycelium traverses the algal filament lengthwise, sometimes as a single thread, but more often as two, side by side. (Fig. 5.) Branches may grow for some distance inside the filament of the alga, or they may at once grow through the cell wall of the host and extend for some distance into the water. Decomposition of the alga begins soon after the fungus attacks it; the chloroplasts draw together into a mass and begin to decay, and the cell walls break down.

The mycelium is regular in size and shape, sparingly branched and non-septate except where reproducing. The diameter of the filaments is from 9 to 16 microns; the branches are usually as large as the main filaments.

* James Ellis Humphrey, The Saprolegniaceae of the United States.

** Since writing this article attention has been called to a set of unpublished drawings made by Prof. D. M. Mottier, of an unidentified fungus that he found in 1893. These drawings and the location in which the fungus was found indicate very clearly that it was the same species as the one herein described.



Aphanomyces phycophilus.

The protoplasm in all parts of the plant is gray, and of a coarse, granular nature.

The mycelium evidently meets with some resistance in passing from cell to cell of the host, for at these places it is often more or less knotted or bent, always on the same side of the cell wall with reference to the direction of growth in the filament, as if it had not been able to penetrate the cross wall immediately. (Fig. 6.) These penetrations of the cross wall are seldom through the center, but usually far to one side of the filament.

The plant is described as producing zoospores in long slender sporangia, but, in this case, no asexual spores of any kind were observed. Oospores, however, were produced in abundance by the union of gametes which, in no case, were found to arise from the same filament.

The sex organs arise as the enlarged ends of short lateral branches of the mycelium and usually apply themselves to each other very early. (Fig. 1.) The oogonium immediately develops rather large, conical projections all over its surface. (Fig. 2.) The antheridium remains small, club-shaped, and nearly transparent even to maturity.

The conjugating tube is formed when the oogonium is still young and before all its oily content has been organized into the egg. (Fig. 3.) At about this time the oogonium is cut off by a cross wall, but, to all appearances, the antheridium remains continuous with the rest of the mycelium.

The mature oospore is about 36 microns in diameter; the spines are from 5 to 8 microns in length. (Fig 4.) The heavy wall of the spore, 3 to 4 microns in thickness, is a very serviceable adaptation for enabling the plant to live through conditions unfavorable for its growth.

The writer is indebted to Professors Mottier and Van Hook for assistance in indentifying this fungus and for valuable suggestions as to methods of studying it.

Inheritance of the Length of Life in Drosophila ampelophila.

Roscoe R. Hyde.

1. Introduction.

I have been experimenting with two different strains of the fruit fly that differ to a marked degree with respect to the length of life. The first or Inbred stock lives an average of about 37 days. The second or Truncate stock lives an average of about 21 days. In both stocks the average life of the male is somewhat longer than that of the female. It is the purpose of this paper to show the behavior of the shortened length of life of the Truncates in heredity. The evidence bears especially on the behavior of the F_1 and F_2 generations that result from crossing the Inbred and Truncate stocks. I shall also present evidence that bears on the question as to whether or not any relation exists between the length of life and the number of offspring produced by these flies.

The data upon which this paper is based grew out of a study of fertility and sterility in these strains. It was found necessary in connection with these studies to keep a careful record of the length of life of the parents. This paper is an analysis of that record. The data includes the record of 898 individuals that were bred in pairs from September, 1911, to April 1913.

The flies were in all cases used as the parents of the next generation and consequently bred in pairs. Accordingly a male and a female were in each case exposed to exactly the same environmental conditions. It is not to be overlooked that the flies live for several weeks, and since the pairs were constantly being made up the environmental influences would be practically constant. I made it a rule to transfer these flies to new bottles every ten days. It is necessary to transfer the parents more frequently in very warm weather, since offspring will hatch which cannot be distinguished from the parents.* As a matter of fact it is safe to say that in

* I have had *Drosophila ampelophila* to complete development from the egg to a fully formed fly within seven days at Woods Hole, Mass., in July, 1913.

these experiments not more than 15 per cent. of the transfers were made before the tenth day. A census was taken of the parents practically every day. In a few cases five days may have elapsed before a record was entered. In case a fly was dead the sex was noted and recorded.

This record, then, includes the length of life of the relatively long-lived Inbred stock; the short-lived Truncate stock; the hybrid offspring between the two stocks and the life of the grandchildren.

2. Analysis of the Data.

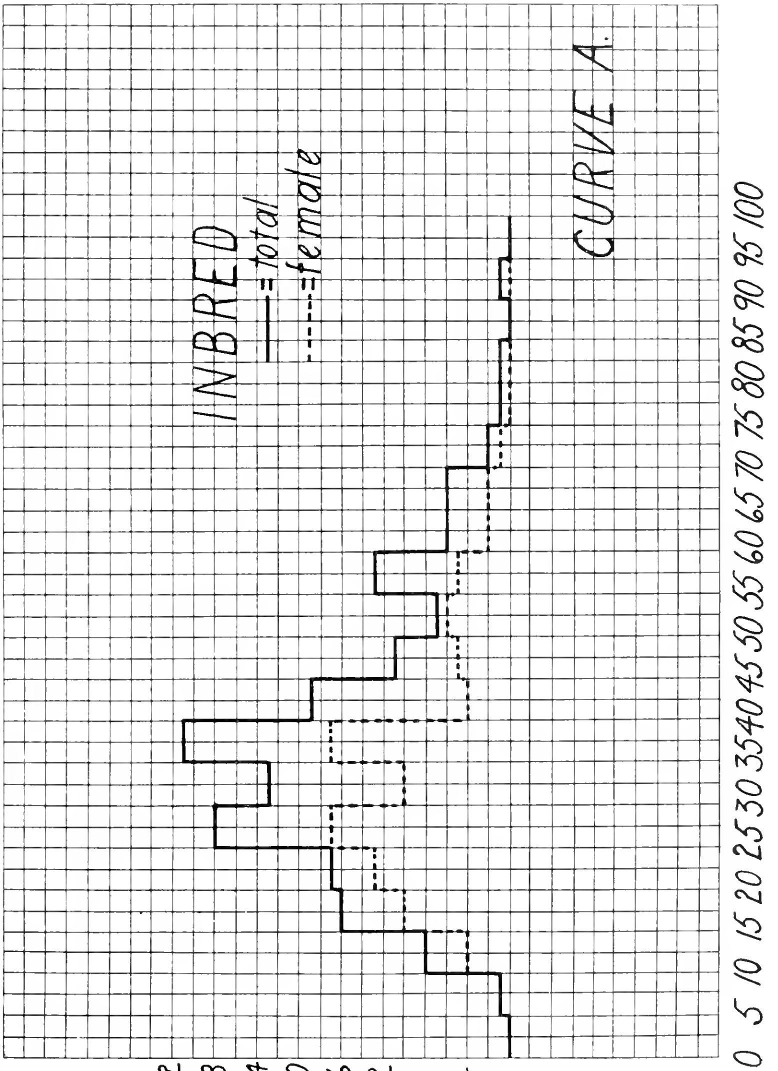
The curves which follow are plotted from the life records of 898 flies which are recorded in Part I and Part II of my Studies on "Fertility and Sterility in *Drosophila ampelophila*."* The length of life is expressed in days and is indicated by the abscissa, while the number of individuals is in each case expressed by the ordinate.

Curve A shows the distribution of the mortality of the Inbred stock. The curve is drawn from the records of 191 individuals. The average life of this lot is 37.4 days. The 94 males lived an average of 40.5 days; 97 females lived an average of 34.5 days. The males lived six days longer than the females.

Curve B shows the distribution of mortality of the 272 Truncates, the average life of which was 21.4 days. The 96 males averaged 26.9 days; the 176 females 18.5 days. The males of this stock lived 8.4 days longer than the females. It is to be noted that the flies of this stock live approximately half as long as those of the Inbred stock.

The hybrid that results from crossing the Truncate and Inbred stocks lives longer than either parent, as is brought out in curve C[1]. For, while the parents live 21.4 and 37.4, respectively, the offspring from the cross live 47 days. This record is based on 42 flies. Thirteen males lived 47.8 days, while 29 females lived 46.4 days. The data is too small to base any safe conclusion in regard to any difference that may exist in the length of life between the male and the female. That the hybrid lives longer than either parent is also borne out by curve C, where a partial record is given of 218 flies. The experiment was discontinued after thirty days, at the end of which time it was found that only 19 per cent. of the flies had died. The mortality in this case corresponds fairly well with the mortality in the case as shown in the curve C[1], in which seven in 42 died within the first thirty days, a mortality of 17 per cent.

*Journal of Experimental Zoology, 1914. Vol. XVII, Nos. 1 and 2.

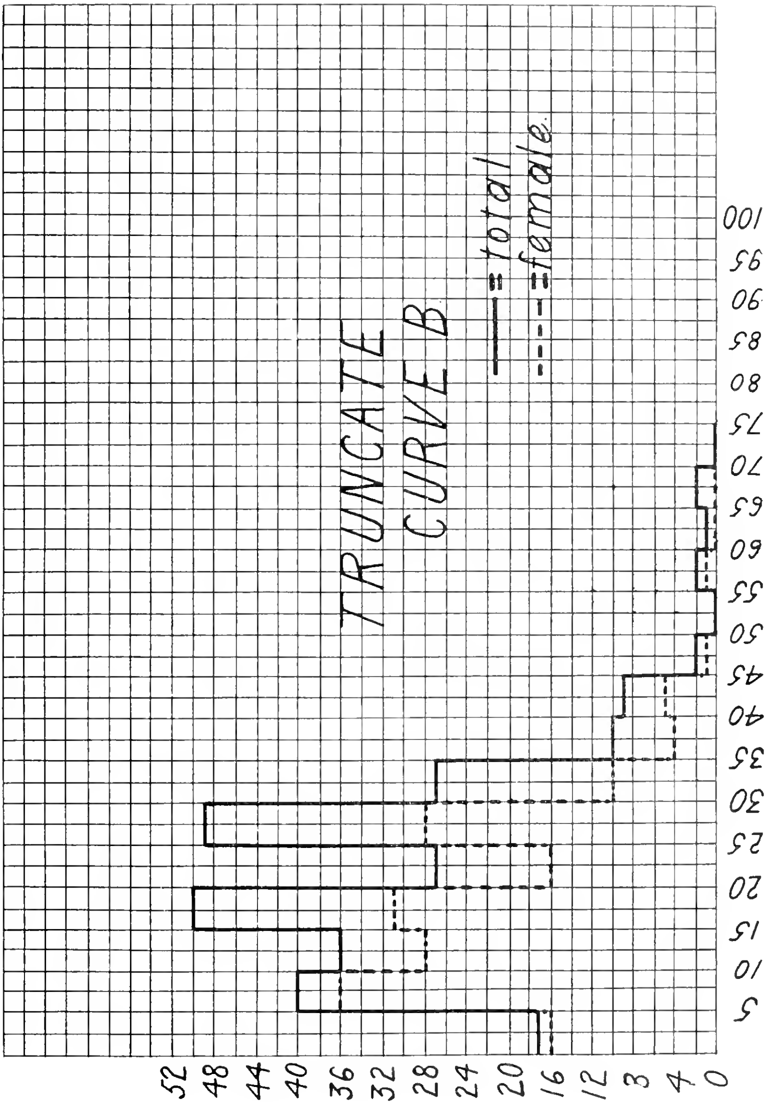

INBRED
—— = total
---- = female
CURVE A.
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
32 28 24 20 16 12 8 4 0

A study of curves D and E shows that the shortened length of life of the Truncates reappears again, and this is true whether the grandchildren have descended from the Truncate male or Truncate female. The 128 flies descended from the Truncate grandmother lived an average of 29.5 days. The 66 males lived 32.8 days, while 62 females lived 25.9 days. The 89 flies that descended from the Truncate grandfather lived an average of 29.3 days. There were 45 males which lived 31.1 days, while 44 females lived 27.3 days.

3. Discussion.

The foregoing data brings out the fact that when the Truncate stock with an average life of 21.4 is crossed to the Inbred stock with an average life of 37.4 days, the hybrid that results lives 47 days. If the complex of factors or whatever concerned upon which the length of life in these flies depends, behaves anything like Mendelian characters in the sense that segregation and recombination takes place, then we should expect the shortened length of life of the Truncates to reappear among the grandchildren. A study of the curves verifies the expectation, for the grandchildren live an average of only 29.5 days.

A study of the curves will show in each case three modes which correspond with three periods of the greatest mortality. The meaning of such a phenomenon is obscure, and had the experiment not extended over a long period of time I would be inclined to doubt its reality. There is a possibility, however, that these depression periods correspond with the output of the sex products. My experience in isolating eggs day by day laid by over 200 females seems to indicate that the eggs are laid in cycles—that is, a female begins to lay eggs when two or three days old. Her egg production gradually rises to a maximum, and then it declines almost to zero. In fact she may cease to lay eggs for a day or two and then a new cycle begins which runs the same course, and this in turn is followed by a third. In the period when the female ceases to lay eggs she is most likely to die. However, if a female survives such a period at the close of the third cycle she will as a rule live to a ripe old age, depositing a few eggs occasionally. It is barely possible that these mortality periods correspond to the depression periods in the egg-laying cycles. It must be admitted however, that critical evidence is hard to obtain, since the egg production seems to be influenced by several factors. Moreover it is not evident that such an explanation applies to the male.


TRUNCATE
CURVE B
total
female
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
0 4 8 12 16 20 24 28 32 36 40 44 48 52

4. Length of Life and Productivity.

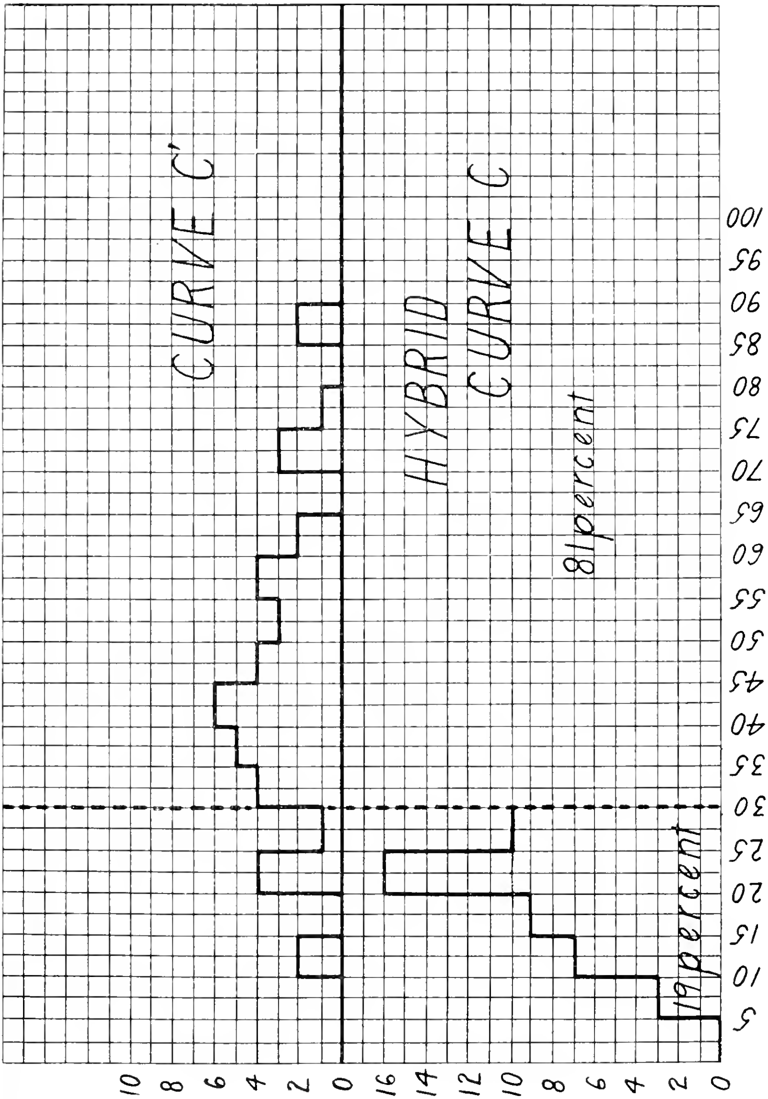
I shall here analyze the data with respect to the productivity of these stocks as determined by breeding in pairs. It is obvious that if a female that would give rise to a large number of offspring should for some reason meet premature death, there would be a correlation between the length of life and the number of offspring produced. The problem, however, is more complicated. In the case of the Truncates it is not evident just how much such a factor as the shortened length of life enters into the results, for I have been able to show that this stock is deficient not only in egg production, but also that marked incompatibility exists between egg and sperm.

In the following curves, F, G, H, I, evidence is brought together that shows the productivity of the F. Truncates. G. The Inbred. H. The Hybrid that results from crossing F and G; and I. The F_2 generation that results from crossing F and G.

In these curves vertical distances express the number of pairs, while horizontal distances express the number of offspring produced. A glance at Curve H, which gives the productivity of the hybrids when the individuals expressed by curves F and G are crossed, moves decidedly to the right. This is evident despite the fact that the experiment was discontinued at the end of thirty days. Curve I expresss the output of the F_2 generation. It is evident that the low production of the Truncates reappears among the grandchildren.

This evidence goes to show that the complex upon which productivity depends is inherited in the sense that low productivity skips a generation when crossed into a high producing strain. In fact the productivity of the hybrid fly is greater than the productivity of both parents combined. I have demonstrated in previous studies that the increased productivity on the part of the hybrid is not due in this case to the increased fertilizing power of the gametes beyond that of the highest producing stock, but is due to a greatly increased output of eggs.

As a matter of fact the fertilizing power of the gametes of the hybrid (*inter se*) is lower than the fertilizing power of the gametes of the high-producing parent. It is evident that the low productivity of the Truncate reappears in the F_2 generation and that this holds true in both the cross and its reciprocal.


CURVE C'
HYBRID
CURVE C
81 percent
19 percent
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
10 8 6 4 2 0
16 14 12 10 8 6 4 2 0

5. General Discussion.

The following is offered by way of explanation of the foregoing facts. Let it be assumed that the complex upon which the length of life of the wild fly depends is expressed by the formula AB. The Truncate stock arose as a mutation from the wild stock and possibly some factor has changed to a. Consequently its formula would be aB. The inbred stock had been in captivity for some time, and it is possible that the B had changed to b. Its formula would be Ab. On crossing these two stocks a hybrid would result, the formula for which is abAB. Consequently in the hybrid, normal conditions are restored, and a fly results that lives longer than either parent. The same explanation holds in the case of the increased egg production to be seen in the hybrid. If this is true we should expect to find wild stocks that live about fifty days and with high egg production and high fertilizing power of the gametes combined. They should be very high producers. The number of factors, however, is not looked upon to be as simple as the formula would seem to indicate. Instead of two factors as the formula shows, there may be many hundreds, but the principle is the same. The things lost or changed in the germ plasm of one stock are compensated in the hybrid by the factors transmitted by the other stock, and thus normal conditions are restored.

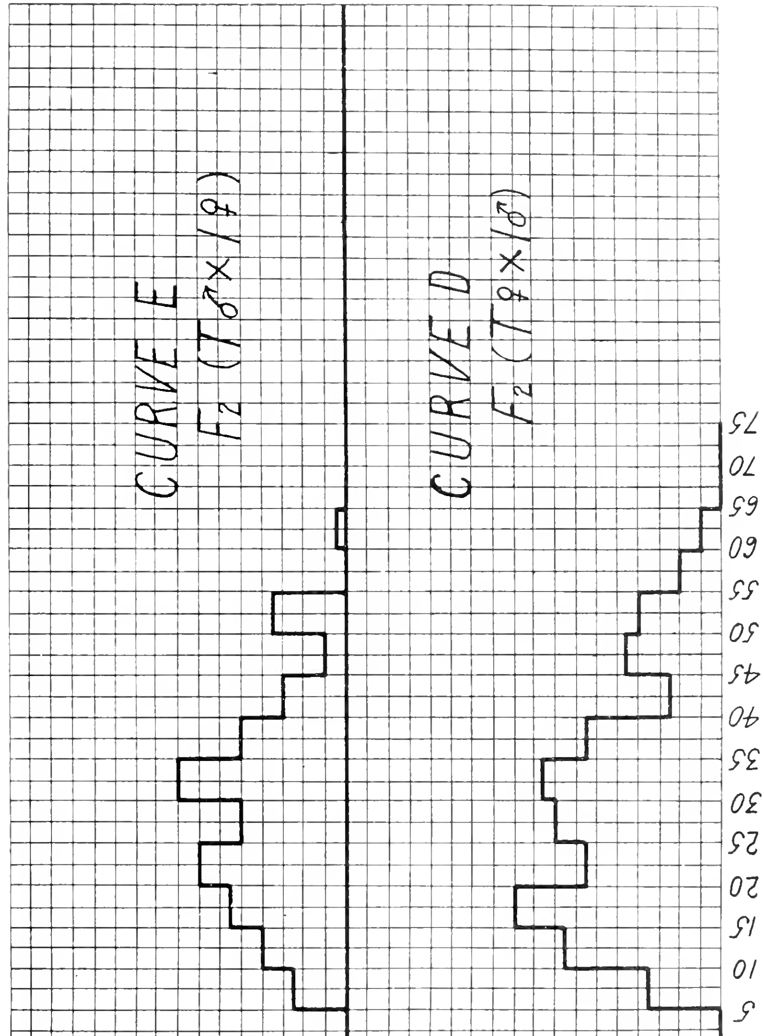
6. Conclusions.

1. Hybrids between the Truncate stock and the Inbred stock are more vigorous than either parent as shown by the fact that the hybrid lives 47 days while the parents live 21.4 and 37.4 days respectively.

2. The flies from the Truncate stock live 21.4 days. The females live 18.4 while the males live 26.4 days.

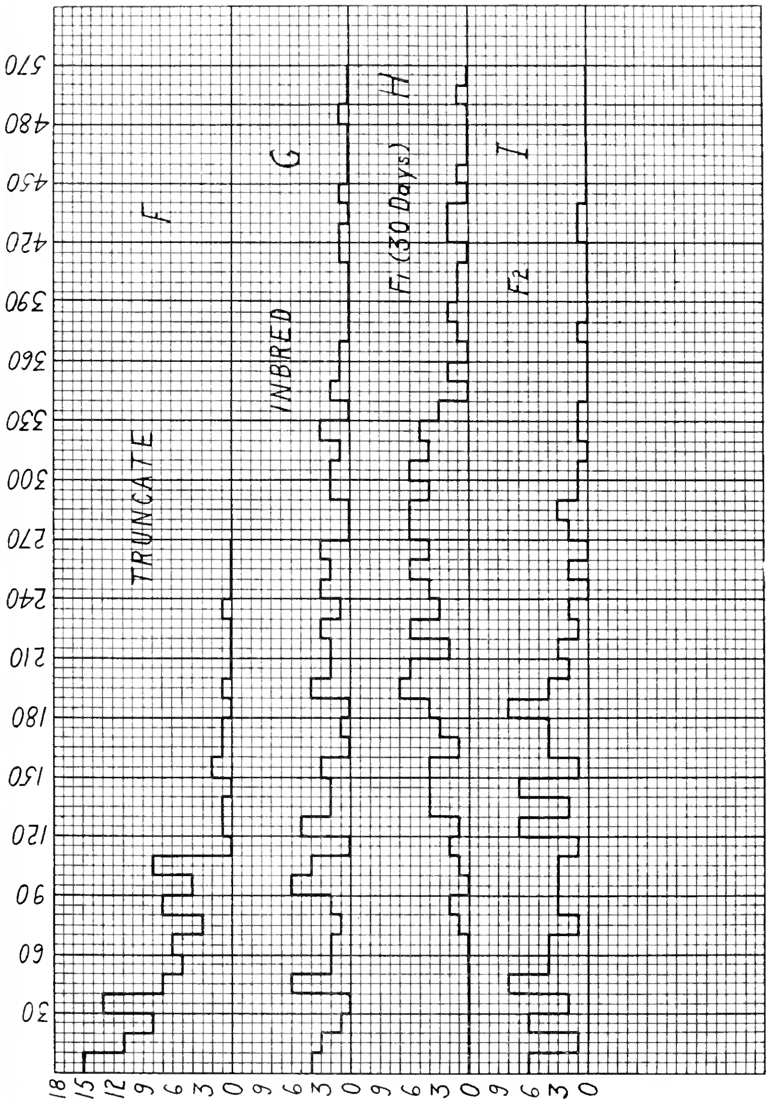
3. The flies from the Inbred stock live 37.4 days. The females live 34.5 days while the males live 40.5 days.

4. The shortened length of life of the Truncate stock reappears among the grandchildren after skipping a generation when crossed to the Inbred stock. The grandchildren lived an average of 29.5 days. Those descended from the Truncate grandmother lived 29.5 days. The males lived 32.8 days and the females lived 25.9 days. The flies descended from the Truncate grandfather lived 29.3 days. The males lived 31.1 days, while the females lived 27.3 days.


CURVE E
F_2 (T♂ × I♀)
CURVE D
F_2 (T♀ × I♂)

5. It seems not improbable that the length of life and the coming to maturity of the germ cells may be in some way physiologically connected.

6. The low productivity of the Truncate skips a generation when crossed to a high-producing strain and reappears in the F_2 generation. It is difficult to correlate the length of life in these strains with the number of offspring produced, because it is evident from my other studies that the fertilizing power of the gametes as well as egg production are involved as variable factors in productivity.


TRUNCATE
F
INBRED
G
F1 (30 Days)
H
F2
I
30 60 90 120 150 180 210 240 270 300 330 360 390 420 450 480 570
18 15 12 9 6 3 0 9 6 3 0 9 6 3 0 9 6 3 0

The Germination of Seeds of Arisæma.

F. L. Pickett.

The corms of *Arisæma triphyllum* grown for the study of form and development showed great variation in size, and there was a seeming discrepancy between the number of leaves above ground and the number of corms found in the soil after the leaves had withered. Following these observations arrangements were made to check up carefully the points suggested.

On December 26, 1912, 900 seeds of *Arisæma triphyllum* were planted in rich, loose loam in large clay flower pots and subsequently subjected to three sets of conditions as noted below. As leaves appeared above the soil they were counted, one to three times per week, until no more appeared, and a record kept for comparison with the number of corms found after the growing season was over. In every case the seeds were carefully washed from the fruit pulp before planting, and when planted were covered with sandy loam to a depth of 2 cm., this being approximately the condition in natural planting.

One bunch of 300 seeds was placed in the greenhouse at a temperature of 75 to 80 deg. Fahr. immediately after planting. From this planting 208 leaves appeared between January 15 and March 19, 1913. No leaves appeared after the last date.

A second bunch of 300 seeds planted as the first, was left in the greenhouse vestibule at a temperature of 50 to 60° Fahr. From this planting 226 leaves appeared between February 19 and April 25, 1913. No leaves appeared after the last date.

A third bunch of 300 seeds, planted as the first, was placed in a cold frame until March 13, 1913, where the temperature fell slightly below the freezing point, and was then removed to the greenhouse. From this planting 209 leaves appeared.

In the summer of 1913 when the leaves of the cultures were dead the corms were carefully removed and counted. The number of corms and the number of leaves from each culture are given below.

Lot No. 1 showed 260 corms, 208 leaves, i. e., 52 "blind" corms. Total germination 86.6 per cent.

Lot No. 2 showed 246 corms, 226 leaves, i. e., 20 "blind" corms. Total germination 83 per cent.

Lot No. 3 showed 261 corms, 209 leaves, i. e., 52 "blind" corms. Total germination 87 per cent.

It is not the purpose of this paper to discuss the variations which may be due to different temperature conditions, but merely to show the high percentage of germination and to indicate the fact that some seeds germinate "blindly," that is, the embryo grows, a corm and roots are produced, and food is transferred from seed to corm without the formation of leaves or other photosynthetic organ. At the end of the growing season the connection with the seed is broken off, leaving the new plant independent.

A glance at the corms from these cultures at once suggests a difference in their food supply and growth. Some are three to six times as large as others. While the numbers of large and small corms are not exactly the same as the numbers of leafy and leafless plants, they are nearly enough so to suggest a relation.

A similar set of experiments was arranged in which seeds of *Arisæma Dracontium* were used. The seeds were prepared and planted December 26, 1912, the same as in the case of *A. triphyllum*. Lot No. 1 was left in the main room of the greenhouse, and showed, between February 6 and March 8, 1913, eight leaves. On June 19, 200 corms and 24 seemingly good seeds were removed.

Lot No. 2 was left in the cold frame from December 26 to March 15 and then removed to the greenhouse. This culture showed eleven leaves between April 3 and April 25. On June 20, 179 corms and one sound seed were removed.

Lot No. 3 was left in the greenhouse vestibule until March 12, and then removed to the greenhouse. Between April 23 and June 20 four leaves appeared, and on the last date 187 corms were removed. These results are tabulated below.

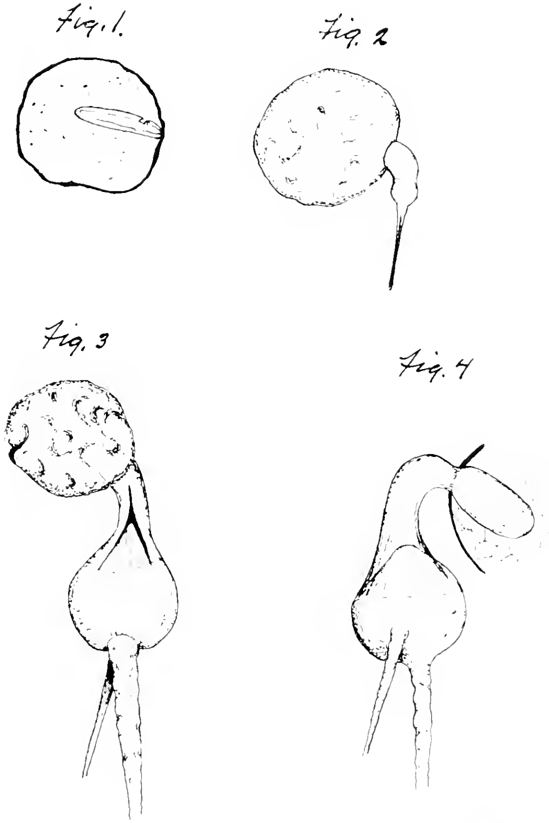
Lot No. 1. 300 seeds, 8 leaves (2.66 per cent.), 279 (93 per cent.) corms and viable seeds.

Lot No. 8. 200 seeds, 11 leaves (6.11 per cent.), 180 (90 per cent.) corms and viable seeds.

Lot No. 3. 200 seeds, 4 leaves (2 per cent.), 187 (93.5 per cent.) corms and viable seeds.

These corms have been replanted and their further development will be reported later.

Because of the "blind" germination seeming to be the normal thing with A. *Dracontium*, a brief account will be given.



The Germination of Seeds of Arisæma.

One to five seeds are borne in each berry of the aggregate fruit. Each seed is two to three millimeters wide and three to four millimeters long, and is composed of a hard testa covering a flinty gelatinous endosperm, in which is imbedded the almost straight, cylindrical embryo, Fig. 1. Under proper conditions the seed absorbs water and the embryo lengthens by growth both above and below the plumule. The growth of the cotyledonary petiole is more rapid than that of the radicle, so that the radicle, with the plumule, is soon pushed outside the seed coat. The cotyledonary petiole reacts to the stimulus of gravity so that the radicle is soon directed downward, Fig. 2. The one cotyledon remains inside the seed as an absorbing agent, Fig. 1. The radicle grows down rapidly to form a primary root. Later one or two other roots may be formed. Immediately after the establishment of a root system or water absorbing system, the portion just below the plumule becomes enlarged by the storage of food stuff transferred from the endosperm of the old seed. Figs. 3 and 4.

In case the germination is complete, the formation of a root system is followed by the growth of the single simple leaf up from the plumule, through the cotyledonary petiole to the light, Fig. 6. Usually, however, only scales are formed around the bud. In either case, when the food material has been absorbed, the tissues connecting seed and seedling shrivel up, leaving the young plant independent. After a period of about eight weeks from the beginning of germination the corms will be found free from the seed and with the roots detached and broken down, all ready for a period of rest, Fig. 5.

It may be of interest to note that A. *Dracontium* gives other evidence of incomplete response to seasonal changes. During the summer of 1913 the corms of a considerable colony were dug up for experimental purposes. Although these corms were scattered in the soil but a few inches apart, and some had shown very vigorous growth of stem and leaves, about half of them had made no start toward growth. The conditions were certainly the same for all individuals of the colony, and were good, as shown by the growth just mentioned. Whether this plant is subject to definite periodicity requiring more than the usual rest season, or is controlled by some as yet unconsidered influence, can only be left a question.

Studies of Camptosorus rhizophyllus, an abstract of The Development of the Prothallium of Camptosorus rhizophyllus,* and The Resistance of the Prothallia of Camptosorus rhizophyllus to Desiccation.†

F. L. Pickett.

As is well known the Walking Fern, *Camptosorus rhizophyllus*, is found chiefly on rocky ledges in more or less shaded places, where the water supply is irregular and slight at all times. The colonies in the neighborhood of Bloomington, Ind., have abundant water supply only at times of heavy rain and of course enjoy such supplies for but brief periods. The fact that this fern could not only withstand the many longer or shorter periods of drought but could multiply in the regular way under such conditions suggested the probability of some special structural or physiological adaptation. The scheme for vegetative increase by means of stoloniferous leaves is well known and gives the plant its specific name. But the presence of many small plants which could not have had such origin and so must have been produced through the production of the prothallial or sexual stage, along with the fact that the prothallia of many of our ferns cannot survive the lack of a normal supply of moisture for more than a few hours, suggested another possible adaptation as well as a point of attacking the problem.

Cultures were made of sowing spores on sterilized soil in clay saucers protected under bell jars. Both the peculiarities of form and the resistance to desiccation were studied.

The following peculiarities of form and development have been noted. The development of a plate of cells is not uniform, beginning sometimes immediately after the germination of the spore and at other times not

* Bot. Gaz., 57: 228-238, Mar., 1914.

† Bull. Torr. Bot. Club, 40: 641-645, Nov., 1913.

until a protonemal thread of two to five cells has been formed. The differentiation of an apical cell or group is late and irregular, resulting in unsymmetrical growth. The marginal cells show unusual growth, producing variously formed outgrowths, sometimes bearing antheridia and occasionally producing extra growing regions which may even become independent proliferations.

With reference to drought resistance the following facts have been noted: Allowing a culture to become dry for one or two days in the normal air of the greenhouse seems in no way to injure the plants beyond checking growth during the dry period. One culture left in dry air with slight additions of water once a week showed nearly all the prothallia alive and in good condition after a period of three months. The major part of the plants of another culture are in good shape and have produced a number of sporophytes although subjected to such irregular moisture conditions for a period of nine months. In a culture receiving only air which had been dried by passing through pure glycerine, most of the prothallia were in good condition after four weeks and a few survived such treatment for a period of six weeks.

In conclusion, the two specially important adaptive features are, the unusual power of promiscuous growth of prothallial cells, and the ability to resist extreme desiccation in intermittent periods.

Irish Potato Scab (Oospora scabies) as Affected by Fertilizers Containing Sulphates and Chlorides.

S. D. Conner.

In the spring of 1911 a pot experiment with Irish potatoes was started at the Purdue Experiment Station by the author. It was the intention to investigate the composition and quality of potatoes grown in several types of soil with different fertilizers, the ordinary silt loam of the station farm being the principal soil used. Peat and sandy soils were also used, as well as eight pots containing pure silica sand. The principal fertilizers studied were sulphate of potash and chloride of potash. Two varieties of potatoes were used, Early Ohio, one of the best early varieties, and Carmen No. 3, a good late variety.

The experiment was not planned to cover an investigation of potato scab, although this development of the research may be one of the most significant features noted. The seed potatoes planted the first year did not show any scabbiness and no attempt was made to prevent it. When the potatoes were harvested, however, it was seen that formalin should have been used, as the crop was badly affected by the scab fungus *Oospora scabies*. The scab was very much worse in the brown peat than in the other soils, as will be seen from Fig 1. There was also a slightly greater amount of scab in the pots where chloride of potash was used than there was where sulphate was used, the unfertilized pots being affected the worst of all. In 1912, to prevent scab the seed potatoes were all treated with formalin and one-half the pots, which are in duplicate, were given an application of flowers of sulphur, which is a treatment that has been reported as a success by certain investigators.* No great differences as to scabbiness were seen in the crop of 1912, and photographs were not taken.

In 1913 the seed potatoes were again treated with formalin, but no sulphur was added. When the potatoes were harvested this year a sur-

* B. D. Halsted, Bul. 112, N. J. Agr. Exp. Sta.; also Bul. 120 N. J. Exp. Sta.

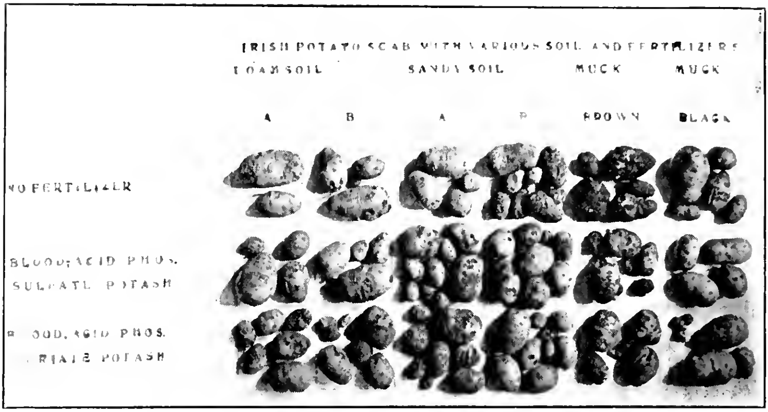


Fig. I. Potatoes Grown in Pots, 1911. Various Soils and Fertilizers Affecting Scab.

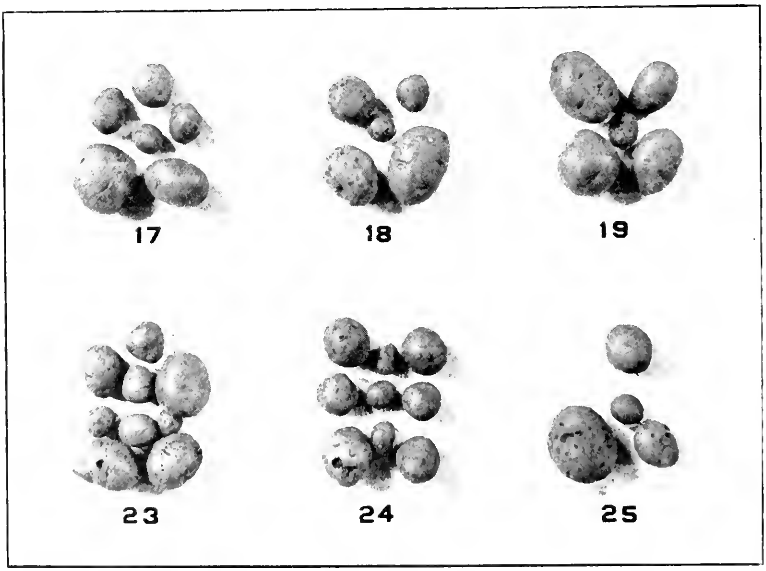


Fig. II. Potatoes Grown in Pots, 1913. Loam Soil. Very Little Scab. See Table I. for Treatment.

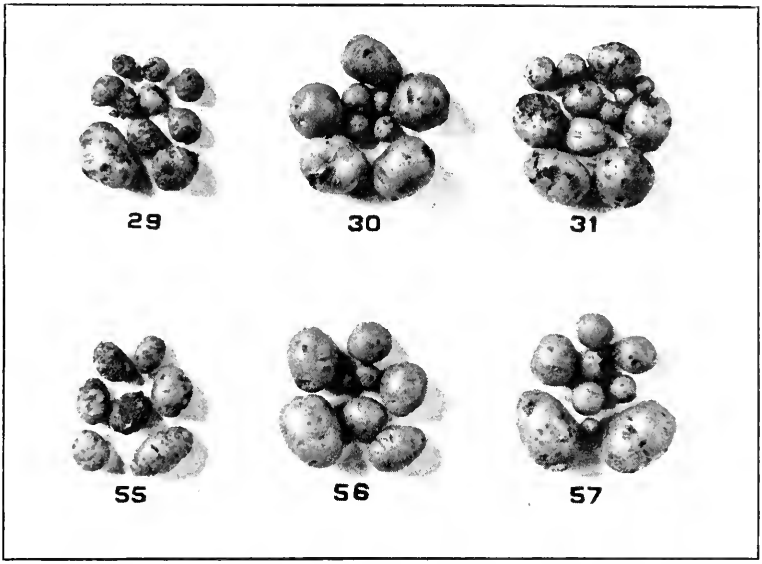


Fig. III. Potatoes Grown in Pots, 1913. Peat Soil. See Table I, for Treatment Affecting Scab.

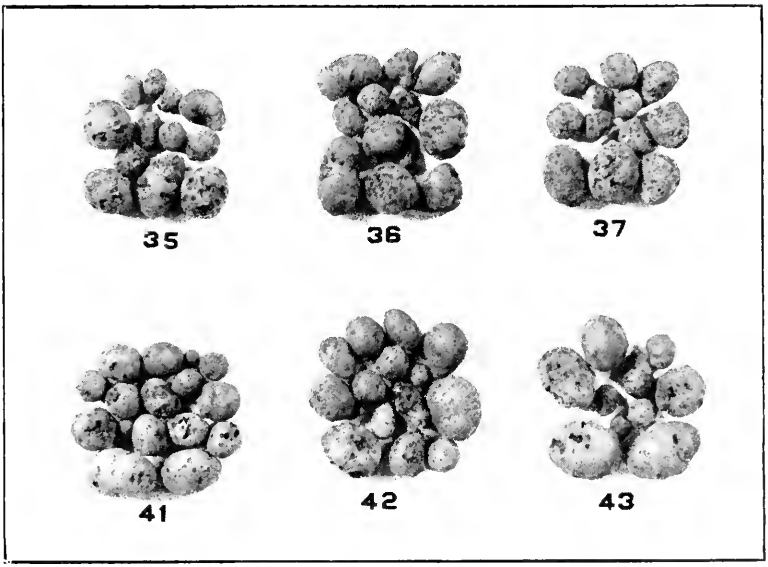


Fig. IV. Potatoes Grown in Pots, 1913. Sandy Soil. See Table I, for Treatment Affecting Scab.

prisingly large amount of scab was noted. The soil, the treatment, and the approximate percentage of scabbiness are given in Table I and photographs of the early potatoes are shown in Figs. II, III, and IV.

As the seed potatoes had been treated it is evident that the scab spores had lived over the winter in the pots which were left out in the ground. It appears that very little scab had survived the climate and soil conditions in the loam soil, while in the soils of more open texture such as peat and sand, the spores had been able to survive.

The unfertilized soils in most cases are affected to the greatest extent. In every case flowers of sulphur, which had been applied in 1912, has had a deterrent effect in the development of scab. In the fertilizer treatment sulphates have kept the scab down while the chloride has apparently encouraged it.

The variations noted in the amount of scab on the potatoes grown in silica sand merit special attention, as in these pots all factors except soil treatment have been eliminated and there are four pots which have not had chloride in any form either in the original sand (the soils all have more or less chlorine naturally) or in any treatment. The sulphur factor was more nearly controlled in these pots than in the soil pots as di-calcic phosphate was used in 1913 in place of acid phosphate. Acid phosphate which contains more or less calcium sulphate was used in all soil pots that were fertilized; it was also used the first season in the silica sand pots, and it was necessary that some sulphate should be added as a plant food. The treatment of each pot and the amount of scab on the potatoes grown in silica are shown in Table II. Fig. V is a photographic reproduction of all the potatoes grown in the silica pots in 1913. It will be noted from the accompanying table and illustrations that sulphur has had a marked influence in reducing scab, but that sulphates have not. On the other hand, wherever chloride has been added either with or without sulphates very much scab was always present. This seems to indicate that chlorides are needed in the development of the scab fungus. The fact that chlorides are present in quite large amounts in soils, especially those near the sea coast, may account for the fact that chlorides have not been found to increase scab in experiments where such effects were noted.*

* H. J. Wheeler and G. M. Tucker, Bul. 40, R. I. Exp. Sta.; also G. E. Stone, 20th Ann. Rep. Mass. Agr. Exp. Sta., 1908.

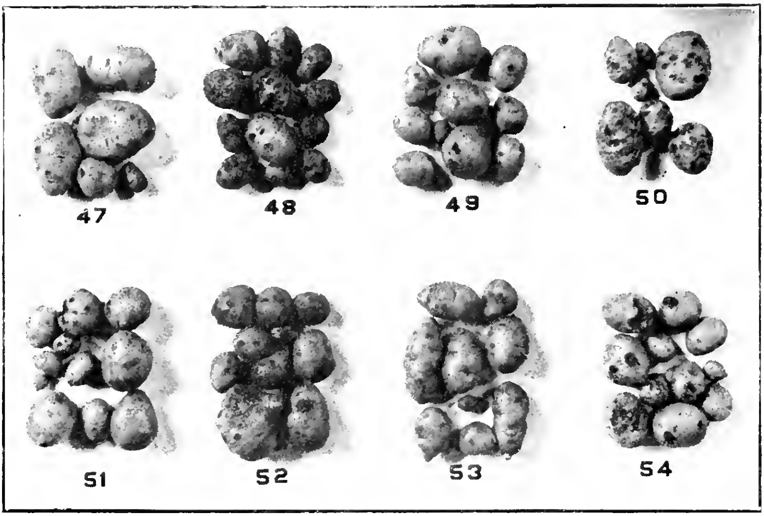


Fig. V. Potatoes Grown in Pots, 1913. Silica Sand. See Table II, or Treatments Affecting Scab.

TABLE I.

Potato Scab (Oospora Scabies) Pot Cultures, 1913.

Kind of Soil.	Treatment of Soil.	Early Ohio Variety.		Carmen No. 3 Variety.	
		Pot No.	Per Cent. of Scab.	Pot No.	Per Cent. of Scab.
Silt Loam.	None	17	1	20	0
	N P K_2SO_4	18	1	21	0
	N P KCl	19	1	22	2
	None ... sulfur	23	3	26	1
	N P K_2SO_4 ... sulfur	24	1	27	0
	N P KCl ... sulfur	25	1	28	1
Brown Peat.	None ... sulfur	29	60	32	5
	N P K_2SO_4 sulfur	30	15	33	10
	N P KCl sulfur	31	25	34	15
Black Peat.	None ... sulfur	55	50	58	1
	N P K_2SO_4 sulfur	56	3	59	3
	N P KCl sulfur	57	15	60	5
Sandy Soil.	None	35	80	38	30
	N P K_2SO_4	336	65	39	50
	N P KCl	37	75	40	50
	None ... sulfur	41	28	44	3
	N P K_2SO_4 sulfur	42	20	45	3
	N P KCl sulfur	43	24	46	5

N = 7 gr. dried blood + 6.7 gr. nitrat soda per pot.

P = 12.8 gr. acid phosphate per pot.

K_2SO_4 = 3.6 gr. sulphate of potash per pot.

K Cl = 3.6 gr. chloride of potash per pot.

Sulfur = 8 gr. sulfur per pot.

Per cent. of scab is an approximation of the surface ot the tubers affected.

TABLE II.

POTATO SCAB (OOSPORA SCABIES) IN SILICA SAND POT CULTURES.

Treatment of Soil	Pot No.	Per Cent of Scab.
N P K_2SO_4	47	4
N P KCl	48	75
N P K_2SO_4 + Na_2SO_4	49	4
N P K_2SO_4 + NaCl	50	75
N P K_2SO_4 + sulfur	51	8
N P KCl + sulfur	52	25
N P K_2SO_4 + Na_2SO_4 + sulfur	53	2
N P K_2SO_4 + NaCl + sulfur	54	20

N = 7 gr. dried blood plus 6.7 gr. nitrate soda per pot.

P = 5.1 gr. di-calcic phosphate per pot

K_2SO_4 = 3.6 gr. sulfate of potash per pot.

KCl = 3.6 gr. chloride of potash per pot.

Na_2SO_4 = 3.4 gr. sulfate of soda per pot.

NaCl = 2.8 gr. chloride of soda per pot.

Sulfur = 8 gr. per pot or approximately 360 lbs. per acre.

All pots had a treatment of 100 gr. calcium carbonate per pot.

Early Ohio potatoes treated with formalin were planted.

Wabash Studies. V. A Topographic Map of the Terre Haute Area.

Charles R. Dryer.

The west sheet, covering an area about five miles square, was presented to the Academy in 1909 and a poor photographic copy of it was published in the Proceedings for that year. The east sheet, covering an area six by seven miles, is now completed. The two sheets cover a strip five to six miles wide north and south and twelve miles long east and west extending across the Wabash valley. The original draught and tracing are on a scale of six inches to the mile and the contour intervals are five, ten and twenty feet, according to the relief. The datum planes used for the west sheet were the levels of the Vandalia and Big Four railroads. After that was completed the United States Geological Survey established bench marks in the area which were used for the east sheet, although found to be 3.65 feet above those of the west sheet.

On the east sheet levels were run with a dumpy level along east-west lines one mile apart and the intervening spaces were filled in with a hand level used on a staff. The levels of the city engineer's office reduced to U. S. G. S. datum, were used wherever available. The work was all done by students of the Department of Geography and Geology of the Indiana State Normal School. In all about forty different persons worked upon it during periods varying from six weeks to thirty-six weeks each. Of these Melvin K. Davis and Garl H. Barker became the most proficient, and to them was assigned the plotting and final draft of the map.

The map is not good enough for sewer, drainage or hydraulic work, but would be of some value for highway and railroad location. For geographic and geological purposes it is far better than none. Its final displacement by a better one will not destroy the values of the experience obtained by its makers or the facility it affords for general field work.

Center of Area and Center of Population of Indiana.

W. A. Cogshall.

The center of area and the center of population for the State of Indiana were determined lately for the Board of State Charities. The process in the determination of the center of area was to draw two lines at right angles across as good a map of the State as could be found, the intersection falling at the estimated center. The areas of the north and south sections were then measured with a planimeter and the east and west lines shifted till the two measured the same. The areas on each side for north and south line were treated in the same manner and the result checked by measurement on several different maps. The intersection of these lines is near the village of Traders Point, in Pike Township, Marion County.

The center of population is really a problem in center of gravity. It is not a point about which the population is equally distributed, but a point such that if a map of the State were loaded in proportion to the population of each locality, the map could be supported by that point and would balance. The population of any one locality is therefore only one factor in determining the location of the center, the other factor being the distance of such locality from the center.

In this determination the statistics used were supplied by Mr. Butler and consisted of the population of each township of each county. I assumed that the population would be evenly distributed over the township in the cases where no towns existed. Where a township had a large part of its population concentrated in a town, I estimated the center of gravity of the township accordingly. The distance of these township centers from a pair of arbitrary east-and-west, and north-and-south lines was measured on a large scale map. The solution for the center of gravity gave the distance of such center from the intersection of the arbitrary lines. This intersection was eleven miles north of Lebanon and the corrections found as the result of the computation placed the real center of population in Eagle Township, Boone County, about $1\frac{1}{2}$ miles southwest of the Station of Zionsville.

It is a remarkable fact that the centers of area and population are so close together.

The Shrinkage of Photographic Paper.

R. R. Ramsey.

In mounting some spectrograph prints I was very much chagrined to find that they were at different lengths, as if they had been taken on different spectographs. These prints had been printed on developing paper, developed, washed, dried and then soaked and mounted wet. It had happened that the paper used came in quite large sheets and in cutting down to size it was economical to cut some pieces lengthwise of the paper, while other pieces were cut crosswise. Several prints were made and the best were selected for mounting. In this chance selection some were lengthwise and others were crosswise of the paper. The expansion and contraction in the process of developing and washing was different in the different directions and it was necessary to make a new set of prints, care being taken to have the paper all cut the same way. The mounting was done before drying, to prevent excessive expansion.

I thought it might be of interest to experiment with several brands of paper to determine if this fault was found in all brands of paper or in this particular brand alone.

An 8x10-inch plate was exposed to sunlight and then developed, giving a very dense film. On the edges millimeter scales were ruled with the dividing engine. A space of 20 centimeters was ruled on the long edge and a 15 centimeter space on the short edge of the plate. Thus by printing and developing I had a photograph of the scale, and measurement would give the amount of shrinkage or expansion. Five different papers were used. All were printed, developed, fixed, and washed in the usual manner. After washing, a sample of each brand was mounted on cardboard. The others were stuck back side to glass and allowed to dry. When dried measurements were taken of the length and breadth. Then samples of each brand were selected from the unmounted photographs, soaked in water and mounted on cardboard. After drying, these were also measured.

The accompanying table will give the results:

Paper.	Dried on Glass.		Mounted Wet on Cardboard.		Dried, Soaked and Mounted Wet on Cardboard.	
	Length.	Breadth.	Length.	Breadth.	Length.	Breadth.
Darko-Matt	—.55%	— 51%	2.3%	23%	2.6%	.5%
Velox C	— 32%	— 45%	.52%	1.4%	8%	1.8%
Velox S	— 2%	— 31%	1.6%	.3%	1.9%	7%
Azo C	—.075%	— 18%	1.8%	.3%	2.1%	66%
Azo E	— 06%	— 23%	.28%	1.5%	52%	1.8%

The results show that all brands act very much alike. When dried on glass there is a trifle shrinkage. The mounted photographs show considerable expansion and in every case a larger amount in one direction than in the other. In some cases the per cent. of expansion is teu times that in the other direction.

Acyl Derivatives of O-Aminophenol.

J. H. Ransom and R. E. Nelson.

In an extended piece of work published some years ago the senior author (Amer. Chem. Journ., **23,** 1) found that when o-nitro phenylethylcarbonate was reduced with tin and hydrochloric acid a urethane was obtained, soluble in alkalis and evidently having the carbethoxy group attached to nitrogen. By modifying the conditions he was able to isolate an isomeric basic material in which the carbethoxy group was attached to oxygen. On standing this rapidly changed to the urethane. The same urethane was obtained on treating o-aminophenol, in ether solution, with chlorcarbonicethylether. A similar rearrangement occurs when o-nitro phenylbenzoate is reduced in acid solution (Böttscher, Ann. Chem. Pharm., **210,** 384). In determining the constitution of the oxyphenyl urethane Ransom made the diacyl derivative by using benzoyl chloride in alkaline solution. He also found that the same substance was produced when Böttscher's benzoyl o-aminophenol was treated with chlorcarbonicethylether in alkaline solution. In both cases saponification gave benzoic acid and oxyphenylurethane, indicating that in the latter case a molecular rearrangement of the diacyl derivative had occurred, so as to leave the lighter group attached to nitrogen. Other diacyl derivatives of o-aminophenol were made and in every case the lighter group was found attached to the amide nitrogen. If one of the amide hydrogens is first replaced by a hydrocarbon radical no rearrangement occurs, but isomeric substances are formed when the acyl groups are introduced in reverse order. The same is true when the amide and hydroxyl groups are in the meta or para position to each other.

It seemed desirable to determine whether the carboxylester group would become attached to nitrogen in the presence of a carbonyl group already attached to the same nitrogen; also whether of two carboxyl groups introduced the lighter one would go to the nitrogen. Finally it seemed of interest to determine if rearrangement would occur in case the radicals introduced were nearly of the same weight. If the rearrangement did not occur or proceeded more slowly than the others it was thought there would be a chance of studying more thoroughly the mechanism of the rearrangement.

OXYPHENYLISOAMYLURETHANE.

O-aminophenol was prepared by the reduction of the nitrophenol. Two grams of this were suspended in ether and the calculated amount (2 mol.) of chlorcarbonicisoamylether slowly added. The hydrochloride of one molecule of the aminophenol precipitated. After filtering, the ether solution was evaporated, leaving about two grams of a solid. It crystallized from ligroin in white needles melting at 68.5°–69.5°. It is insoluble in cold water and acids, but is sparingly soluble in hot water and very soluble in chloroform, benzol, alcohol and ether. It is also quite soluble in dilute alkalis and from this solution is precipitated by acids thus showing its acid character.

The same substance was also produced by the reduction, with tin and acids, of o-nitrophenylisoamylcarbonate made by Ransom's method (*loc. cit.*). The melting point was the same, and a mixture of the two had the same melting point as either.

Another sample of the nitroisoamylcarbonate was reduced, but as soon as the action was complete the product was thrown into a concentrated (1:1) solution of potassium hydroxide kept cold in a freezing mixture. This solution was quickly extracted with ether and the ether solution dried with solid potassium hydroxide. When dry the ether solution was saturated with dry hydrochloric acid gas. A voluminous white precipitate separated which was filtered out and quickly dried on a porous plate in a desiccator. The melting point was 133°–134° and the substance was quite soluble in cold water and acids, but alkalis precipitated an oil from the mixture. A small amount of this was dissolved in warm water and allowed to stand. Soon an oil separated which was extracted with ether. On evaporating the ether a solid remained which was soluble in alkalis and had all the properties of the urethane described above. Evidently the substance melting at 133° was the hydrochloride of o-aminophenylisoamylcarbonate which changed to the urethane on being warmed with water. In the dry condition the hydrochloride is moderately stable.

BENZOYL O-OXYPHENYLISOAMYLURETHANE.

One and five-tenths grams of the oxyphenylisoamylurethane were dissolved in a slight excess of a 10 per cent. solution of potassium hydroxide, and to this was added 0.8 grams (one mol.) of benzoyl chloride. Slowly a brown oil separated which solidified in an ice box. After extracting with ether and recrystallizing several times from dilute alcohol white needle shaped crystals were obtained which melted at 64°-65.5°. It is insoluble in water, dilute acids and alkalis, but soluble in ether, chloroform, benzol, and alcohol. 0.2591 grams gave 10 c. c. of nitrogen at 22.5° and 748 mm. pressure. This is equivalent to 4.39 per cent nitrogen. Calculated for $C_{19}H_{21}NO_4$ equals 4.28 per cent.

To one gram of this diacyl derivative 2 c. c. of a 10 per cent. solution of alcoholic potash were added. Saponification began at once and when all had passed into solution it was acidified and extracted with ether. The ether solution was washed with a solution of sodium bicarbonate and the ether evaporated. The residue after recrystallization from ligroin melted at 68.5°–69.5°, and when mixed with the urethane having the same melting point no depression of melting point was observed. From the sodium bicarbonate solution, on acidifying, benzoic acid separated and was identified in the usual way. The result indicates that the benzoyl group was attached to oxygen.

ACTION OF CHLORCARBONICISOAMYLETHER ON BENZOYL O–AMINOPHENOL.

Benzoyl o-aminophenol was prepared following the method of Ransom. Two grams of this were dissolved in excess of a 10 per cent. solution of potassium hydroxide and 1.6 grams of chlorcarbonicisoamyl ether slowly added. On shaking, an oil slowly separated and this was extracted with ether. From the ether an oily residue was obtained which after several recrystallizations from alcohol formed a white solid melting at 64°–65.5°. A mixture with the supposed isomer had the same melting point. Saponification resulted in the production of benzoic acid and the urethane (m. p. 64°–65.5°). Evidently the benzoyl group in this, as in the former case, is attached to oxygen and must have shifted from its original attachment to nitrogen.

ACTION OF CHLORCARBONICETHYLETHER ON OXYPHENYLISOAMYLURETHANE.

One and one-fourth grams of oxyphenylisoamylurethane were dissolved in 4 c. c. of a 10 per cent. solution of potassium hydroxide and to this was added 0.7 grams of chlorcarbonicethylether. A heavy red oil separated. This was extracted with ether and the ether solution washed successively with dilute alkali, dilute acid and water. It was then dried with calcium chloride and the ether allowed to evaporate. The oil did not solidify. It was distilled under a pressure of 16 mm. at 185°–200°, the distillate soon solidifying to a yellow crystalline mass. After several recrystallizations from dilute alcohol the crystals became white and melted at 65°–66°. It is insoluble in water, acids and alkalis, but soluble in alcohol, ether, chloroform, and benzol.

ACTION OF CHLORCARBONICISOAMYLETHER ON OXYPHENYLETHYLURETHANE.

The ethylurethane was prepared according to Ransom's method and two grams of it were dissolved in a slight excess of potassium hydroxide. To this was added the calculated amount (1 mol.) of chlorcarbonicisoamylether. After shaking, a light yellow oil separated which became darker on standing. This was extracted with ether and the ether allowed to evaporate. An oil remained which refused to solidify even in a freezing mixture. It was distilled under a pressure of 15 mm. at 184°–190°, the distillate solidifying to a crystalline mass. After several recrystallizations it became white and melted at 65°–66°. It has all the properties of its supposed isomer above described. On saponifying some of the impure material two substances were obtained. A part melted at 133°–134° and is probably carbonylaminophenol produced from the urethane by loss of alcohol. The other part after purification melted at 84°–85° and on mixing with oxyphenylethylurethane (m. p. 86–87) the melting point was raised slightly. Evidently the carbethoxy group remains attached to nitrogen and no rearrangement occurs in preparing the diacyl derivative by this method. Since the supposed isomer is identical with this, there must have been a rearrangement during its preparation in the sense that the two carboxyl radicals exchanged places, the lighter changing from oxygen to nitrogen. The following equations express the reactions involved and the rearrangement that must have occurred in one case. $KOC_6H_4NHCOOC_5H_{11} + ClCOOC_2H_5 > C_2H_5OOCOC_6H_4NHCOOC_5H_{11} + KCl$ $C_2H_5OOCOC_6H_4NHCOOC_5H_{11} > C_5H_{11}OOCOC_6H_4NHCOOC_2H_5$. The final product is o-oxyphenylethylurethaneisoamylcarbonate.

SUMMARY.

The work here outlined, together with that previously reported, shows that when two carboxyl radicals (COOR and $COOR_1$) are introduced into the molecule of ortho aminophenol the lighter one becomes attached to the amide nitrogen, the position not being influenced by the order in which the groups are introduced. And that to accomplish this a molecular rearrangement occurs in one case. This is also true when both radicals are carbonyls (COR and COR_1). In case one radical is carbonyl and the other carboxyl the latter becomes attached to nitrogen without being influenced by the relative weights of the entering groups. The hope that the introduction of radicals of nearly the same weight (C_6H_5CO — 105, $C_5H_{11}COO$ — 115) would result in the formation of isomeric substances was not realized, the velocity of the rearrangement being almost instantaneous in every case. Consequently the mechanism of the rearrangement cannot be explained. It is possible that there is an equilibrium of the two isomeric forms and that one of them is in large excess, but there is little evidence to support this view. Work already begun with the orthoaminomercaptans may throw light upon the problem.

Boiling and Condensing Points of Alcohol Water Mixtures.

P. N. Evans.

The boiling points of mixtures of alcohol and water depend on the proportions of the constituents and range from about 70° C. for pure ethyl alcohol to 100° C. for pure water. Except at a concentration of about 92 per cent. alcohol by weight (about 96 per cent. by volume) any mixture of alcohol and water when boiled gives off a vapor of different composition from the liquid, the vapor being richer or poorer in alcohol than the liquid when the latter contains respectively less or more than 92 per cent. of alcohol. The vapor has, of course, a condensing point identical with the true boiling point of the liquid from which it is given off.

The purpose of the work here reported was to ascertain experimentally the relation between the boiling point (or condensing point) and the composition of both the liquid and vapor phases, so that with the information so obtained it would be possible by observation of the corrected boiling point to learn the composition of the boiling liquid and of the condensing vapor.

PROCEDURE.

The gravity and temperature of a strong alcohol were determined with a Westphal balance, and the weight-per cent. of alcohol calculated by means of Mendelejeff's table. Five hundred cubic centimeters were placed in a one-liter distilling flask with an accurate thermometer graduated in tenths of a degree placed with its bulb just below the side-neck. The liquid was then slowly distilled at a uniform rate of about one drop per second until 15 c. c. had passed over, the distilling temperature being read when 7.5 c. c. had collected in the graduated receiver. The per cent. of alcohol in the distillate and in the residue was determined from the gravity as before.

The average of the percentages found in the liquid in the flask before and after distillation was taken as that of the liquid phase, and the percentage in the distillate as representing the vapor phase at a moment half-way through the distillation when the boiling point was observed.

The original volume of the liquid in the flask was restored by the addition of 15 c. c. of water, and the slightly more dilute mixture so obtained was used for the next experiment. Forty-three mixtures were investigated in this way, ranging from 91 to 0 per cent. of alcohol.

Corrections were introduced in the temperature readings for the barometric pressure and for the exposed column of mercury in the thermometer, assuming that the barometer effect would be the same as in the case of water—an assumption very nearly in accordance with the facts, as shown by the tables of Regnault and Classen given in Biedermann's Chemiker-Kalender.

RESULTS.

The temperature results are probably accurate within 0.2 degrees, and the concentrations within 2 per cent.

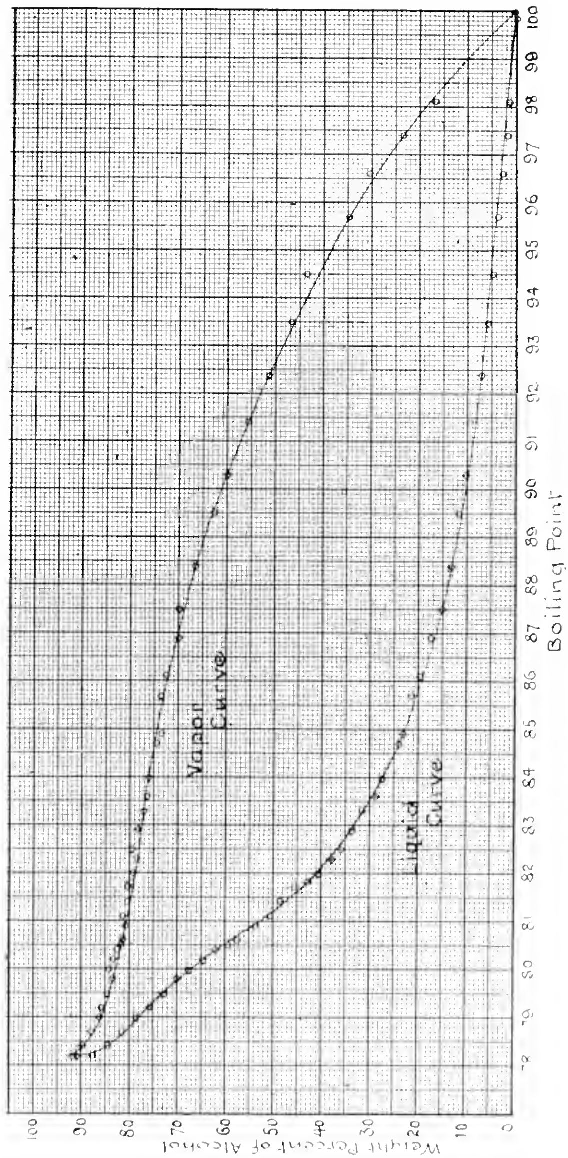
The results obtained are given in the following table:

Number.	Gravity before distillation.	Temperature during gravity determination.	Per cent. alcohol before distillation.	Gravity of residue.	Temperature during gravity determination.	Per cent. alcohol in residue.	Average per cent. alcohol in liquid.	Gravity of distillate.	Temperature during gravity determination.	Per cent. alcohol in distillate.	Observed temperature of distillation.	Barometer.	Barometer correction in boiling point.	Room temperature.	Correction for exposed mercury column.	Corrected boiling point.
1	.815	20	91.1	.812	23	91.1	91.1	.811	22	91.8	77.2	750	.4	23	.6	78.2
2	.822	22	87.7	.821	23	87.7	87.7	.815	23	90.0	77.2	750	.4	22	.6	78.2
3	.829	23	84.6	.829	23	84.6	84.6	.819	22	89.6	77.4	750	.4	22	.6	78.4
4	.836	24	81.5	.838	22	81.5	81.5	.823	22	88.0	77.6	748	.5	22	.6	78.7
5	.845	22	78.7	.843	25	78.8	78.8	.825	22	86.5	77.7	743	.7	22	.6	79.0
6	.852	22	75.8	.851	23	75.8	75.8	.827	22	85.8	77.8	740	.8	22	.6	79.2
7	.857	24	72.9	.860	21	72.9	72.9	.829	23	84.6	78.1	741	.8	22	.6	79.5
8	.864	23	70.4	.866	23	69.6	70.0	.832	22	83.8	78.4	741	.8	23	.6	79.8
9	.873	21	67.5	.873	21	67.5	67.5	.833	20	84.2	78.6	743	.7	21	.6	79.9
10	.879	21	65.0	.880	21	64.6	64.8	.835	20	83.5	78.9	743	.7	21	.6	80.2
11	.884	21	62.7	.885	23	61.4	62.0	.838	19	82.7	79.1	743	.7	21	.6	80.4
12	.891	22	59.2	.893	20	59.2	59.2	.839	20	81.9	79.5	750	.4	21	.6	80.5
13	.898	20	57.1	.899	21	57.5	57.3	.839	21	81.5	79.6	750	.4	21	.6	80.6
14	.904	21	54.1	.904	23	53.2	53.6	.839	23	80.8	80.2	757	.1	23	.6	80.9
15	.908	23	51.4	.910	22	51.0	51.2	.840	21	81.2	80.3	756	.2	22	.6	81.1
16	.915	22	48.6	.916	22	48.2	48.4	.842	21	80.4	80.5	756	.2	22	.6	81.4
17	.920	22	46.4	.923	22	45.0	45.7	.843	20	80.4	80.8	756	.2	22	.6	81.7
18	.926	23	43.8	.928	22	42.5	43.1	.844	21	79.6	81.0	756	.2	22	.6	81.8

Number.	Gravity before distillation.	Temperature during gravity determination.	Per cent. alcohol before distillation.	Gravity of residue.	Temperature during gravity determination.	Per cent. alcohol in residue.	Average per cent. alcohol in liquid.	Gravity of distillate.	Temperature during gravity determination.	Per cent. alcohol in distillate.	Observed temperature of distillation.	Barometer.	Barometer correction in boiling point.	Room temperature.	Correction for exposed mercury column.	Corrected boiling point.
19	.923	22	40.5	.932	25	40.0	40.2	.845	20	79.6	81.2	755	.2	19	.6	82.0
20	.936	24	38.0	.938	23	37.5	37.7	.848	19	78.8	81.5	755	.2	20	.6	82.3
21	.940	24	36.0	.942	23	35.5	35.7	.846	20	79.2	81.6	755	.2	20	.7	82.5
22	.945	23	33.9	.947	22	33.3	33.6	.849	19	78.3	82.0	755	.2	20	.7	82.9
23	.949	23	31.7	.950	23	31.1	31.4	.851	20	77.1	82.4	755	.2	21	.7	83.3
24	.952	24	30.0	.955	23	28.1	29.0	.853	20	76.2	82.7	756	.2	21	.7	83.6
25	.956	23	27.5	.956	25	26.9	27.2	.853	21	75.8	82.5	748	.5	20	.7	84.0
26	.958	24	26.2	.961	22	24.7	25.4	.856	22	74.2	83.4	748	.5	22	.8	84.7
27	.962	23	23.7	.964	23	22.3	23.0	.858	19	73.7	83.7	750	.4	21	.8	84.9
28	.965	23	21.7	.966	23	21.0	21.3	.859	20	73.7	84.3	750	.4	21	.8	85.7
29	.966	23	21.0	.969	23	18.9	19.9	.860	22	72.5	84.8	747	.5	22	.8	86.1
30	.970	23	17.9	.972	22	16.7	17.3	.866	22	70.0	85.5	745	.6	23	.8	86.9
31	.973	22	15.8	.974	24	14.4	15.1	.865	23	70.0	86.2	747	.5	23	.8	87.5
32	.975	24	13.3	.977	25	12.3	12.8	.873	23	66.7	86.9	756	.6	24	.9	88.4
33	.977	25	12.3	.979	25	11.0	11.6	.882	24	62.5	88.1	748	.5	25	.9	89.5
34	.980	22	11.0	.982	23	9.3	10.1	.891	21	60.0	89.1	750	.4	22	.9	90.3
35	.982	23	11.0	.984	24	7.9	9.4	.901	20	55.8	90.1	750	.4	22	.9	91.4
36	.985	22	7.9	.987	22	6.4	7.1	.910	22	51.4	91.1	750	.4	22	.9	92.4
37	.987	22	6.4	.989	20	5.0	5.7	.919	22	46.8	92.2	750	.4	23	.9	93.5
38	.990	21	4.4	.991	23	3.9	4.1	.927	22	43.7	93.1	747	.5	21	.9	94.5
39	.991	23	3.9	.992	24	2.8	3.3	.947	21	33.5	94.3	747	.5	22	.9	95.7
40	.992	24	2.8	.994	22	2.2	2.5	.953	21	30.6	95.2	747	.5	22	.9	96.6
41	.995	22	1.7	.996	21	1.1	1.4	.964	21	23.6	96.0	747	.5	22	.9	97.4
42	.996	22	1.1	.996	23	0.9	1.0	.972	22	16.7	96.8	751	.4	22	.9	98.1
43	.998	25	-0.5	.999	22	-0.3	-0.4	.999	21	-0.1	98.7	753	.3	22	.9	99.9

The last experiment (No. 43) was with water only.

The relations existing between the boiling point or condensing point and the composition of the liquid and vapor phases are shown clearly by the following plot:


Vapor Curve
Liquid Curve
Boiling Point
Weight Percent of Alcohol
78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
0 10 20 30 40 50 60 70 80 90 100

A convenient table of results estimated from the curves is here given:

Boiling Point	Weight Per Cent. Alcohol in		Boiling Point.	Weight Per Cent. Alcohol in	
	Liquid.	Vapor.		Liquid.	Vapor.
78.2	91	92	86.5	18	71
78.4	85	89	87.0	17	70
78.6	82	88	87.5	16	69
78.8	80	87	88.0	15	68
79.0	78	86	88.5	13	67
79.2	76	85	89.0	12	65
79.1	71	85	89.5	11	63
79.6	72	84	90.0	10	61
79.8	69	84	90.5	10	59
80.0	67	83	91.0	9	57
80.2	64	83	91.5	8	55
80.4	62	82	92.0	8	53
80.6	59	82	92.5	7	51
80.8	56	81	93.0	6	49
81.0	53	81	93.5	6	46
81.2	50	80	94.0	5	44
81.4	47	80	94.5	5	42
81.6	45	80	95.0	4	39
81.8	43	79	95.5	4	36
82.0	41	79	96.0	3	33
82.5	36	78	96.5	3	30
83.0	33	78	97.0	2	27
83.5	30	77	97.5	2	23
84.0	27	76	98.0	1	19
84.5	25	75	98.5	1	15
85.0	23	74	99.0	0	10
85.5	21	73	99.5	0	5
86.0	20	72	100.0	0	0

The information here given enables one to determine quickly the approximate concentration of any alcohol-water mixture by observation of its boiling point, with corrections for barometric pressure and exposed mercury column. The accuracy is, of course, less than by the usual and more difficult analytical method of distillation and the determination of the gravity of the distillate with a pyknometer.

It is also possible to tell the approximate composition of both liquid and vapor (or distillate) at any moment during the distillation of a mixture. This application has proved interesting in interpreting the behavior of alcohol-water mixtures during distillation and partial condensation in the writer's laboratory classes.

It is the intention to continue the experiments by examining mixtures containing over 92 per cent. of alcohol; the observations will require greater accuracy, and a differential thermometer graduated in hundredths of a degree will be employed.

Purdue University,
Lafayette, Ind.

(Abstract.)

On the General Solution and So-Called Special Solutions of Linear Non Homogeneous Partial Differential Equations.

L. L. Steimley.

The integrals of a partial differential equation of the first order were first classified by Lagrange, who separated them into three groups, namely, the general, the complete, and the singular integrals. For a long time this classification was thought to be complete. In fact, Forsyth in his *Differential Equations*, published first in 1885, gives a supposed proof of a theorem stating that every solution of such a differential equation is included in one or other of the three classes named. This error is also carried through the second and third English editions and the two German editions, the last one being published in 1912.

In 1891 Goursat pointed out in his *Equations aux derivees partielles du premier ordre*, that solutions exist which do not belong to any of these three classes and showed indeed that the existing theory was not complete even for the simplest forms.

In November, 1906, Forsyth, in his presidential address to the London Mathematical Society, emphasized the fact that the theory is incomplete, and in his closing remark says: "It appears to me that there is a very definite need for a re-examination and a revision of the accepted classification of integrals of equations even of the first order; in the usual establishment of the familiar results, too much attention is paid to unspecified form, and too little attention is paid to organic character, alike of the equations and of the integrals. Also, it appears to me possible that, at least for some classes of equations, these special integrals may emerge as degenerate form of some semi-general kinds of integrals; but it is even more important that methods should be devised for the discovery of these elusive special integrals."

Forsyth also in an address delivered by request, at the 4th International Congress of Mathematicians, takes advantage of the opportunity offered, to again emphasize the incompleteness of the existing theory of partial differential equations of the first order.

In attacking this problem the logical place to begin is with the simplest case, namely, with the linear equation. This is the equation dealt with in the paper. It can be written in the form

$$\sum_{i=1}^{n} \chi_i \left[z, x_1, x_2, \quad . \quad . \quad . \quad . \quad . , x_n \right] = Z \left[z, x_1, x_2, \quad . \quad . \quad . \quad . \quad . , x_n \right].$$

The restrictions made on this equation are that all common factors have been removed from Z, X_1, X_2, ... , X_n; that there is also a set of values of the variables z, x_1, x_2, ... , x_n in the vicinity of which the functions X_i and Z have no branch points and otherwise behave regularly.

Forsyth, in his treatise on *Partial Differential Equations* published in 1906 goes to much labor to give solutions that are examples of the so-called special integrals. In the present paper a means is developed by which all the elusive special integrals can be readily determined and a new and complete classification is given of all the integrals of the equation.

A Modified Permeameter.

Edwin Morrison and B. D. Morris.

In his work on the Magnetic Induction in Iron and Other Metals, Ewing briefly describes a permeameter. (See page 247, Art. 148.) The instrument is for the purpose of determining the magnetisation of a metal by means of the tractive force. In Ewing's work the permeameter method constitutes the fourth method of measuring the magnetic properties of a metal, that of the ballistic, the direct magnetometric, and the optical methods having been

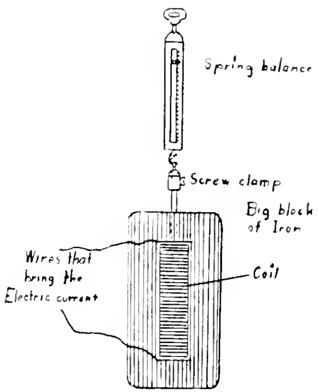


Fig. 130.

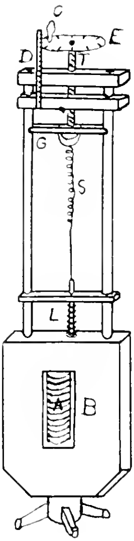


Fig 1.

previously described. After describing the apparatus and developing the equations the author closes his discussion thus: "The tractive method is at best inexact, but it affords a ready means of making rough measurements, especially for purposes of comparison."

Two primary objects were sought in modifying the Thompson Permeameter as shown in Ewing's work, Fig. 130, page 249: First, to render the instrument more accurate, and Second, to avoid complexity such as is necessary in the ballistic method so that the magnetic properties of iron may be introduced earlier in a students' course.

The modified apparatus is shown in Fig. 1. The solenoid (A) is surrounded by a cast iron field (B) which furnishes a metal path for the return lines of force. The lug (L) is separated from the core of the solenoid by a very thin piece of paper. The core of the coil can be easily replaced by a core of a different metal, thus giving a different test. The force required to separate the lug from the core is measured by means of the spring (S). Since the pull exerted by a spring is directly proportional to the distance it is stretched it becomes necessary simply to measure accurately the distance the spring is stretched in separating the lug (L) from the core. The upper end of the spring is attached to a sliding guide bar (G), to which is fastened a micrometer screw (T). By turning this micrometer screw the spring may be stretched sufficiently to pull the lug away from the core which is being tested. The number of whole turns of the screw may be read from the index bar (D), and the fractional part of a turn to one-tenth of a turn may be read from the disk (E.) By standardizing the spring and reading micrometer by means of known weights the force in screw turns may be reduced to grams or pounds.

The permeameter with the auxiliary apparatus is set up as shown in Fig. 2.

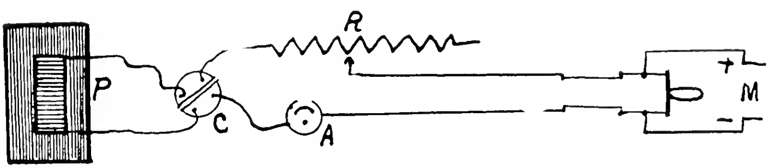


Fig. 2.

P, is the permeameter.

C, is rotary commutator by means of which an alternating current may be thrown through the solenoid, thus demagnetizing the core.

R, is a variable resistance by means of which the current may be varied from zero to twenty five amperes.

A, is an ammeter

M, represents the source of current, which is the ordinary 110 volt direct lighting current.

The method of obtaining data is as follows: First demagnetize the core specimen to be tested by rotating the rotary commutator, thereby causing an alternating current to flow through the solenoid. When the specimen is demagnetized it will exert no pull on the lug (L). Next pass a very slight current through the solenoid, place the lug in contact with the core and turn the crank until the lug and core are separated. The number of turns can be read directly from the slide index (D) and the disk (E). The current strength is read from the ammeter. The current is then increased and the force measured which is required to separate the lug and core. This process is continued, noting in each instance the current strength and the pulling force of the spring, until the pulling force ceases to increase with an increase of current, indicating that the core is saturated. The current is now decreased step by step and the pulling force and the current strength noted in each case. When the current reaches zero it is reversed and the process indicated above is repeated. When the current is again brought back to zero it is reversed the second time and increased to the point of saturation. Thus data for the complete hysteresis loop may be taken.

The equations for transforming the results from a permeameter into the B and H values for plotting the hysteresis loop are as follows. (See Ewing's work page 248.)

$$\text{Pull in lbs.} = \frac{(B - H)^2 \times S(\text{sq. cm.})}{11183000}$$

$$\text{or } B = 3344 \sqrt{\frac{\text{Pull in lbs.}}{S(\text{sq. cm.})}} + H$$

$$\text{or } B = 1317 \sqrt{\frac{\text{Pull in lbs.}}{S(\text{sq. cm.})}} + H$$

The value of H may be determined by the following equation, in which N is the number of turns, I the current strength in amperes and l is the length of the solenoid in cm.

$$H = \frac{1.26\ N\ I}{l}$$

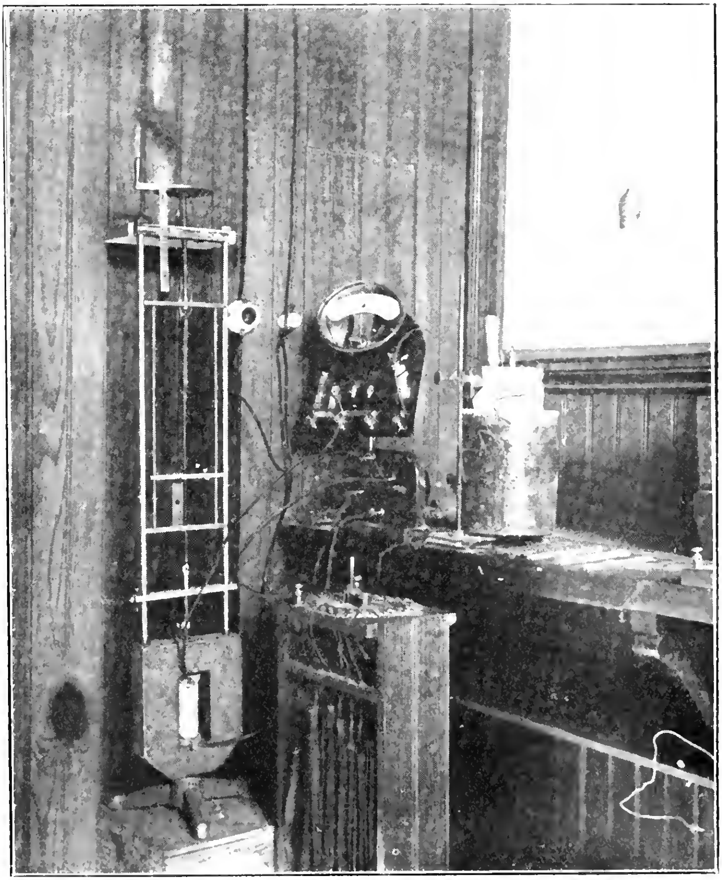


Fig. 3.

DATA.

Length of solenoid, 9.5 cm. Number of turns, first coil 176, second coil 273. The force of the spring represented by one turn of the micrometer screw is 13 grams or 0.028 lb.

Record for a Cold Rolled Steel Rod 0.5 in. Diam. Coil 176 Turns.

Amp. I.	Pull in Turns.	Pull in Pounds.	Amp. I.	Pull in Turns.	Pull in Pounds.	Amp. I.	Pull in Turns.	Pull in Pounds.
0.0	0.0	0.0000	0.0	1.0	0.028	0.0	1.0	0.028
0.4	0.4	0.0112	0.4	0.3	0.008	0.4	0.2	0.006
0.8	3.0	0.0840	0.8	2.5	0.060	0.8	2.0	0.056
1.2	10.5	0.294	1.2	9.0	0.262	1.2	8.5	0.238
1.6	17.0	0.4761	1.6	18.0	0.484	1.6	19.0	0.541
2.0	22.0	0.6160	2.0	26.0	0.628	2.0	25.0	0.700
2.5	28.0	0.7840	2.5	28.5	0.798	2.5	30.0	0.840
3.5	35.0	0.9800	3.5	36.0	1.008	3.5	35.0	0.980
4.5	36.0	1.0080	4.5	40.0	1.120	4.5	39.0	1.094
5.0	38.0	1.0640	5.0	40.0	1.120	5.0	40.0	1.120
5.5	38.0	1.0640	5.5	40.0	1.120	5.5	41.0	1.148
6.0	39.0	1.0940	6.0	40.0	1.120	6.0	41.0	1.148
5.5	39.0	1.0940	5.5	40.0	1.120			
5.0	38.0	1.0640	5.0	10.0	1.120			
4.5	39.0	1.0949	4.5	40.0	1.120			
3.5	37.0	1.0360	3.5	8.0	1.064			
2.5	32.0	0.8960	2.5	36.0	1.008			
2.0	28.0	0.7840	2.0	31.0	0.868			
1.6	27.5	0.7700	1.6	28.0	0.784			
1.2	23.0	0.6140	1.2	24.0	0.672			
0.8	17.0	0.4761	0.8	18.0	0.484			
0.4	6.0	0.1642	0.4	8.0	0.204			
0.0	1.0	0.0280	0.0	1.0	0.028			

Above Results Converted into H and B Values.

Amp. I.	H.	B	Amp. I.	H.	B.	Amp. I.	H.	B.
0.0	0.00	0.00	0.0	0.00	497.79	0.0	0.00	497.79
0.4	9.32	324.14	0.4	9.32	307.82	0.4	9.32	239.75
0.8	18.64	878.84	0.8	18.64	742.27	0.8	18.64	747.30
1.2	27.96	1642.76	1.2	27.96	1550.66	1.2	27.96	1480.26
1.6	37.28	2137.28	1.6	37.28	2106.88	1.6	37.28	2225.33
2.0	46.60	2381.40	2.0	46.60	2404.10	2.0	46.60	2525.60
2.5	58.25	2692.25	2.5	58.25	3039.95	2.5	58.25	2617.25
3.5	81.55	3025.75	3.5	81.55	3173.05	3.5	81.55	3025.75
4.5	104.85	3030.95	4.5	104.85	3253.05	4.5	104.85	3216.35
5.0	116.50	3185.10	5.0	116.50	3264.70	5.0	116.50	3264.70
5.5	128.15	3196.75	5.5	128.15	3276.35	5.5	128.15	3315.50
6.0	139.80	3255.30	6.0	139.80	3288.00	6.0	139.8	3327.15
5.5	128.15	3243.65	5.5	128.15	3276.35			
5.0	116.50	3185.10	5.0	116.50	3264.70			
4.5	104.85	3220.35	4	104.85	3253.05			
3.5	81.55	3162.25	3.5	81.55	3150.05			
2.5	58.25	2874.15	2.5	58.25	3149.75			
2.0	46.60	2680.60	2.0	46.6	2818.10			
1.6	37.28	2617.60	1.6	37.28	2671.28			
1.2	27.96	2451.96	1.2	27.96	2466.56			
0.8	18.64	2071.04	0.8	18.64	2088.24			
0.4	9.32	1215.02	0.4	9.32	1352.92			
0.0	0.00	497.79	0.0	0.00	479.79			

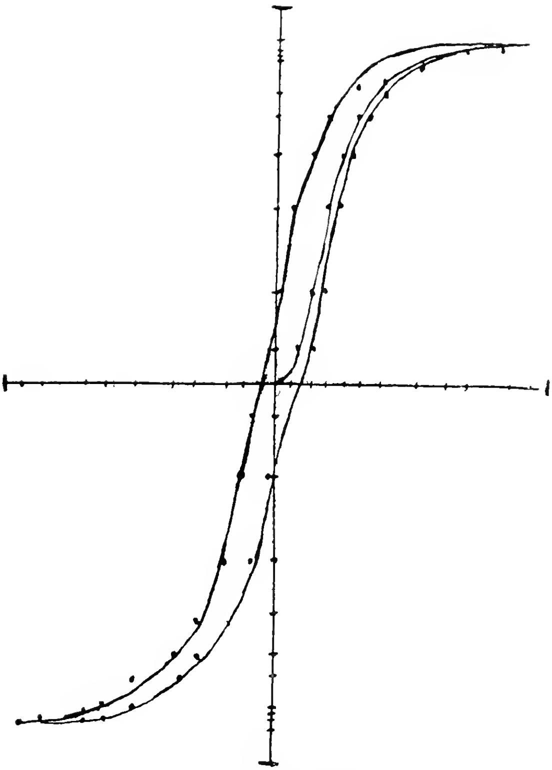


Fig. 4. Hysteresis Plot.

CONCLUSIONS.

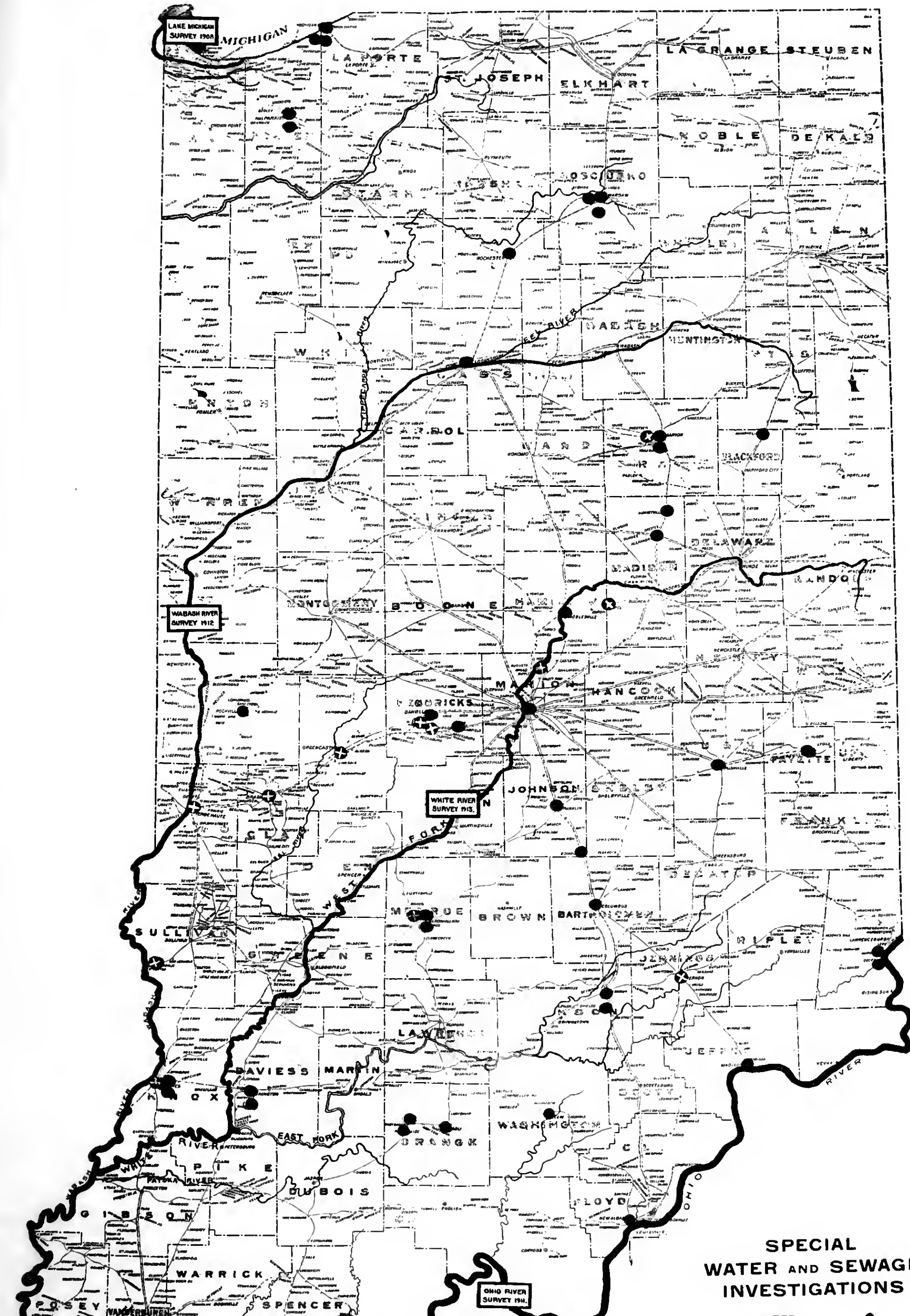
The plot here given establishes the fact that the magnetic properties of iron and steel can be obtained by the permeameter method to a reasonable degree of accuracy, sufficient for student purposes.

From a number of tests which have been made the permeameter establishes in an interesting way the fact that a much stronger current is required to bring a hard metal to magnetic saturation than a soft metal.

The permeameter test also demonstrates that the magnetic pull exerted by a soft metal is much stronger than that of a hard metal under the influence of the same current.

These peculiarities are more easily shown by this instrument than any toher, owing to the fact that different metals can be examined under the same conditions.

Physical Laboratory, Earlham College.



SPECIAL WATER AND SEWAGE INVESTIGATIONS

WATER - - ●
SEWAGE - - ⌗

OCT. 1, 1907, TO OCT. 1, 1913.

Sanitary Survey of Indiana Rivers.

Jay A. Craven, C. E.

In August, 1908, the investigation by the Indiana State Board of Health of the southern end of Lake Michigan bordering Indiana revealed a serious condition. It was found that the Lake water was "grossly polluted and unfit for use as a source of water supply for drinking and domestic purposes." The zone of pollution extended for five miles from shore. Although Indiana Harbor, East Chicago, Whiting and a portion of Hammond contributed domestic sewages directly to the Lake, it was found that this apparently had little influence on the character of the Lake waters. The main source of pollution was found to be the Calumet River with its great volume of sewage and manufacturing wastes. The portion of the lake investigated is readily seen on the accompanying map.

The deplorable situation called for a more thorough survey of the condition, and to this end preparations and plans were made for an investigation of the Calumet River, to determine the "exact condition of the river, the amount and kind of pollution entering it from the Indiana cities, how it was disposed of, and if possible, through its report to lend assistance for the final solution of the problem which faces the Indiana cities and also a part of Chicago."

About twenty-five miles of the Grand Calumet River was surveyed in the summer of 1910. It has a varying width of from twenty-five to three hundred feet and an average depth of six to eight feet until it reaches Lake Calumet, from which point it averages twenty-five feet. It receives most of the sewage and trade wastes from the four cities along its banks, together with a portion of that of Chicago. Many large manufacturing concerns contributed a large part of the most offensive refuse.

Forty-three sampling points were established in the East Chicago canal, the Grand Calumet River, The Little Calumet River and Lake Michigan. Samples for the putrescibilty reaction, oxygen consumed and dissolved, were collected at all the sampling points and sewer outlets over a period extending from June 29th to August 1st. In addition to this, bacterial analyses were made on river samples during that period. The portion of the river investigated is shown on the map of Indiana.

The results of this work were summarized as follows: "It appears that the Calumet River is, for a part of its course, a septic tank, in which the sewage entering it travels but a short distance from its point of entrance before undergoing putrefaction." As the conditions were serious, involving the health of the people of several cities and extending over a large territory, it was thought that the problem could be more advantageously dealt with by the formation of a sanitary district to study the conditions and reach a final solution, and it was so recommended.

At the same time these conditions along the lake were being investigated, the states bordering the Ohio River were much concerned with the condition of the river and a preliminary survey had been made of that portion of it bordering Ohio by the Ohio State Board of Health. Indiana was next in line in doing similar work along its borders, and in the summer of 1911 that portion of the river lying between Cincinnati, Ohio, and the mouth of the Wabash River, a distance of 357 miles, was surveyed. A houseboat was equipped for the survey in which living and working quarters were provided, and it was found to be admirably adapted to the work.

The total drainage basin to the Ohio-Indiana line is 80,947 square miles, and the population located on this area was about 8,000,000. Four hundred and fourteen samples were collected for chemical and bacterial analysis, 333 of which were river samples.

With the exception of three or four points in the river, and these at or near the entrance, the analysis did not show a serious condition to exist, one which at the stage of water encountered would create a nuisance. At no point along the river was the raw water found to be fit for drinking purposes, however.

One noticeable feature that should be mentioned is the high typhoid death rate in the cities using raw river water, and the decrease in the rate after the introduction of filter plants where this step had been taken. At Cincinnati for three years before filtered water was used the average rate was 61.0 per 100,000 and the average rate for the three years following the introduction of filtered water was 12.6.

As an Indiana problem alone, future investigations could be limited to Cincinnati, Louisville or Evansville, and as the former are much the larger, contributing therefore a much larger amount of sewage and wastes, active steps toward an abatement of the problem at these two places will have to be taken before Indiana is affected. The question of the disposal of manufacturing wastes is a comparatively easy one for Indiana manufacturers. It is an individual problem for each concern to solve, but there are very few where a treatment of the waste would be required, and then only after the problem has been taken up at all points along the river.

In the report made in 1911 it was said that the problem was not one for the individual states, but that it would have to be controlled by the Federal Government, and preparations are now being made by the Government for a thorough survey of the entire river.

Continuing the policy of surveying our rivers, and therefore our natural water supplies, a survey of the Wabash River was made in the summer of 1912. From the experience gained the previous summer, a two-roomed houseboat was built, one room to be used for the laboratory work and the second for living quarters. The work covered the river from Bluffton near its source to the mouth, a distance of 450 miles. Because of the shallowness of the river at the upper end, this portion was covered in a rowboat, and samples shipped to Lafayette to the houseboat laboratory. From this point down, the houseboat was used. Eight hundred and twenty-three samples were collected for a chemical and bacterial analysis, 696 of them from the river.

At no point was the river seriously polluted; i. e., a nuisance did not exist. At a few places, however, as at Wabash, where a large strawboard plant is located; at Lafayette, where there is another one; at Terre Haute, with many manufacturing concerns, and at Vincennes, with its strawboard works and distilleries, considerable pollution was found. As this condition was always below the cities and they were not bothered, and the natural purification of the river remedied this condition before the cities and towns below were reached, no complaints were heard. The population on the watershed is not large in comparison with its size, and the flow is sufficient to care for the sewage and wastes by dilution.

Although from a physical standpoint the river was found to be in good condition, the analyses showed that it was unfit in its raw state for drinking and domestic purposes, and that it would be necessary to filter the water to make it potable. The great burden imposed upon a filtration plant by the use of the river for the disposal of sewage and manufacturing wastes in constantly increasing quantities, should be lessened as much as possible. Some degree of purification of all manufacturing wastes and domestic sewage should be required. Partial purification, such as screening or the passing the sewage and wastes through Imhoff tanks, will give a satisfactory effluent for some time to come. Some such treatment should therefore be required of all cities and towns and manufacturing concerns, and it was so recommended.

Last summer similar work was done on White River from Winchester, near the source, to the mouth, a distance of about 388 miles being covered. From Winchester to Muncie the trip was made on foot: from Muncie to Indianapolis a rowboat was used; between Indianapolis and Martinsville, information and samples were collected in an auto, and from Martinsville down, the houseboat which had been used on the Wabash River was again put in service. It had been brought up to this point during the early spring.

Navigation was more difficult than had been previously experienced, and many obstructions in the way of snags and sand bars were met. Altogether 779 samples were collected, 334 of them from the river. The river for about 100 miles below Indianapolis was found to be in a serious condition, due to the great amount of sewage and manufacturing wastes introduced into the river at Indianapolis. The flow of the river during dry seasons is entirely too small to care for this great amount of sewage, and the only remedy for the situation is the treatment of this refuse, which has already been begun in an experimental way. When Indianapolis has relieved its portion of the pollution, other cities will have to do likewise, and in this way, the condition of the river will gradually be restored to as near its original state as possible.

Altogether, a total distance of 1,195 miles were covered in the survey of the last three rivers, and over 2,000 samples were analyzed, 1,363 of them river samples. The work done has revealed serious conditions on two of the rivers, the Calumet and White, steps for the improvement of which have already been taken. In the case of the other two, steps for the restoration of the water to its former condition should be taken, and future pollution prohibited. The accompanying map shows the extent of the work done on Indiana rivers.

These surveys have shown the need of more legislative power, to be vested in a central authority, naturally the State Board of Health, whereby the rivers, our natural water resources, can be saved for future generations. At the present time control of streams is given where they are used for water supplies, but no steps can be taken by the Board of Health unless petitioned by the health officer or citizens of the locality affected. The time is coming, and the sooner such control is given the easier will be the solution of the problem. The data collected will be invaluable in the future for comparative purposes, when the people become awakened to the seriousness of stream pollution.

The Relation of Lakes to Floods, with Special Reference to Certain Lakes and Streams of Indiana.

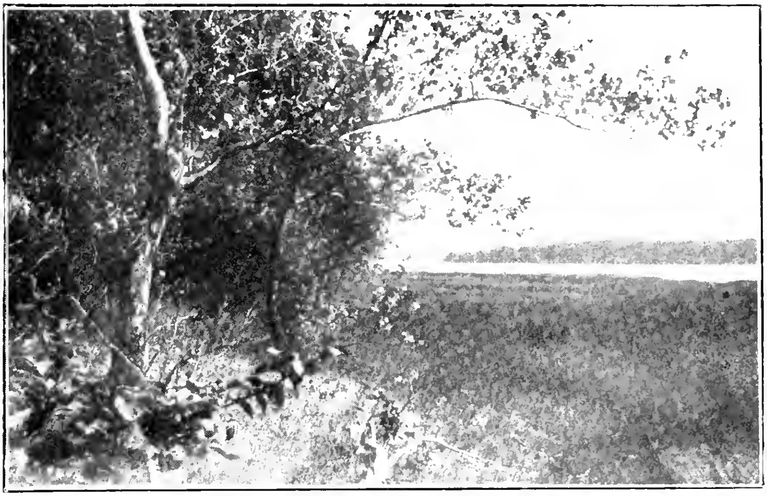
Will Scott.

The problem of flood prevention is a part of a larger problem which we have considered either in a fragmentary way or not at all. This larger problem is the development of the waters of our state as a natural resource. To regard a river as a menace because its higher stages, under present conditions, are destructive; or to consider a lake to be a waste area because it can not be plowed, indicates a very limited insight or selfish motives. Some of the factors that must be considered in the development of this resource are power sites, building sites, water supply for cities, water for irrigation, places for recreation, avenues for transportation, and fish production.

It may be regarded as self-evident, that a whole drainage system must be treated as a unit. It is impossible to develop one power site, without affecting another; floods prevented in the upper course of a stream will make them less destructive in its lower course, etc.

The thing that affects most fundamentally these elements of value in a stream is its rate of discharge. The work of Tucker ('11) has shown that not nearly all of the power sites in Indiana are developed; and that those that are developed are limited in value because of the low minimum discharge. High banks along streams are worth much more for building sites than for farm land. The more constant the stream level is, the more these sites are worth. And so with all of the values that attach to a stream; the more regular the discharge, the greater these values are.

The attention of every one is attracted to the great losses that are caused by floods; but few recognize the decreases in value that are occasioned by the low stages of streams. The losses by floods are sudden and dramatic. They are more or less irregular in their occurrence, while the losses caused by low stages are constant and inconspicuous. The losses



North Side. Former Fish Breeding Ground, Now a Rocky and Unproductive Waste.

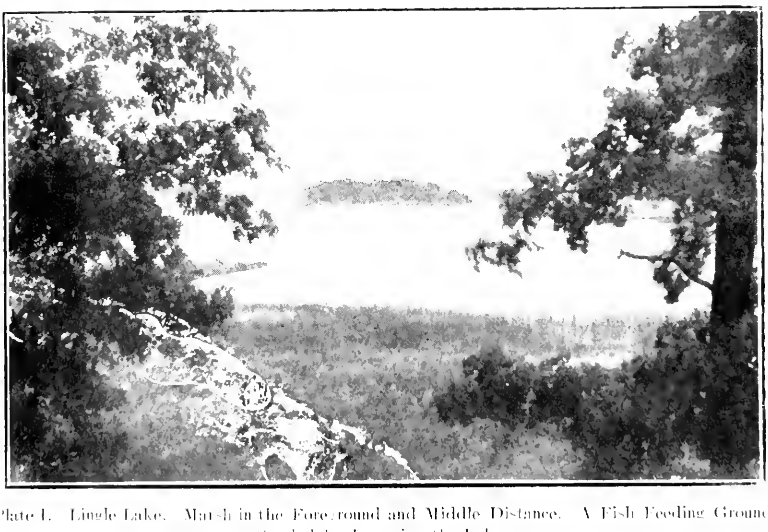


Plate I. Lingle Lake. Marsh in the Foreground and Middle Distance. A Fish Feeding Ground Spoiled by Lowering the Lake.

of the first class represent developed resources; while those of the second class represent resources that are for the most part undeveloped. This accounts for the difference in the attention that each receives. The problem is not the prevention of floods but the production of regular discharge in our streams. The rainfall is irregular, and if it is allowed to run off as it falls an irregular discharge must result. Each drainage system presents a different set of conditions that must be met in solving this problem. The solution of the problem in northern Indiana is intimately associated with the development of our lakes.

This paper is limited to a discussion of some lakes of Kosciusko County and their relation to the Tippecanoe drainage system of which they form a part.

That the Tippecanoe River has a more regular flow than the Wabash is due to the fact that the Tippecanoe has many more lakes and swamps in its headwaters. (The closer proximity of the Wabash to bed-rock probably has some influence on the irregularity of its flow.)

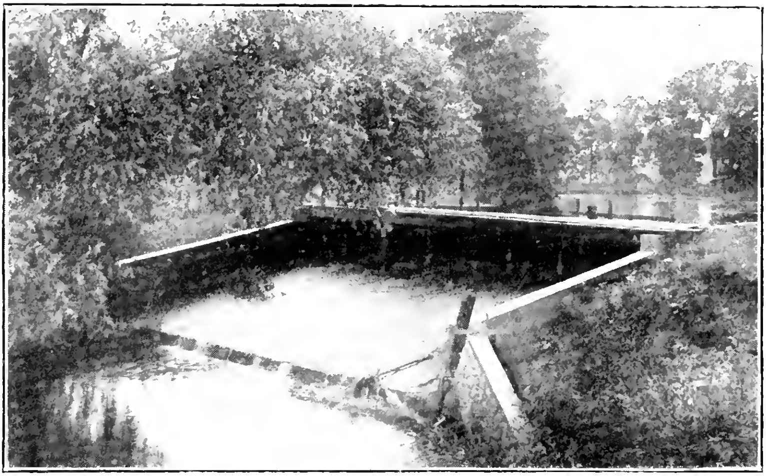
Some of the facts concerning the Wabash at and above Logansport, and the Tippecanoe River at and above Delphi are as follows:

	Drainage Area. Sq. Miles.	Discharge, 1904.		Sec. Ft. per Sq. Mile.	
		Maximum. Sec. Ft.	Minimum. Sec. Ft.	Maximum.	Minimum.
Tippecanoe at Delphi	1,890	15,430	269	8.164	.142
Wabash at Logansport	3,163	48,080	260	15.02	.081

That is, the minimum discharge per square mile of drainage basin in the Wabash is 57.7 per cent of that of a square mile in the Tippecanoe, while the maximum discharge per square mile of basin is 183 per cent of that of the Tippecanoe. This indicates roughly the value of lakes under natural conditions.

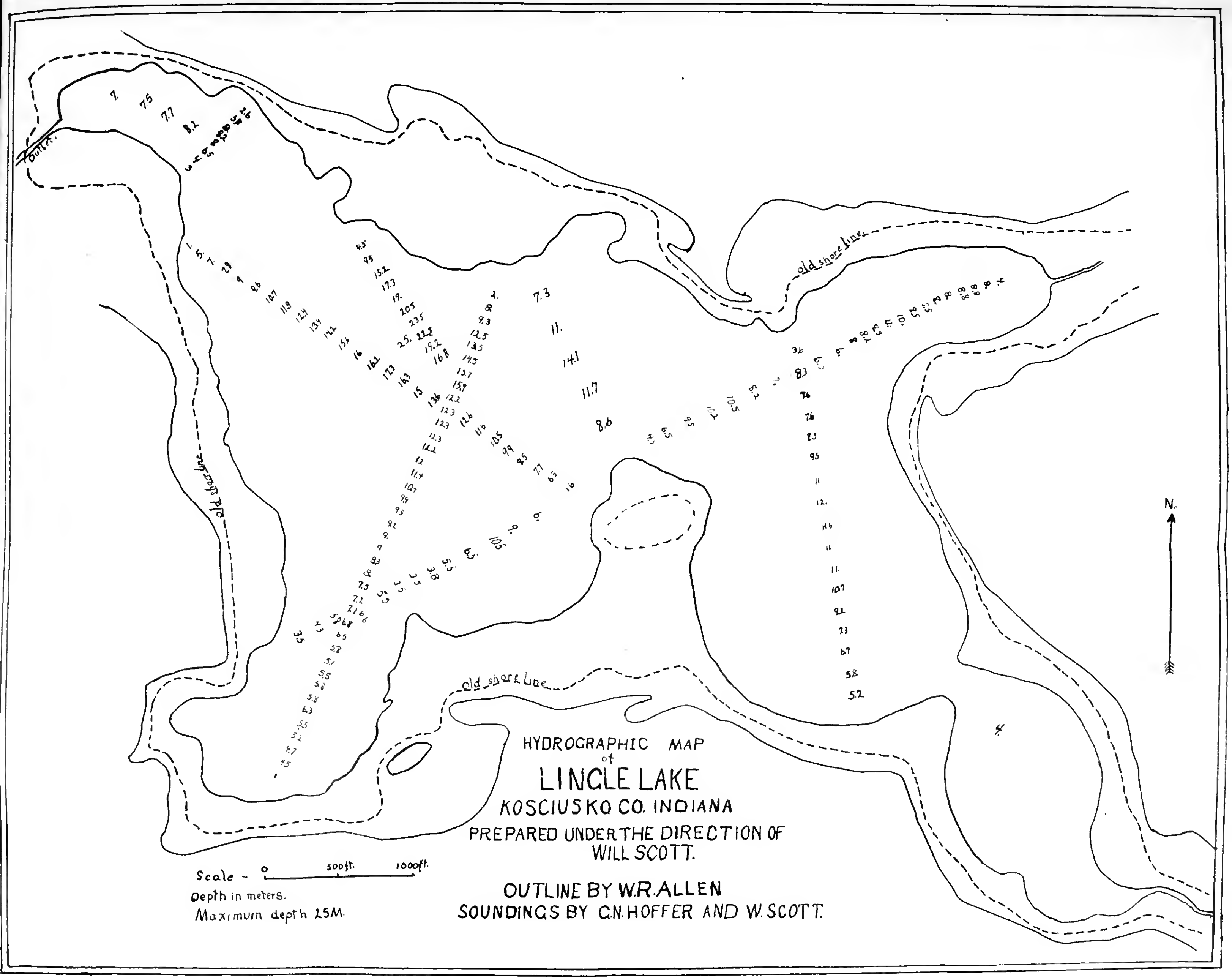
The most important factor in the economy of lakes is the treatment of the outlet. This may be left in a natural condition, it may be dredged, or it may be dammed. I wish to describe the effect of these three conditions on the drainage systems below the lake and upon the lake itself.

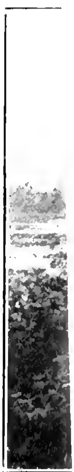
A lake with a natural outlet usually impounds water early in the year. With the first warm months their outlets become obstructed with



Spillway and Dam.

Plate II. Webster Lake. Fish Feeding Ground Formed by Damming the Lake.


HYDROGRAPHIC MAP
of
LINGLE LAKE
KOSCIUSKO CO. INDIANA
PREPARED UNDER THE DIRECTION OF
WILL SCOTT.
OUTLINE BY W.R. ALLEN
SOUNDINGS BY G.N. HOFFER AND W. SCOTT.
Scale - 0 500ft. 1000ft.
Depth in meters.
Maximum depth 25M.
N.
Outlet
old shore line
old shore line
old shore line



1

plants* growing in them so that the excess of water is discharged gradually during the months that follow.

To leave the outlet of a lake undisturbed has many advantages to the lake. First of all, it insures a shore line of considerable age. On the windward side there is usually a wave-cut terrace, which forms the natural breeding ground for most of our lake fish. On the lee side there are usually plants which furnish protection and feeding ground for fish.

If the outlet is dredged the capacity of the lake as an impounding basin is decreased. The plants which obstruct the outlet are destroyed, so that the excess of water is rapidly discharged. For example Lingle Lake was lowered four feet by dredging. Caving of the banks and the obstruction of the outlet by waves has raised the water to within approximately two feet of its original level. This has decreased its area 10,152,800 square feet, and its capacity 40,107,600 cubic feet. See accompanying map.

The present area of Lingle Lake is .537 square miles. This reduction in level has exposed a large area of wave-cut terrace on the north and east shores, and thus destroyed the best nesting places for fish (especially sunfish and bass). None of this land is used and apparently cannot be used. On the south and west extensive marl deposits were exposed on which sedges grow, forming an inferior pasture. The possibilities of aquiculture have been limited, while the available area for agriculture has been increased to a much less degree.

To illustrate the effect of damming lakes, I shall discuss five lakes, whose area is accurately known, and with whose environs I am familiar. These are Eagle Lake (Winona Lake), Little Eagle Lake (Chapman Lake), Webster Lake, Tippecanoe Lake, and Palestine Lake. If dams were constructed so that the level of these lakes could be fluctuated respectively 2, 3, 3, 5, 3 feet they would store and control 27.289 sec. feet per annum, distributed as follows: Eagle 2.02, Little Eagle 4.359, Webster 3.039, Tippecanoe 12.99, Palestine 4.509.

If this excess were discharged during the driest three months it would produce 109.156 sec. feet for that period. The minimum discharge for the Tippecanoe River at Delphi during 1904 was 269 sec. feet. If the excess just cited had been available during that period it would have increased the minimum discharge 40.5 per cent.

* This stream obstruction by plants may be excessive. It accounts for part, if not all, of the discrepancy between rainfall and discharge noted by Tucker ('11, p. 507).

Mill and Race. (See Text.)

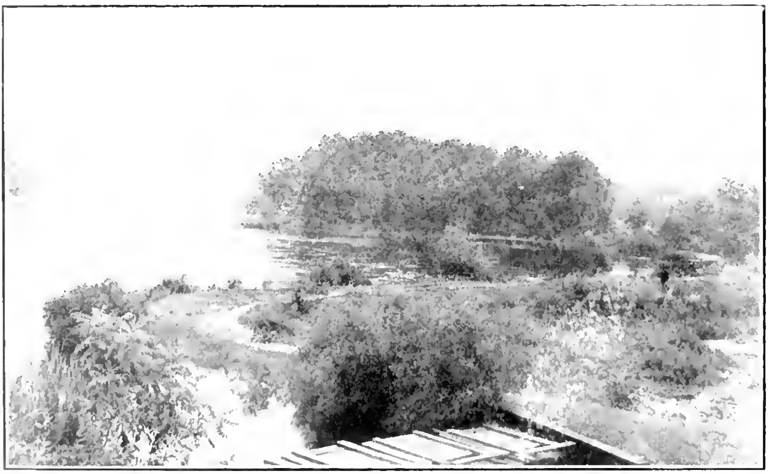


Plate III. Webster Lake. Head of Race and Mill.

It is a well-established fact that the value of a power site is largely determined by the minimum rate of discharge. This means that the value of the water power along the Tippecanoe would be increased more than 40 per cent. by treating five lakes as I have suggested. Not only would this value be enhanced; but it would afford a better avenue of transportation, a more delightful place for recreation, and its yield of fish would be increased. By properly controlling all of the lakes in this basin, it is probable that the minimum rate of flow could be more than doubled. (The exact data for the remaining lakes in this system we hope to collect during the present year.)

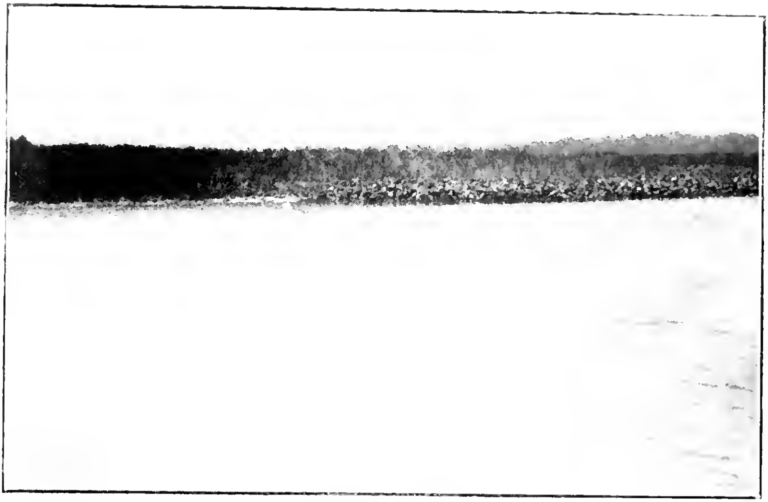
The effect upon flood conditions is evident. The increase of the minimum discharge decreases the maximum discharge. Since it is the top of the flood that does the damage, it will be possible to practically eliminate excessive destruction along this stream. This will improve conditions in some degree along the streams to which the Tippecanoe is tributary.

It is very evident that handling lakes as I have indicated will make the streams that drain them more valuable and less destructive. It remains to determine, as accurately as the available data will permit, the effect upon the lakes themselves and their environs. Raising the level of any lake will of course inundate some land. The value of this land must be considered in determining the advisability of manipulating lake levels. These lakes are all intramorainal and are surrounded by moraines, rising rather abruptly from the water; or by marshes, which in most cases have been formerly a part of the lake.

Where the shore rises abruptly a narrow strip would be submerged by raising the level of the water. In many cases these slopes are used for the sites of summer homes, and it is only a question of time until all of them will be so utilized. The raising of the water along these sites would make boat landing less difficult and would not injure the facilities for bathing.

It is on the wave-cut terraces, which are formed along these moraines that most of the fish of the lake breed. This breeding ground would be narrowed at first, on account of the increased depth of the outer margin; but in a short time it would be more extensive than ever because of the increased width of the terrace.

The marsh land on the margin of lakes is often worthless and never valuable. It is sometimes used for pasture and occasionally it is mowed



The West Side, a Marsh.

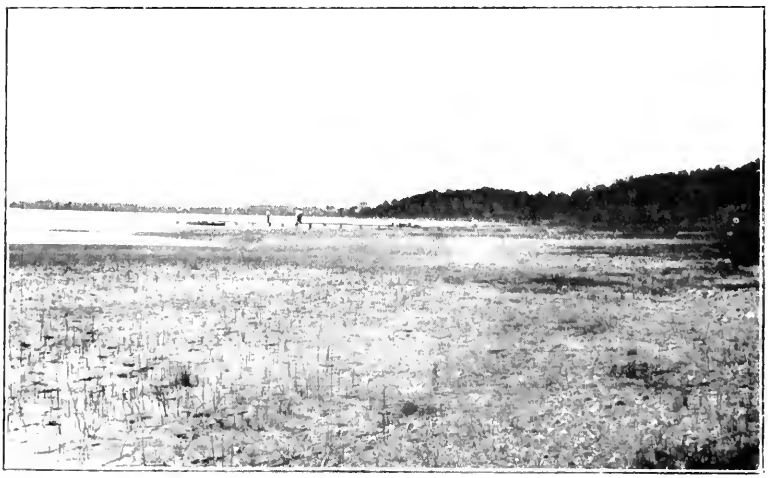


Plate IV. Chapman Lake. The East Side, a Barren Slope. This Lake Has Recently Been Lowered Three Feet.

for marsh hay. The products in each case are coarse and of little worth. When these marshes are flooded they produce excellent feeding grounds for fish.

The damming of a lake would be sufficient, in many instances, for the development of water power. This could be used at the site of the dam or it could be converted into electricity and delivered to the property owners whose holdings abut the lake. The power thus produced would be sufficient in most lakes to offset the damage caused by the overflow of marshes, provided a just appraisement could be secured. The owners of the high ground around the lake would very generally favor the change. because of the value added to the cottage sites.

THE EFFECT UPON THE PARTICULAR LAKES UNDER CONSIDERATION.

Webster Lake.—Webster lake has an area of 1.5 square miles. It has already received the treatment that I have outlined. I have been unable to determine the date of the first dam. The present dam was constructed in 1905. It gives a head of nine feet when the water is flowing over the spillway. The power is used to run a flouring mill owned by Mr. John Strombeck. One large turbine and two smaller ones are used. The large wheel delivers sixty horse-power at a nine-foot head and forty horse-power at a six-foot head. The ratings of the smaller wheels were not available. The dam is an earthen one except the spillway with its apron and wings, which are of concrete.

With the dam out the present lake would be cut into a number of smaller ones, connected by marshes. This former marsh land now furnishes excellent feeding ground for fish. As a direct result of this, Webster Lake has become one of the finest lakes in the state for bluegill fishing. I have counted forty fishing boats in view at once; and from fifty to eighty fish are counted a good string for a half day's fishing.

The present level makes it possible to use the surrounding moraines for the building of summer homes and resorts. One large hotel and several cottages have already been erected on the south shore. The town of North Webster has easy access to the lake. Many good building sites remain to be developed.

It is difficult to estimate the value of the power, the increased value of the adjoining real estate, and the augmented fish production; but this certainly would exceed the value of the marsh land that would be exposed if there were no dam. For map see Large ('96).

A Shallow Lake Which Produces Enormous Amounts of Fish Foods.

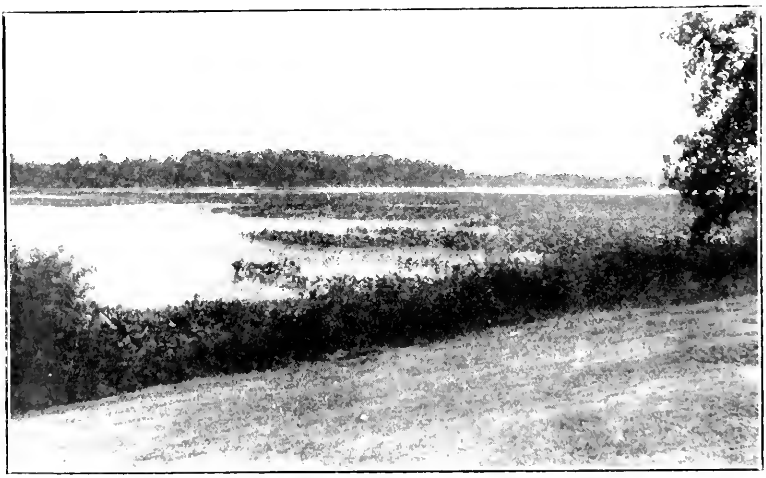


Plate V. Palestine Lake. Note the Close Proximity of Cultivated Land to the Water. No Waste Area as in Partially Drained Lakes.

Tippecanoe Lake.—Tippecanoe has an area at present of 1.71 square miles. If the level were raised five feet the area would be increased to 2.93 square miles. Its maximum depth is 121 feet, which is probably the greatest depth in any Indiana lake. The lake is bordered along most of its shoreline by moraines that rise rather abruptly to considerable height. The rest of the shore is bordered by marshes. Raising the level five feet would submerge most of the marsh land and a very narrow strip along the steeper shores. One building would be affected, but $600 would easily replace it. The bathing beaches would be narrowed, but the action of the waves would soon broaden them. These are the items of loss.

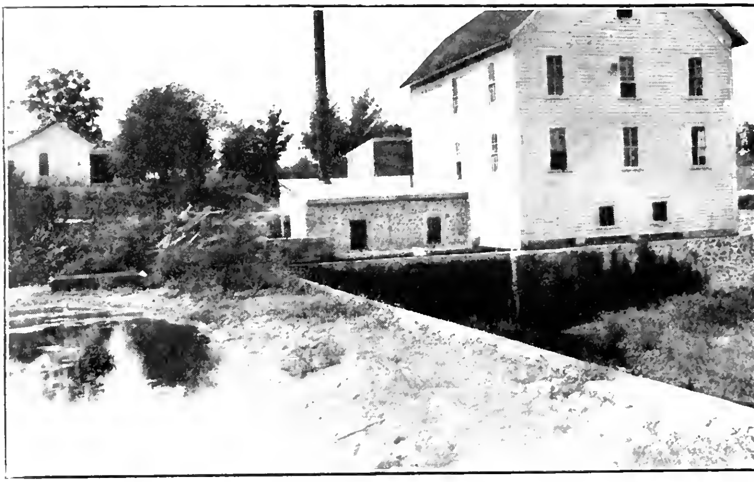
By overflowing the marshes the shore line would be brought to other good building sites. This would increase its value from that of ordinary farm land to that of water-front building site. The value of the former is about $100 per acre, while that of the latter is at present between $500 and $1,000 per acre.

The great depth of Tippecanoe Lake and the steep slope of much of its bottom make the area available for fish breeding and feeding very limited. The fish production could probably be doubled by utilizing the marsh land for feeding grounds and the wider wave-cut terraces as breeding ground.

The basin that discharges through the outlet of Tippecanoe Lake has an area of 136 square miles. One inch run-off from this basin would produce 10 sec. feet for one year. Twelve or fifteen inches run-off could be expected which would produce, respectively, 120 and 150 sec. feet for one year. The five-foot fall that would be produced by the dam could be increased two or three feet by building a race a quarter of a mile in length. For map see Large (96).

Eagle Lake.—Eagle Lake has an area of .87 square miles. The swamp land that surrounds it covers about one-half square mile. A part of this swamp land has been filled by Winona Assembly and now forms very valuable real estate. This would make it rather impracticable to raise the lake more than two feet above its present level. But little of the remaining low land is used. About twenty acres are mowed for marsh hay and a similar amount is used for pasture, of which it produces a very inferior grade.

The outlet has been dredged so that the land below the lake could be drained. A dam has been built across this ditch, making a difference in level of six feet. By raising the dam two feet a fall of eight feet would be secured. The catchment basin discharging through the outlet of this lake contains forty square miles.



The Dam From Above.

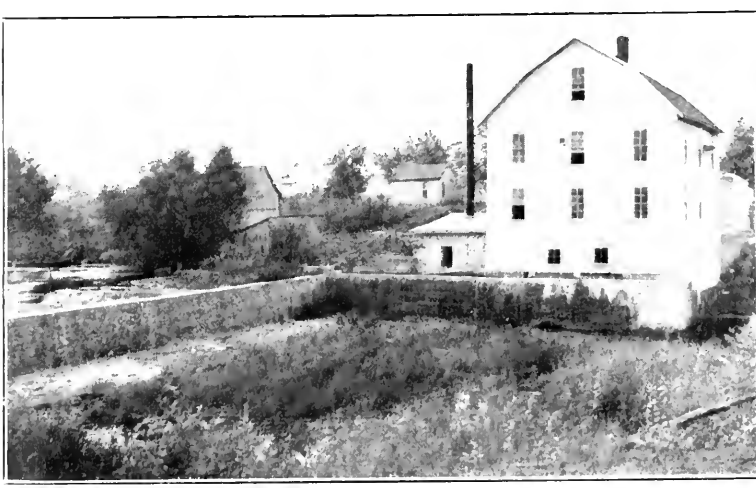
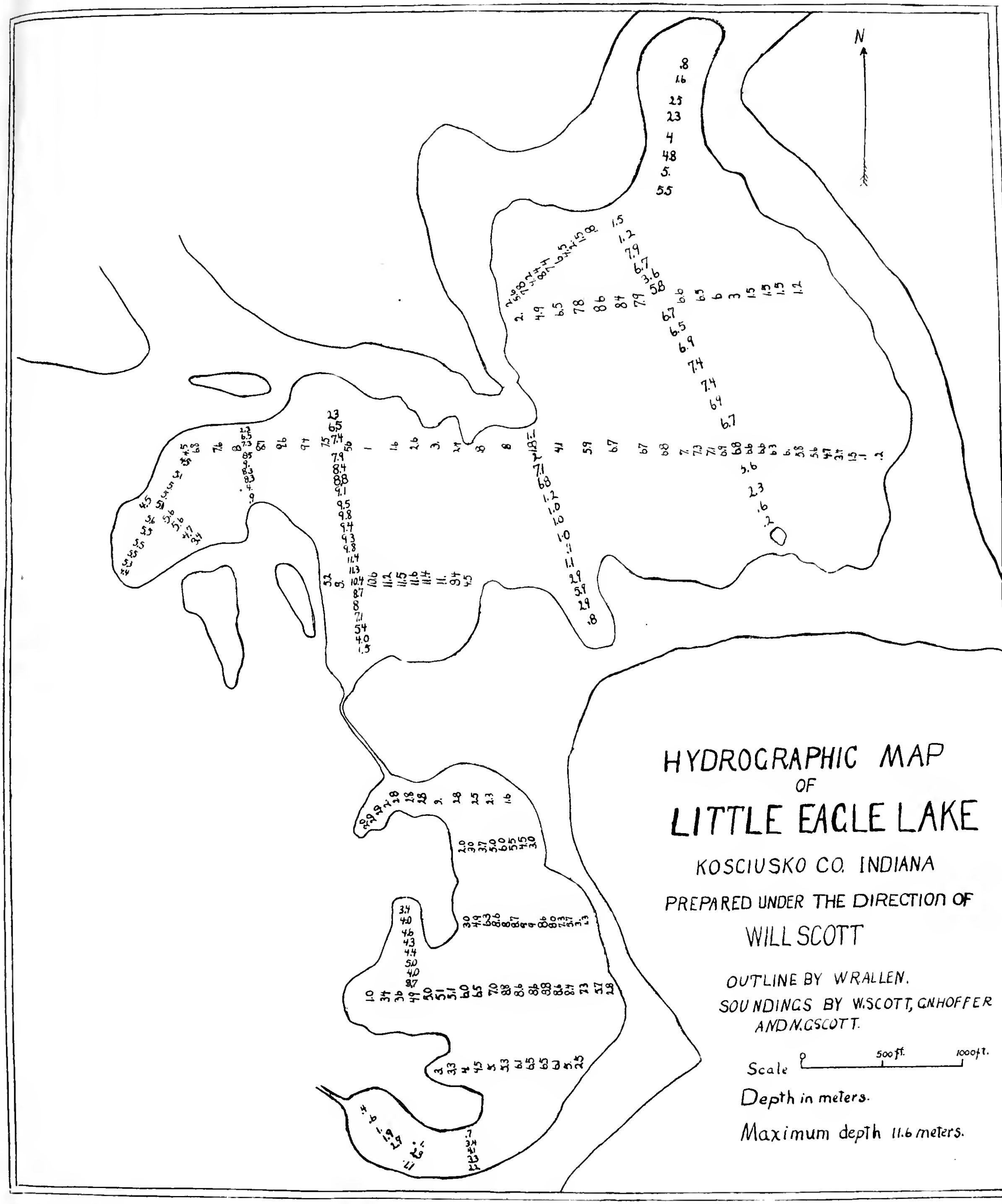


Plate VI. Palestine Lake. General View of the Dam and Mill.


N
HYDROGRAPHIC MAP
OF
LITTLE EAGLE LAKE
KOSCIUSKO CO. INDIANA
PREPARED UNDER THE DIRECTION OF
WILL SCOTT
OUTLINE BY W.R.ALLEN.
SOUNDINGS BY W.SCOTT, C.N.HOFFER
AND N.G.SCOTT.
Scale 0 500 ft. 1000 ft.
Depth in meters.
Maximum depth 11.6 meters.

The changes produced in Eagle Lake by raising the dam two feet would not be very great. Fishing would be improved and some power could be developed with an almost negligible loss of property.

Little Eagle Lake.—Little Eagle Lake (Chapman Lake) has an area of .822 square miles. It has a maximum depth of 38 feet. Along most of its shore line the bottom slopes rather gently, so that a slight change in level makes a marked change in area.

In recent years the outlet of this lake has been dredged, in an effort to reclaim some marsh land on the south and west of the lake. Some onions have been raised on this land, but most of it is not productive, for all of the lowland lying west of the lake is composed of marl.

This dredging of the outlet has exposed many acres of fine fish breeding ground on the east side and it has reduced the feeding ground on the west side. The east side has many good building sites, some of which are developed. The lowering of the lake has reduced the value of these properties by making the landing with boats more difficult and by making the shore line more distant.

The changes proposed for this lake would just about restore the original conditions. See accompanying map.

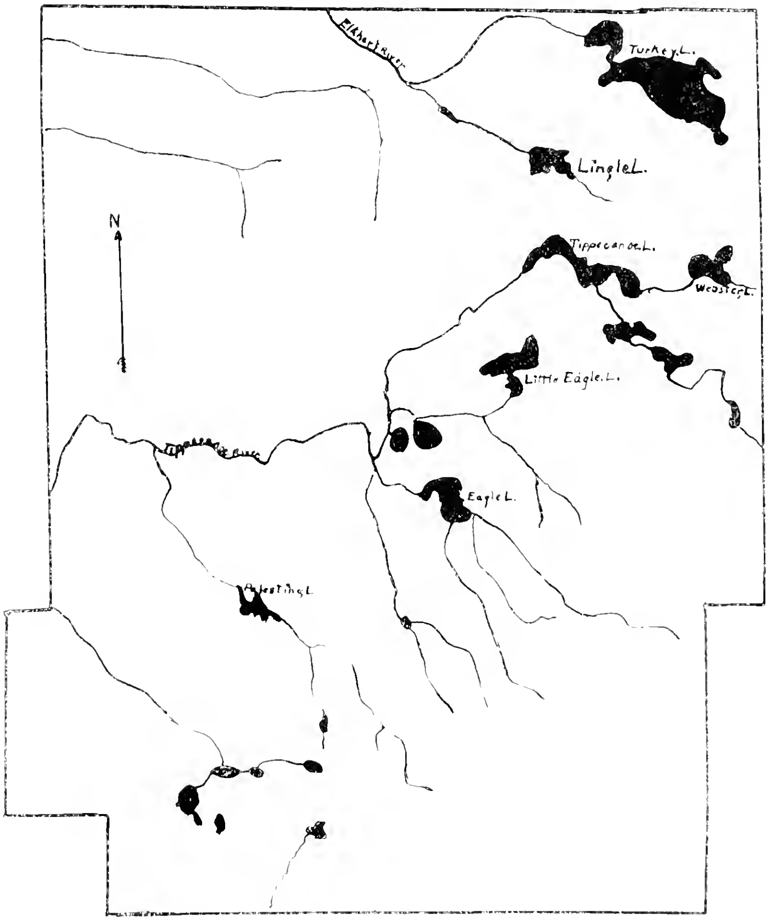
Palestine Lake.—Palestine Lake is said to contain 1,100 acres or 1.71 square miles. There are two small depressions whose maximum depth is 30 feet, but the most of the lake is less than ten feet deep. All shallow parts of the lake, comprising about five-sixths of it, are filled with an almost continuous mass of water plants. These shallows evidently formed an old flood plain or marsh that has been covered with water by damming the outlet.

The water from the dam is used to run a flouring mill. The turbine delivers forty-seven horse-power at a seven-foot head.

We have not completed the sounding and mapping of this lake and until this is finished it is impossible to say with certainty just what would be the best treatment for this lake to receive. It is certainly a valuable impounding basin as it is; and it seems that a small amount of land would be submerged by raising the water above its present level; thus increasing its efficiency as an impounding basin, and the amount of power developed.

On the other hand, this is one of the few lakes in which the lowering of the outlet would expose a relatively large amount of land. Because of this exceptional condition, it is necessary to collect all of the data before

MAP OF KOSCIUSKO COUNTY, INDIANA, SHOWING THE LOCATION OF THE LAKES DISCUSSED IN THIS PAPER.



a just estimate of the various values can be made. It may be more economical in this case to remove the dam, in order to secure land for farming; but the evidence at present indicates that the dam should be raised rather than lowered.

CONCLUSION.

From the data presented, it is evident that the storage capacity of lakes can be increased by damming, and that by properly manipulating these dams the excess accumulated can be discharged during periods of minimum rainfall. This will benefit the streams to which the lakes are tributary (1) by decreasing the maximum discharge, thus preventing floods, and (2) by increasing the minimum discharge, which will add to all the elements that have been enumerated in stream valuation.

By analyzing the conditions carefully in each lake these changes can be made so that the value of the lakes and the property adjoining, when considered as a whole, will be increased.

Many details are yet to be worked out, but the advisability of this procedure is already apparent.

REFERENCES.

Large, Thomas: Map of Webster Lake. Proc. Ind. Acad. Sci. '96. Map of Tippecanoe Lake. *Ibid.* '96.

Norris, A. A.: Map of Winona, Pike and Center Lakes. Proc. Ind. Acad. Sci. '01, p. 117.

Tucker, W. M.: Water power of Indiana. Rept. Ind. Dept. Geol. and Nat. Res. '11. pp. 469-538.

First Steps in Indiana Forestry.

Stanley Coulter.

It is not meant by the title chosen to intimate that much preparatory work along forestal lines has not been done in the state. The work of awakening popular interest in forestry has been well done, it not, perhaps, overdone. In the schools by direct instruction, through the stimulus of arbor day exercises and by the wise and vigorous activity of the Indiana Forestry Association, practically every community has been reached. Upon the Forest Reserve the State Board of Forestry has conducted a large series of experiments and has collected a vast mass of data touching practically every phase of wood-lot management. Its reports and press bulletins, together with its educational contests, have served to increase and intensify interest in the movement for the conservation of our remaining forests. I suggested that perhaps this preparatory phase of the work had been over-accented, for there is such a thing, on the one hand, as spending so much time on preparation as to leave none for accomplishment, and on the other, by overstimulus to incite to ill-considered and poorly planned efforts. In Indiana the latter has been the case. An examination of the facts shows a very large number of instances of tree planting; plantings running up to the hundreds in number, into the thousands of acres in area and containing hundreds of thousands of trees. A review of the inspection of plantations as given in the reports of the State Board of Forestry reveals an activity in tree planting that is positively marvelous and almost incredible when the returns or rather lack of returns are taken into account. It is a sad fact but a true one that approximately 70 per cent of these plantings are total failures. In them, the total crop sold at the highest price would not equal the cost expended upon them. The remaining 30 per cent can only be regarded as partially successful. Only in a small fraction of the cases can the stand be regarded as representing the full capacity of the area. The schools also have had arbor day exercises for years, exercises which have doubtless been helpful and stimulating in many ways, but the school yards in the main are as destitute of trees as they were before arbor day was projected.

All of this shows interest; it further shows a willingness to expend time and effort and money in tree planting, but it also shows with equal clearness that there has been enthusiasm without knowledge, and that in Indiana the first steps in forestry from the standpoint of results are yet to be taken. Incidentally it may be remarked that tree planting is not necessarily forestry, it is merely a single phase of forestry.

For the purpose of this paper we may omit the consideration of ornamental plantings, whether of streets or lawns or parks, and confine the discussion to the wood-lot and to the denuded area which is to be reforested. In the management of the wood-lot from the standpoint of conservation three things are sought: (1) The largest amount of timber per acre that the land will carry; (2) the best quality of timber possible; (3) the production of this maximum quantity and optimum quality in the shortest time possible. If these ends are accomplished there is evidently need of a technical knowledge which is usually not possessed by the landowner, and which in the multiplicity of his activities he has no time to acquire. If the largest quantity and best quality possible is secured from a given area it will be because those species of trees are selected which are adapted to the conditions of soil, of moisture, and of climate. It will also be in part because of species equally adapted to a given locality, those which make the more rapid growth, are more immune to insect and fungus invasion, which are less sensitive to unfavorable climatic conditions, have been chosen for encouragement. In a general way conditions which make for a vigorous and healthy growth make also for the best quality of timber, whether we consider weight or strength or direction of fibre or beauty of grain. In the large range of species available, in the variety, indeed, found in the average wood-lot, how many landowners have a sufficiently accurate knowledge upon these points to enable them to select species for encouragement with such certainty as to insure profitable returns? Taking the plantings referred to above, the failures came from lack of knowledge, not from lack of interest or enthusiasm. Most of the plantings were of black locust or hardy catalpa, planted, probably, with the purpose of short rotation management for post or tie stuff; but very often locust was planted on ground which in all reason should have been planted to catalpa and catalpa was planted on ground far better suited to locust. The result, of course, has been failure more or less complete, with loss of money and time and use of land and, worst of all, loss of faith in the possibility of forest improvement. The argument is that this knowledge is strictly technical knowledge, the property of the specialist. It is not within the knowledge of the landowner, nor would he be justified in taking the time required for acquiring it from his other work. This is a very summary and incomplete resume of some of the silvical factors entering into the problem of securing maximum quantity and optimum quality in the shortest time.

The wood-lot, also, if it serve its purpose must yield its owner reasonable returns upon his investment and yield such returns at regular intervals. If it fails to do so its maintenance is bad business. If the wood-lot is regarded as an investment, perpetuity must always be in mind. It is then not merely securing a return at some given period of time, it is insuring by sufficient reproduction the harvesting of similar crops at future periods. How much shall be cut? How often shall cuttings occur? What relation shall the time of cutting bear to the time of regeneration? What species in the stand shall be encouraged and what species eliminated? How shall the amount cut be known to equal the amount grown between cutting cyles? These are a few of the factors entering into the problem from the standpoint of management, which is after all applied economics. Here again the knowledge is expert knowledge, it is not in the possession of the landowner nor has he time to acquire it. Yet because these factors are not considered ultimate failure is bound to result.

It seems that we have an inevitable deduction. Provision should be made as a part of the force under control of the State Board of Forestry for an *expert field agent* whose duty it should be to furnish working plans to the wood-lot owner which will give direction and certainty to his efforts to secure the largest quantity and the best quality in the shortest time possible. Each tract should be inspected carefully before the working plan is outlined in order that local conditions, which are of the highest importance, may be taken into account. Along constructive lines, the lines of securing results, the appointment of a trained field agent is absolutely the first step. Until such an office is created forestry work will be as ineffective and futile in the future as it has been in the past. Advice as to cleanings, thinnings, reinforcement, control of noxious insects and injurious fungi would naturally be among the functions of such a field agent.

Before any very great measure of success can be hoped for, provision must be made of such a character that the landowner may secure the needed supply of seedlings, true to species and at a reasonable price. Under present conditions this is practically impossible. Nurseries as at present organized deal in forest trees mainly to supply the demand for street and ornamental planting. The placing of an order for a given species running up into the thousands or perhaps tens of thousands of seedlings is practically impossible except perhaps in the case of black locust and catalpa. Indeed it is not probable that nurserymen would care to undertake to meet such demands. The cost of collecting the seed, the additional area and labor involved, taken in connection with the fact that such orders could only be expected occasionally and that there would be no possible method of estimating the average annual demand for each of the species, would make such an enterprise one of very doubtful profit under favorable conditions and of very certain and large loss under unfavorable conditions. This means the establishment of a state nursery or nurseries, by the State Board of Forestry under expert direction, from which needed material for future plantings may be secured.

The experimental work at the reserve has gone far enough to indicate what species should be encouraged in reenforcement and new plantings, to demonstrate the best time for planting as well as the best method of planting, to show clearly enough the proper care and treatment after planting and to furnish a fair estimate of the expense involved in a correct practice. It is well within the law under which the board was created, that it should now take the next logical step, namely, the furnishing of suitable material for such plantings at practically the cost of production. Under the very best conditions from 3 to 6 per cent. is the best dividend that can be expected in forestal enterprises, so that any marked increase in the initial cost precludes all possibility of profit. The distribution of this material should be carefully controlled. It should be supplied only for afforestation or the reenforcement of existing wood-lots and never for street or ornamental purposes. The experience of the state nurseries in Connecticut, Massachusetts, and other states shows that this control offers no difficulty and that a demand is met which the nurserymen cannot meet and do not care to meet. Indeed it has been shown that since the establishment of state nurseries the sale of forest tree stock by nursery firms has largely increased, although it may be questioned whether the relation is a causal one. It is certain that the Board of Forestry by establishing such nurseries would accomplish much in the way of improving existing wood-lots and in the afforestation of denuded and waste lands. It cannot be too strongly emphasized that in such work the state is not entering into competition with nurserymen, but is merely endeavoring to meet exceptional needs which lie beyond the field of ordinary nursery organization and purpose. It would of course be better if a series of nurseries could be established so located as to give not merely the best conditions for the growth of the seedlings, but also to meet the needs of different localities. This refinement of method is perhaps beyond the bounds of reasonable expectation, but certainly the supply of desirable species true to type at the minimum cost is another step in a constructive forest policy. Apparent difficulties cannot be considered in this connection, but in the main they will be found to concern details capable of a fairly easy adjustment; none seem to be fundamental.

A third step in a constructive forest policy would be the organization of a series of cooperative plantings. In this case the landowner and state cooperate. The proper official selects and furnishes the young trees, personally oversees their planting and gives direction for their future care. The landowner pays transportation charges on the seedlings and furnishes the labor involved in the planting; he also agrees to follow the directions for after care and to make report upon the planting at specified times. The advantage is two-fold; the constructive work of the Board of Forestry covers a large part of the state, while the landowner secures expert advice and material in return for his labor and care. This plan has been in successful operation in Ohio for a number of years with extremely satisfactory results in the majority of cases. Of course in this as in all other cooperative enterprises an occasional man fails to keep faith. Practically the same plan prevails in all agricultural colleges. Purdue University has cooperative plats in all parts of the state bearing upon every form of crop from alfalfa to apples. Such cooperation would involve but little expense if the office of field expert in Forestry were created and a state nursery established. Indeed, the expense involved in the salary of a field expert, in the establishment and maintenance of state nurseries for furnishing tree seedlings and in the institution of a series of cooperative plantings taken together would seem absurdly small when compared with the interests involved.

Successful tree planting, which is only another name for successful forestry, is in a certain sense an essentially local proposition. So much depends upon the quality and character of the soil, upon the water level of the soil, upon the climate, exposure, topography and a host of other factors, that what might be good practice upon one tract would be bad practice upon another possibly but slightly removed. All of which means that deductions drawn from the study of a single area cannot be safely applied over the area of a state. Concretely, the deductions drawn from the experimental studies at the Forest Reservation are applicable only to like areas, that is to those with similar escological conditions. They are not applicable to the conditions prevailing in the central counties and are of little significance so far as the sand-dune regions of the state are concerned. So much depends upon the soil character as regards the health and vigor and rapidity of growth of the tree that it must always be taken into account. In an area such as Indiana, elevation and climate are so nearly uniform as to be negligible, but the soil is in different case. As each species has its optimum soil any constructive forest policy will provide for demonstration areas so located as to represent every type of soil found in the state. This would involve the purchase of land unless arrangements could be made to utilize some of the holdings of properly located state institutions. That the acquisition of land by the state for forestal purpose is regarded as sound economic policy is plainly shown by the large and constantly increasing area of such holdings in New York, Pennsylvania, Michigan, Minnesota, and other states. The tracts need not be large for the accomplishment of the desired purpose, so that the entire amount required would probably not exceed 200 or 300 acres. For the success of such work absolute control of the tracts should be vested in the State Board of Forestry, a fact which makes purchase more desirable than a use by sufferance of the lands of state institutions. An attempt to carry out the suggestion of former Governor Marshall that such demonstration plats should be operated upon county farms showed the extreme difficulties attending the very first steps in such joint control.

If we consider the problem of the recovering of denuded and waste areas the necessity of the expert field agent becomes more apparent. What to plant in any given locality is a problem involving a very wide range of factors running from silvical requirements to economic conditions. Yet a consideration of all of these factors is absolutely essential if the work proves at all profitable. From the merely silvical standpoint it is perhaps natural to infer that the species that have grown upon any given area, having proved their fitness for the particular locality, are the ones that in afforestation operations would give the greatest promise of success. As a matter of fact such a conclusion is more often incorrect than correct. The region has lost its forest floor with all its far-reaching influence in maintaining soil fertility, moisture and porosity; it has been subjected to the desiccating and compacting effects of sun and wind; by drainage its water level may have been decidedly lowered; it has lost the protection of adjoining forests and is therefore more sensitive to adverse climatic conditions such as changes of temperature, wind, etc.; many of the trees in the original forest may have been of species which can only find their normal development and growth rate when sheltered or partially sheltered. Indeed it is very rarely the case that the original forest can be restored. Its place must be taken by one composed of species adapted to the new conditions. Just what species these new conditions indicate it is difficult for the expert to determine; it is entirely beyond solution by the average landowner save through the expensive school of experiment. In afforestation more definitely and vitally than in reinforcement and improvement do we find that the imperative need in forestry in Indiana is the field expert.

Incidentally much remains to be done in the way of education. Relatively few species are of sufficient economic value to promise profitable returns. Each of these species has its optimum conditions, each has advantages and disadvantages arising from its silvical properties. Careful studies should be made of these available species and of their requirements for the most rapid growth and healthiest development. These studies should be supplemented by others which definitely locate the areas in the state where these optimum conditions for the various species are to be found or if the specific locality is not given, of the type of soil furnishing these conditions. If this were done the landowner in Hancock or Elkhart or Gibson county would have in his possession the data needed for the formulation of a rational management of his wood-lot. The preparation of such a series of studies would take time, but the good accomplished would be immeasurable. The old prophet cried, "The people perish through ignorance," which we may paraphrase to read, "Our forests perish through ignorance."

Back of all this and in a certain sense fundamental is a classification of the soils of the state. Any true conservation demands that every resource be utilized for its highest values. This is as true of soils as of gas or gold. In Indiana certain soils give and always will give their highest values in the form of ordinary field crops, or horticulture. Other soils always have and always must yield their highest return from tree crops.

Some intermediate conditions may indicate that a part of a given area should be devoted to crops, part to trees. It is necessary that the absolutely agricultural, the absolutely forestal and the intermediate soils be accurately delimited. When this is done the soil can be managed in such a way as to yield its highest returns. Until this is done we shall continue to have the economic anomaly of trees upon agricultural land and of crops upon forestal lands. The United States is far behind other countries in this classification of its soils and the devotion of each type to its highest form of utilization. Until such classification is made little constructive work of a permanent character can be done.

Summarizing: There is no lack of interest and enthusiasm; indeed they have far outrun knowledge. Enough data bearing upon the subject are in hand to justify constructive work. To insure success six things are necessary.

1. The Field Expert at the service of landowners.

2. The state nurseries for furnishing material true to species at the minimum price.

3. Cooperative plantings extended until they reach every county in the state.

4. Demonstrations plats so located as to represent fairly every soil type in the state.

5. Definite instructions as to available species for given localities or at least for given types of soils.

6. A classification of soils.

The consideration of a constructive policy which would produce results in the way of improved forest conditions, of a rapid and rational reclothing of denuded and waste areas would naturally include many topics not discussed in this paper, not because of their lack of pertinence, but for a very apparent lack of time. In the case of the tens of thousands of acres of waste and wasting lands, in the southern hill region, in the northern sand-dunes, in undrainable lowlands, can the individual afford afforestation work, or is the problem one for the state? If it is a problem for the state, how is the land to be acquired and what shall be the nature and control of such tracts after their acquirement? Personally, I have some very decided views upon the points which I hope to present at some other time. At present I merely suggest them as an evident part of any comprehensive constructive forest policy, though not perhaps to be regarded as among the first steps in its initiation.

The Taxation of Forest Lands in Indiana.

H. W. Anderson.

The common argument against the preservation of woodlands by landowners in this and other states similarly situated is that the land in timber is lying idle and that the taxes are "eating it up." Many farmers today would have a forty or sixty-acre woodlot had they not felt that the taxes on this land was wasted money. It is true that woodlands are often assessed at much below their actual value because the income from them is small, but unless there is marketable timber on the land there is no annual return, as in the case of yearly crops such as wheat and corn.

Many business or professional men in our cities would like to own a piece of timber land where they could take their families for a few weeks in the summer or where they could go to hunt or camp. These men can afford to buy cheap land on which there is a growth of young timber which on account of its slow growth would not be of much actual value to the present owner, but would be a valuable piece of land in the future. Here again the problem of meeting the yearly taxes prevents the prospective buyer from purchasing the land. The present owner of this land will probably cut down the young growth, plow up the ground and try to raise a few nubbins on it.

Again there are lands in the southern part of the state which on account of their untillable character might be purchased cheaply and be utilized for growing timber on a commercial scale if the taxes were properly adjusted. These lands for the most part are now supporting a scrub growth of useless trees and underbrush.

In order to encourage the farmer and landowner to hold on to their woodlots or small forest lands and to encourage timber growing on a commercial scale there should be devised a system of taxation for such lands which would be fair to the other taxpayers of the state and yet not burden the woodlot owners with an unreasonable tax on land which is returning nothing to them at the present time. Many states, recognizing the unfairness of a general property tax on woodlands have so modified their taxation laws that this object may be accomplished. It is also true that the basis of taxation in one state may not apply in another, so that each state should make a careful study of the conditions within its bounds before modifying its taxation laws. For example, some of the eastern states have townships and counties in which the larger per cent. of the land is covered with forests. To exempt these from taxation for a period of years would work a hardship on the remaining taxpayers of the township or county. In this state, however, we have no such condition to meet.

A brief examination of the taxation laws pertaining to the forest lands in various states may be of interest. These facts were obtained from the "Report of the Special Commission on Taxation of Woodlands in Connecticut." This report was made in 1913, so that it contains the latest available data on the subject. This report shows that the following fourteen states have made special laws in regard to forest taxation: Alabama, Connecticut, Iowa, Maine, Massachusetts, Michigan, Nebraska, New Hampshire, New York, North Dakota, Rhode Island, Vermont, Washington and Wisconsin. Thirty-four states have no special legislation but tax woodland under the general property tax.

Eight of the fourteen states mentioned above have laws which, being similar in nature, may be grouped under one head. These provide for an exemption of all taxes for a period ranging in the different states from ten to thirty years. There are usually conditions attached to these exemptions requiring certain care of the forest or the planting of certain species. Washington exempts all fruit trees and forest trees artificially grown, while North Dakota grants a bounty on forest planting. Iowa has a tax on the basis of a valuation of one dollar per acre for a period of eight years. Here the owner must meet certain conditions as to area of reservation, number of species and care of trees.

The laws of Michigan are especially interesting and will be dealt with in detail. This state has a yield tax law. It provides for the reservation of a limited area. There must be at least 170 trees per acre. Grazing and the removal of not more than one-fifth in any one year are forbidden. Then there is levied a final tax of 5 per cent. of the valuation at the time of cutting. The main criticism of this law is the complicated machinery employed in the valuation and the collection of the taxes. No provision is made for the larger forest areas.

Many states have appointed special committees or commissions to investigate the subject of forest taxation and to recommend measures to the legislature. In Massachusetts, Ohio and New Hampshire constitutional amendments were necessary to permit state legislation along this line. These amendments were made and adopted by the vote of the people. This is of special interest to us since I shall presently show that a constitutional amendment is also necessary in this state.

Wherever commissions have been appointed to investigate this subject they have urged strongly the necessity of special legislation and have stated that the general property tax is not satisfactory in that it is unjust to the holder of woodland and gives uncertainty to forest investment.

The recommendations made by the commission in Connecticut are especially important in that their investigations were made public after a thorough study of the taxation laws of this and European countries. I shall quote them in full:

"The Commission recommends the enactment of a law which will include the following provisions:

"(1) Separate classification of forest lands for the purpose of taxation to be made on application of the owner, provided the value of the land alone does not exceed $25 per acre. Certificate of classification to be issued by the state forester after due examination as to compliance with requirements of the law.

"(2) At time of classification, present true and actual value of land and standing timber to be determined separately, and valuation then established to be continued for a term of fifty years, with revaluations to be established at the end of that period and continued for a further term of fifty years.

"(3) When classified, natural forest land to be subject to tax at a rate not exceeding ten mills on both land and timber at the separate valuations established as indicated in (2), and a yield tax to be levied on the timber when cut, at a rate prescribed by law and varying with the time during which the land has been classified. Such land when cut clear subsequent to classification, and reforested either naturally or by planting, to be reclassified as young forest under (4) if application for such reclassification is made by the owner; otherwise the land to be taxed at the prescribed rate on the valuation already established for the whole property until end of the fifty-year period.

"(4) When classified, land planted with forest trees under specified conditions, or young forest not more than ten years old to be taxed annually at a rate not to exceed ten mills on a valuation of the land alone established as indicated in (2), and a yield tax of 10 per cent. to be levied on the value of the timber when cut."

The remaining recommendations apply only to conditions in Connecticut and need not be given here.

The system of taxation here recommended is based on sound forestry principles, and on the whole would be applicable to Indiana conditions. However this may be further simplified since the object of levying a small land tax in Connecticut is to prevent impoverishment of those townships where there are large areas of forest, a condition which does not exist in this state. A reasonable yield tax is all that is required in Indiana.

The ideal system of taxation is that used in many European countries, i. e., the income tax. In this connection I wish to quote from a recent article by Professor F. R. Fairchild of Yale University:

"There is a tendency among the progressive states of Europe toward agreement upon the general outline of tax system. As a rule the tax systems of European states are based primarily upon income, rather than upon property as in the United States. The general income tax is normally the basis of the system; the tax is usually progressive, the rate increasing with the size of the income. . . .

"Forests in Europe are ordinarily subject to state taxation and to local or communal taxation. As a rule forests are subject to one or more of three important taxes: (1) the income tax, (2) the ground tax, and (3) the property tax.

"The Ground Tax. The ground tax is a yield tax. It is based upon the productivity of the soil and is measured by the yield which is normally to be expected in view of the general character of the soil and the use to which it is devoted. It is not based upon the actual income received from any particular piece of land. No account is taken of the peculiarities either in the management of the property or in the personal situation of the owner. Having determined the quality of the soil and the general character of the forest stand, it is assumed that the management is the same as normally prevails in that region. Also when the prevailing kind of wood and management have been decided upon, no account is taken of peculiarities in the condition of a particular forest. The owner who, by careful management keeps his forest in unusually good condition pays no extra tax on account of the increased yield resulting. . . . In determining the money value of the yield, use is made of the average prices of timber and other forest products which have prevailed during a number of past years.

"On account of the difficulties inherent in the ground tax, this form of taxation has generally declined in importance. In only a few states today is the ground tax the principal method of taxing forests. In most progressive states the ground tax remains only as a supplementary tax in a system based primarily upon other methods of taxation.

"The Income Tax.—Most European states have as a more or less important part of their revenue system a general income tax. This is a tax upon incomes from certain specified sources which include pretty much all important sources of income. The income from forestry is subject to the income tax where such a tax exists. . . .

"The income tax, unlike the ground tax, is a personal tax. Instead of assuming a certain normal income, as is done under the ground tax, the income tax takes account of the actual income received by the individual in question from the particular source specified. . . .

"The rate of the income tax varies with the size of the income and is different in different states. It is seldom that the maximum rate exceeds 5 per cent."

We cannot hope to have these ideal systems of taxation for some time to come, so it is best to look toward the modification of our present system in order to make it more just and tolerable.

Our woodlands are a valuable asset to the state and it is our duty to see that everything is done to conserve them. An attempt has been made by the speaker to show that our present system of taxation is unjust toward the owners of woodland and should be changed. Unfortunately our constitution provides for a general property tax. Section 1, Article X, states that "The general assembly shall provide by law for a uniform and equal rate of assessment and taxation." It would, therefore, be necessary to have an amendment to our constitution to cover this matter. Other states have accomplished this and there seems no good reason why it cannot be done in this state.

However it is not the purpose of the speaker to go further in this matter than to urge the appointment of a commission by the Governor of

Indiana for the investigation of the conditions in this state and the recommendation of some plan whereby the woodlands of the state may be more justly taxed. As a scientific body interested in this question we should represent to the proper authorities our desire for the appointment of such a commission in this state.

Forests and Floods.

F. M. Andrews.

The relation which forests bear in many ways to the flow of rivers is a question of the utmost importance to the whole country. When one observes what has been and still is being done in most parts of the United States toward forest destruction it seems strange that the people, as a whole have been so slow in waking up to the seriousness of the situation. Only within very recent years is the public beginning to realize that the forests are vanishing rapidly and that they are confronted by a serious problem. They have destroyed the vast forests of this country apparently with no thought or regard for the consequences. Now they are beginning to reap the reward of their shortsightedness in a score or more ways. Chief among the results caused by the continued removal of the forests is the frequent recurrence of floods which become more and more destructive. There have been and perhaps still are some people who believe that the forests are inexhaustible. How such belief can exist at the present, in view of such evident disappearance of forests everywhere is very surprising. A less commendable attitude than this apparent ignorance is the position some assume that there will be timber enough in the country during their lifetime and that therefore they need not concern themselves as to the future. A great service, however, for the preservation of our forests and their proper management has been performed by the admirable work of the Forestry Department of the United States Government. Excellent work also has been rendered by the various forestry schools of the different institutions and by farsighted individuals the country over who have seen the impending dangers and have endeavored by means of education and by timely counsel and advice to avert the dire consequences resulting from the wholesale destruction of the forests.

Within recent years special and important studies have been made in order to ascertain to what extent the flow of various streams is dependent on forests[1] and surface conditions in general.[2] Hall and Maxwell in their study gathered together the data for a number of rivers from records which had been kept for sixteen to thirty-four years. The following data, taken from their table on page 4 of Hall and Maxwell's papers, will furnish proof that floods are on the increase.

The Potomac River was measured at Harper's Ferry, Va. It drains a basin of 9,363 square miles. In the first period of record (1890–1898) of nine years there were nineteen floods lasting thirty-three days. There were 1,351 days of low water.

In the second period of record (1899-1907) of nine years there were twenty-six floods lasting fifty-seven days. The increase of rainfall in the second period was only .13 of an inch per year. Days of low water 1,693.

The Monongahela River was measured at Lock 4, Pennsylvania. It drains a basin of 5,430 square miles.

In the first period (1886-1896) of eleven years there were thirty floods lasting fifty-five days. There were 912 days of low water.

In the second period (1897-1907) of eleven years there were fifty-two floods lasting one hundred days. There were 979 days of low water. The rainfall decreased only .08 of an inch per year.

The Cumberland River was measured at Burnside, Ky. It drains a basin of 3,739 square miles.

In the first period (1890-1898) of nine years there were thirty-two floods lasting eight-nine days. There were 1,261 days of low water.

In the second period (1899-1907) of nine years there were forty-three floods lasting 102 days. There were 1,576 days of low water. The rainfall decreased .54 of an inch per year.

The Wateree River was measured at Camden, S. C. It drains a basin of 5,125 square miles.

In the first period (1892-1899) of eight years there were forty-six floods lasting 147 days. There were 1,164 days of low water.

In the second period (1900-1907) of eight years there were seventy floods lasting 187 days. There were 508 days of low water. The rainfall increased .25 of an inch per year.

The Savannah River was measured at Augusta, Ga. It drains a basin of 7,300 square miles.

[1] Toumey, James W. The Relation of Forests to Stream Flow. Yearbook of the Departments of Agriculture, 1903, pp. 279-288.

[2] Hall, Wm. L. and Maxwell, Hu. Forest Service Circular 176, 1910.

In the first period (1890-1898) of nine years there were forty-seven floods lasting 116 days. There were 566 days of low water.

In the second period (1899-1907) of nine years there were fifty-eight floods lasting 170 days. There were 292 days of low water. The rainfall decreased .17 of an inch per year.

The Ohio River was measured at Wheeling, W. Va. It drains a basin of 23,820 square miles.

In the first period (1882-1894) of thirteen years there were forty-six floods lasting 143 days. There were 1,333 days of low water.

In the second period (1895-1907) of thirteen years there were fifty-nine floods lasting 188 days. There were 1,609 days of low water. The rainfall decreased .14 of an inch annually.

The data here cited for the above mentioned rivers is also true for many other streams, but these will serve as good examples of what has been and is taking place wherever deforestation has occurred. In such rivers as the Ohio, Cumberland, and Wateree, changes are most conspicuous, and it is in these that most of the forest has been removed, while least change appear in those streams where most of the forests remain.[3]

This state of affairs is what we should expect, but the data given for the rivers referred to proves this by direct observation and leaves the matter no longer a question of guesses or opinion.

From what has just been said it is certain that as deforestation progresses floods will, with equal amounts of precipitation, become more frequent and increase in severity. To be sure, there are other factors that enter somewhat into any consideration of the cause of floods. Among these may be mentioned rainfall, season of the year and temperature, character of the soil, presence of lakes which might impound a good part of the "run-off" temporarily and afterwards gradually supply it to the streams, and thus while at first preventing flood afterwards lessen the lengthy periods of low water. Also the question of whether the land is nearly level or very hilly and steep is important. A heavy precipitation might do no damage whatsoever in the former case, whereas in the latter among steep and deforested land the destruction might be appalling.

But after we have considered all these points and many others that might be mentioned, the fact remains that the chief cause of the frequent

[3] Hall, Wm. and Maxwell, Hu. Forest Service Circular 176, p. 3.

and destructive floods in this state and elsewhere is the wholesale destruction of the forests.

Another proof of the efficiency in controlling the "run-off" has been furnished by Toumey.[4] He made a study of a number of small areas with reference to precipitation and run-off in the San Bernardino Mountains, California. He found in every case that the forest had a very decided effect in regulating the run-off of the water and in the regulation of stream flow. In this way the forests of southern Indiana especially have been of great value. Within the last quarter of a century by far the greater part of the Indiana forests have been removed, so that now but few areas of the primeval forests remain. That rain therefore, which falls, has in most cases, nothing on the steep soil to check it and disastrous floods are the result.

In the forest the heavy rain is first checked by the large trees and their foliage. From these the water next falls to the smaller trees and bushes, then to the thick carpet of leaves. The lower part of this bed of leaves is in partial decay and here again much of the water percolating through is temporarily arrested. From here the water is further arrested by the generally deep humus soil. In this way even most long-continued and heavy rains are effectually checked and a disastrous flood cannot well occur in a region possessing such a covering of the land. In addition most of the water which is checked in this way instead of rushing off as on barren land, gradually runs or seeps away, thus regulating the flows of streams and maintaining the nearly even and continued flow of springs.

There have been later floods in the Ohio River than the one of 1907, and the same applies to the streams of Indiana, due to deforestation which has taken place wherever timber was available.

A recent and severe penalty due mostly to reckless deforestation was given the state of Indiana and the whole Ohio valley in the disastrous flood of the Ohio River and its tributaries in the spring of the present year. This equaled or surpassed in some places the record of any previous flood and was especially remarkable for the suddenness of its appearance. The precipitation over much of Indiana and the Ohio valley in general was enormous and much above the average. For example Reynolds[5] states

[4] Toumey, James W. The Relation of Forests to Stream Flow. Yearbook of the Department of Agriculture, 1903.

[5] Reynolds, Robert V. R. The Ohio Floods: Their Cause and The Remedy. American Forestry, May, 1913, p. 288.

that from March 23 up to the morning of the 27th, Bangorville, Ohio, had a total of 9.50 inches (the normal rainfall for the whole month of March at that place is 3.93 inches); Marion, Ohio, 10.60 inches (normal for the month 3.51 inches); Bellefontaine, Ohio, 11.16 inches (monthly normal, 3.79 inches).

In the state of Indiana, in places, at least, the precipitation was even greater than in those just mentioned for Ohio. For example at Bloomington, Indiana, on March 25th, 6.56 inches[6] of rain fell, and for the month of March 13.3 inches. The normal rainfall for Bloomington for March is about 3.91 inches. The 6.56 inches of rainfall on March 25th, which was probably equaled or excelled in other states, occurred to a greater or less extent over at least half of the state of Indiana. This immense volume of water from an area in Indiana of about 18,175 square miles rushed away from the deforested hills unimpeded. As a result almost every stream in the state was immediately flooded far beyond its banks and every movable object washed away. It is probable that with such huge and sudden precipitations as occurred in March of 1913 the floods would not have been entirely prevented if the region affected had been covered by a dense forest. It would have prevented, however, most of this great flood and at the same time have prevented all or nearly all of the destructive results. If the flood during the spring of 1913 had occurred in winter, when the ground was frozen hard and covered with a deep snow, the results would have been appalling beyond description. Under such conditions in the deforested area the snow would soon have been melted and have added to the volume of water. The frozen soil could not have absorbed any of the water; little forest remains to have checked the flow in any way, so that the crest of the flood would have been higher and the extent of its destruction would have been much greater than it was. Yet this is exactly what Indiana and other states may expect sooner or later. Another great flood like that of 1913 might occur says Reynolds[7] "within the next decade, especially if, as asserted, we are now passing through a cycle of wet years." Under present conditions, however, with the greater part of the forests gone, and their destruction going rapidly on, we can easily see that heavy and sudden precipitations of equal intensity to those just referred to will cause greater floods and bring greater havoc than before. Floods are frequently fol-

[6] Government Station Report for Bloomington, Ind., March 25, 1913.

[7] Reynolds, Robert U. R. The Ohio Floods: Their Cause and The Remedy. American Forestry, May, 1913, p. 288.

lowed by serious drouths, such as the one of this year, frequently finishing the destruction of much that the flood may have left. In southern and southeastern Indiana Culbertson[8] states that "less than 10 per cent. of the original forest areas are still left intact," and the original forests that do remain have in most instances "not more than 30 per cent. of their former number of trees." Other parts of the state that were forested are about in the same condition. Culbertson[9] also draws attention to "the gradual lowering of the ground water level in all portions of the State" and the results of such a disastrous state of affairs. Culbertson[10] also points out for the southern part of Indiana which he studied that many "streams that thirty years ago furnished abundant power for mills during ten months of the twelve now are even without flowing water for almost half the time." The same state of affairs exists in most of the other deforested parts of Indiana. It is not at all difficult for one to recall springs and streams that ran vigorously the entire year but which now are either inactive or else run only during the wet season.

Erosion is generally one of the most conspicuous and damaging results of a flood in a deforested region. In foreign countries which have been deforested for a long time, as for example China, great damage has been done. The same thing I have seen in Italy, a part of whose once forested surface is badly cut up by the rush of unchecked floods. But in this country, especially in the southern part of Indiana, erosion is very evident and bottom lands that were not eroded have been damaged or rendered useless by debris and stones carried down from deforested hills.

A statement from a United States bureau[11] shows some of the results of erosion. "According to the latest determinations (beginning with the classic measurements of the Mississippi by Humphreys and Abbott) the rivers of the mainland United States are annually pouring into the seas fully 1,000,000,000 tons of sediment. This sediment is carried partly in solution but chiefly in suspension, in the 35,000,000,000,000 cubic feet or more of river water drained from the United States and is additional to the coarser detritus pushed or rolled along the sides of the swifter streams. The volume of material thus lost to the land is increasing with settlement and cultivation; it is almost wholly washed from the surface and is the

[8] Culbertson, Glenn. Deforestation and Its Effects Among the Hills of Southern Indiana. Ninth Annual Report of the State Board of Forestry, 1909, p. 63.

L. C., p. 65.

L. C., p. 71.

Yearbook of the Department of Agriculture, 1907, p. 82.

very richest soil material, the cream of the soil. The value of the material is not easily fixed, but at a moderate appraisal the annual loss would exceed all the land taxes of the country. Besides impoverishing the soil, the sediment pollutes the water, reducing their value for domestic and manufacturing purposes and endangering the lives of those compelled to use them, and causing streams to scour their channels and build bars; and through scouring and building it compels the lower rivers to shift and overflow, thereby reducing the value of fertile bottom lands. However estimated the loss is enormous, and the chain of evils resulting from the annual erosion of this billion tons of soil is long and complex and leads directly back to the farm."

How easily and rapidly water may transport objects with the increasing swiftness of the current is seen from the following experiment given by Page[12]: "It has been found by experiment that a current moving at the rate of three inches per second, will take up and carry *fine clay;* moving six inches per second, will carry *fine sand;* eight inches per second, *coarse sand*, the size of linseed; twelve inches, gravel; twenty-four inches, pebbles; three feet, angular stones of the size of a hen's egg."

"It will be readily seen from the above," says Le Conte[13], "that the *carrying-power increases much more rapidly than the velocity.* For instance, a current of twelve inches per second carries gravel, while a current of three feet per second, only three times greater in velocity, carries stones many hundreds of times as large as grains of gravel." "A current" running three feet per second, or about two miles per hour, will move fragments of stone the size of a hen's egg, or of about three ounces' weight." Then from the law established we say[14] "a current of ten miles an hour will carry fragments of one and a half ton, and a torrent of twenty miles an hour will carry fragments of 100 tons' weight. We can thus easily understand the destructive effects of mountain-torrents when swollen by floods."

Hall and Maxwell[15] state that "when the slope exceeds 10 per cent., cultivation does not long go on before erosion sets in, and erosion if unchecked will remove the soil and gully the surface until all fertility has

[12] Page's Geology, p. 28. Quoted by Joseph Le Conte in his Elements of Geology, Fourth Edition, pp. 18-19.

[13] Le Conte, l. c., p. 19.

[14] Le Conte, l. c., p. 20.

[15] Hall, Wm. L. and Maxwell, Hu. Surface Conditions and Stream Flow.—Forest Service Circular 176, p. 10.

gone and all productive power is lost." And further Culbertson[16] says that in southeastern Indiana "contrary to what might have been supposed, a larger per cent of the steep hill slopes has been cleared than the land of the more level regions." In such a case as this just the reverse method of clearing the forests as to location should have been followed for reasons above stated.

One of the ways in which large amounts of forest trees are destroyed is for railroad ties, and enormous numbers of them are required. Brisbie[17] states that "to build 71,000 miles of railway required 184,600,000 ties. Ties have to be replaced every seven years. As every one knows, railroad ties are cut from young timber, the trees being from eight to twenty inches in diameter, and this demand strikes at the very source of our timber supply." "The number of cross-ties in use on the railroads of the United States is estimated to be about 620,000,000; the number used annually for repairs and for extensions of track is estimated to be from 90,000,000 to 110,000,000, requiring, we may say, the entire product of 200,000 acres of woodland annually."[18] So rapid has been the consumption of timber for ties and the exhaustion of the supply so apparent that some years ago the Pennsylvania Railroad Company began to plant trees from which later on to get its ties. For railroads to do this is a rather late plan. Notwithstanding some views to the contrary, iron ties ought to be used and probably will be used in the future. About the year 1888 the fences of the United States were valued at "$2,000,000,000," "and it" cost then "$100,000,000 annually to keep them in repair."[19] These and other causes aside from lumbering show the waste of timber which years ago could have been practically prevented by the use of other and better materials. In most instances if the timber removed from the land and wasted were now available it would exceed in value that of the land

In 1909 there were 48,112[20] saw mills being operated in the United States. Of these in 1910 there were 1,011[21] in Indiana. These mills vary much as to capacity, but the daily output of all is enormous. Timber is today being cut into lumber that a quarter of a century ago in Indiana would in many cases have been rejected as fuel. In addition we have in

Culbertson, Glenn. l. c., p. 63.
Brisbie, James S. Trees and Trees-Planting. 1888, p. 9.
Fifth Annual Report of the State Board of Forestry, 1905, p. 209.
Brisbie, James S., l. c., p. 9.
Elliott, Simon B. The Important Timber Trees of the United States, 1912, p. 10.
American Forestry, 1913.

Indiana as elsewhere the veneer-mills, that are able, however, to cover up a multitude of sins.

Following deforestation comes, sooner or later in this country, the proverbial forest fire which completes the destruction by killing the small trees and destroying the possibility of the future forest. It is not necessary to discuss the results of such fires further than to state that locomotives generally cause most of such conflagrations, and consequently steps are being taken to have the trains in some places, as in parts of Canada, run by electricity. Spark arresters are a failure. In 1909 it was estimated that in Indiana the annual loss from forest fires was $175,000,[22] and this seems to be a very conservative estimate. For the prevention of fires in Indiana some laws have been enacted and in every possible way those in charge have endeavored to lessen the danger. Efforts to pass more favorable laws for forestry have been attempted in Indiana, such as exemption from taxation, but this "failed because it could not be done constitutionally."[23] It would be well if the cutting away of the forests could be controlled by law. For instance it is a serious mistake to allow anyone to buy a stretch of forest, especially in hilly districts, then to move in a sawmill and cut out all the available timber without regard to reforestation or results, and then finally to sell the land for what it will bring or to allow the soil to wash away. In some foreign countries the removal of forests is controlled. In France, for example, even years ago an owner was not allowed to remove forests on his land without "four months" notice in advance. The forest service may forbid this clearing in case the maintenance of the forest is deemed necessary upon any of the following grounds:

"1. To maintain the soil upon mountains or slopes.

"2. To defend the soil against erosion and flooding by rivers, streams and torrents.

"3. To insure the existence of springs and water courses.

"4. To protect the dunes and seashore against erosion of the sea and the encroachment of moving sands.

"5. For purposes of military defense.

"6. For the public health."[24]

---

[22] Tenth Annual Report of the State Board of Forestry, 1910.

[23] Fifth Annual Report of the State Board of Forestry, 1905.

[24] Pinchot, Gifford. Publications of the American Economic Association, 1891, Vol. 6, pp. 214 and 215.

Germany and Switzerland also maintain a wise control over their forests. Similar protection of the forests of this country should be enacted. One very noticeable thing in this state and country is the extreme waste of the forest resources. This is seen from the time the tree is cut in the woods until what remains of it is issued in the finished product.

This is not the case in some foreign countries, and should serve as a useful lesson to the state. Great service has been rendered to the state already by those who have worked to have the present Indiana forestry laws enacted and by those who by instruction or advice have endeavored to further the cause of forestry in Indiana.

Notwithstanding the presence of other factors which may help to produce or prevent floods, the fact remains as has been sufficiently outlined in this paper by various examples, that deforestation is by far the greatest cause of floods. The examples have shown that where forests are present floods are practically absent, and as the forests are removed the floods become more numerous and destructive.

Probably the most thorough study thus far of any single stream in this respect is that made by M. O. Leighton[25] for the Tennessee River. The same state of affairs exists in Indiana, and every effort should be put forth to remedy the danger. The one great element of success will lie in the proper education of the public to the disastrous results of reckless deforestation and the benefits of forest preservation. As Elliott well says: "Probably our forests are in no worse condition today than those of Germany and France two hundred years ago, when those nations began reforestation. Success crowned their efforts and should ours if we put forth the same endeavors."[26]

[25] Leighton, M. O. Floods in the United States. Cited from Hall and Maxwell, l. c., pp. 5-6.
[26] Elliott, Simon B., l. c. p. 12.

The Relation of County Tuberculosis Hospitals to Conservation of Public Health

James Y. Welborn, M. D.

The broad subject of conservation, although in its infancy, is far reaching in its achievements. Like all innovations, appearing at first as current events, gradually enveloping established customs, making history for an epoch, this idea has grown.

The preponderance of forces necessary for any custom, event, political or social decree, upon which a nation reaches a destiny, has, as an essential for success, to be presented at such an opportune time as to arouse this nation's people to a keen interest. The time, the place, the demand and the recognition are all essential forces for any substantial movement.

The phase of our subject I proclaim to be of the greatest importance, because in conserving the health of the people, we thereby promote conditions for a more perfect physical being necessary to reach a goal of ideal perfection. This is true because upon the public health depends the degree of success in arts and sciences and the good spirit of the human race. It may also be added, in the language of Ex-Governor Marshall, "That upon the public health rests the state of the morals of the people."

Now, how do the County Antituberculosis Society movements conserve public health?

First, by an education: teaching sanitary science and preventing loathsome disease. An example of this is demonstrated by the following: A patient of an ordinary family is treated in the hospital. While there, receiving visits from other members, they learn that to eradicate flies and mosquitoes is a means of saving doctors' and druggists' bills, by preventing malaria and other diseases. They are cited to the necessity of destroying all sputa and dejecta from the body as a means of self-protection. They are shown, to some extent, at least, how to select foods, as to variety and purity, and there are innumerable items to be learned relative to sanitary conditions.

Second, presenting to the people a plea that vice, excesses, loathsome habits and poisons are dangerous to good health. Various examples can be pointed out for instance, late hours, alcohol and tobacco, which are prime factors in precipitating severe cases in many of our young men patients. When they are set up as examples to the observing public it often astonishes them as something they had not before thought of. I must also emphasize that when the society is urging all these teachings it forces many negligent physicians to realize the necessity of more strict orders to their patients.

Third, by teaching economy in caring for such victims, thereby reserving forces to be utilized in aggression rather than defense. With resultant effect of the facts in the first and second, there is the beginning of economy, which effects are tremendous in the end, for every case of prevention is the means of saving thousands of dollars, which if saved for other pursuits of the proper kind must broaden the field of attainment by a people physically more able to do work than those weakened by personal or family sickness.

Fourth, that life may be sustained over the disease which has long been thought to be fatal. There are now hundreds of strong working people in the State of Indiana who, if they had not had the intelligent advice and treatment of the society workers, would have been sleeping under sod waiting for other victims of their own infection who were serving their days of invalidism.

The growth of the movement by local organizations has brought about the idea that a united effort is necessary to accomplish the foregoing. As a result, in our state we now have statutes giving power to county commissioners to establish county hospitals for tuberculous (indigent) patients, or to contract with county organizations for the care of such patients. This enables charitable organizations to conduct more successfully the institutions they are establishing. In fact, if this law had not come into effect, public charity could not support the crying demands. Such a failure would gradually burden the cheerful donor, and batlle the philanthropic workers. When such cooperation exists, civil and charitable forces are also supported by individuals able to pay small but reasonable sums for attention, instead of great amounts necessary in seeking distant health resorts. I will suggest that cooperation in this state, will enable each group of people to learn the most conservative methods to be employed in this branch of work. A monthly state journal should be published, in which the workers of this state can embody system and cooperation of efforts.

Playgrounds and Recreation Centers as Factors in Conservation of Human Life.

Dr. W. A. Gekler.

The enormous industrial development of this country in the past thirty years has brought with it the serious problem of devising some means whereby the harmful effects of factory labor and the crowding of workmen and their families into tenements and the districts about the factories may be counteracted and corrected. Our own native-born population, as well as the largest proportion of the immigrants that come to our country, have been forced to adapt themselves to a manner of life which is entirely different from that to which they have been accustomed. The child growing up in these surroundings, as well as the adult worker, needs besides proper food and properly constructed dwelling houses the playground and recreation center to preserve not only the physical but the moral health of the class to which he belongs.

The conservation of the life and health of our population cannot be attained through sanatoria and hospitals. From a business standpoint it is very poor policy to build institutions to repair damage that has been done and then not take the necessary steps of prevention. Although we will never be able to eradicate diseases entirely there is a possibility of a great reduction in disease, and with it a lengthening of the average life of the individual. We need more than good housing conditions, a living wage, pure food and proper sanitary conditions in our factories to bring about these things.

Recreation and play are as necessary for the physical well-being as are some of these other things just mentioned. The growing child needs them for the proper development of his body and the adult needs them to keep his body in a healthy condition. Although the prevention of infectious diseases is in the last analysis a question of quarantine, the physical condition of the individual plays a very important part in every infectious disease. As long as the community must suffer through the sick ness or death of a worker it is very plainly the duty of the community to take the necessary steps of prevention. The playground is one of the necessary means of prevention of disease and has already proven its worth in those communities where it has been given a trial.

The recreation center should be an important factor in the proper education of our workers in the laws of hygiene and health. The ignorance of the average person concerning the facts of health and the early manifestations of such diseases as tuberculosis, cancer and occupational diseases is in no small way responsible for the large number of incurable invalids which our community has to support. It has been estimated that tuberculosis kills almost one-third of our workers who die between the ages of twenty and thirty-five, and it is the experience of nearly all who have much to do with the treatment of tuberculosis, as well as the other diseases mentioned, that a large proportion of our incurable cases have applied to the physician for help and advice only after the disease has progressed to a point where relief or cure are impossible.

The factory and those conditions which have arisen in the growth of our present industrial system have affected not only our public health, but also the moral tone of the community. The church as it exists today is scarcely able to cope with the moral problems which have presented themselves, and it has been found that the moral and physical problems are very closely bound together. The natural desire of the average worker, and we might as well say his need, for play and recreation has had to be satisfied at the saloon, pool-room, cheap theatre or on the street. The enormous increase of crime and degeneracy in the past few years has shown that the effect of, at least, some of these agencies has been to work great harm to the individual and finally through him to the community at large.

The individual needs not exhortation to refrain from doing those things which are harmful to him morally and physically, but an opportunity to satisfy his needs for recreation and play in a way which cannot have this harmful influence. The tendency of the average person when given a choice between the good and the bad is to instinctively choose the good, when he once understands it. The experience of the settlement houses and Y. M. C. A.'s over the country is abundant proof of this. Conditions have now become so that it is the duty of the community to make the playground and recreation center a part of its regular activities as well as the public school and library system. This work should no longer be left to public charity and the philanthropy of wealthy individuals, which of its very nature repels the self-respecting worker who cannot accept charity without sacrificing a part of his self-respect. The playground and recreation center should be built and maintained out of the taxes of which he pays his share, so that he will take advantage of these things as his own and not the gift of those to whose wealth his work has contributed.

Let the playground and recreation center be combined with our public school and library for the physical well-being of the community as well as its education. Make the influence of this combined institution broad enough and free enough to reach all of our workers. Then with proper housing, pure food, a living wage and hygienic surroundings in the work shop and the factory our playground and recreation center will complete the steps we must take for the conservation of human health and life.

Public Toilets, Public Drinking Fountains and Public Spitting in Relation to the Conservation of Human Life.

C. M. Hilliard.

Public supplies and public conveniences are always public dangers, and for two reasons: they may affect large numbers of people, and they are always beyond the control of the individual who is obliged to use them. The municipality and the state has, therefore, a grave duty; viz., to control and to supervise public commodities of all kinds.

We no longer believe that disease is the result of the "malice of Satan," or a "rebuke of God," but rather consider it the result of personal or public ignorance and neglect. Decomposing potatoes and pin-holes in the sewer pipes are no longer believed by intelligent people to be the cause of typhoid fever, but every new case is new evidence of deficient civilization. Infectious diseases are caused by living germs and these parasitic germs live and grow only within the body of man, for the most part. They perish quickly in the harsh external environment. For the continuation of infectious diseases it is necessary that a more or less direct transfer of fresh nasal, oral, urinary or alimentary excretions from one body to another susceptible body take place. The body must be frequently freed of these accummulations of wastes, for just as wastes in a community may "breed" ill health and nuisance, so much more important is it to rid the cell community—the body—of its wastes.

The problem of public sanitation is two-fold. First, it must reduce to a minimum the possibilities of transfer of the germ-laden body excretions from person to person. Secondly, it must provide every public need and commodity that tends to raise the vital resistance of the people. There is no more potent force tending to good health than the condition of the body; its resistance to variable external conditions and parasite invasions depends upon this general health tonus.

Toilet facilities should be furnished by railroads, hotels, bars, amusement places as theatres, fair-grounds, etc., and by municipalities in frequested public places as squares, playgrounds and especially public schools. A sniff of, or a glance at the accommodations offered the public in railroad stations or theatres in many instances is argument enough against conditions as they exist about us.

Public toilets may be exchange places of disease germs. Evidence is not lacking that epidemic disease frequently spreads from these centers. Occasional cases of venereal disease or even of intestinal disease may be traced to toilets. Trachoma and various infections are transmitted from person to person by the common roller towel. The indirect effect of inadequate facilities and revolting toilets, making it impossible or undesirable for people to free the body of its wastes, and hence affecting the resistance of the body, is much more important than the direct transmission of disease germs in this case. A nation's or a town's refinement, education and morality may well be noted by the comfort, privacy and inviting facilities it offers to its inhabitants for the evacuations of the body. It is beyond the scope of my paper to indicate the dire effects resulting from improper functioning and improper attention to this important need. Suffice it to say that many so-called functional diseases as liver and kidney trouble, frequent headaches, intestinal disorders and other disorders are frequent sequelæ due to neglect of ridding the body of its wastes. The impairment of the functioning of these vital organs tears down the general normal barriers to infectious diseases and so indirectly, lack of sufficient and inviting toilets is a cause of much sickness, suffering, and even of death.

The public drinking cup has been condemned because it affords an ideal vehicle for the mutual exchange of saliva. People who will laugh heartily at the joke when you suggest "swapping gum" serenely follow you to the public fountain and mouth the cup directly after you and dozens of others. In 1909 Kansas, Michigan and Mississippi first adopted regulations against the use of the common drinking cup in schools and railroad trains, and now several states, including Wisconsin, Massachusetts and California have legislated against this disease distributor.

As with toilets, the problem of public drinking facilities involves a question of direct transfer of disease virus and one of general body conditioning. It is a simple matter to demonstrate mouth epithelial cells and mouth streptococci on the edge of the public drinking cup, and it is obvious enough that disease germs are always potentially present and may pass in a few minutes, or even seconds from the mouth of the incipiently sick or convalescing, or the healthy "carrier" of diphtheria, scarlet fever, tuberculosis, pneumonia, tonsilitis, mumps, whooping-cough, measles, infantile paralysis, common colds or other infectious diseases into the mouth of the healthy, willing susceptible.

The normal functioning of the body is absolutely dependent upon abundant water being furnished the system, and a deficiency leads to general ill health and lowered resistance. Abundance of water is almost as important as purity of water. Sufficient and attractive facilities as well as clean water offered from sanitary devices should be furnished the public.

The war against public spitting has been vigorously and efficiently waged for some time now and with undoubted good results. Just what the relative importance of large masses of sputum thrown into the environment is when contrasted with saliva exchanges that take place in more obvious and direct ways on things smeared either directly by the lips or by the fingers moistened with saliva, I do not venture to state. Our epidemiological evidence and our laboratory findings seem to be opposed to the theory that disease is very generally spread through the medium of the air. Sputum thrown upon the sidewalk or in the hotel lobby drys slowly as a rule and tends to adhere to the surface upon which it is dried. The dryness, light, time and other factors are germicidal and the disease germs present, especially, tend to quickly perish. Saliva deposited on food by the cook or waiter, on pencils exchanged by children in school, on street-car checks by conductors, on soda glasses, trolley straps, the leaves of books and a multitude of things that we come in contact with in the daily routine seems to find a more direct route and gives ample room for explaining obscure endemic cases of disease of the respiratory tract. For my part, I had rather have the car conductor spit on the floor than deposit a lesser amount on the check he hands me. I believe it is high time our anti-spitting league took on a new, broader work and began an anti-saliva campaign. Spitting may, and undoubtedly does spread disease. It is a vile habit and should be prohibited. The campaign against it will raise the public opinion of cleanliness and civic responsibility and will tend to improve the sanitary tone of a community.

The phenomenon of improved municipal health following the substitution of a pure or purified water supply, for a polluted supply is too common to need illustration. Other sanitary improvements, as installation of a proper sewage or garbage disposal plant or a clean milk campaign, likewise affect the public health in a spectacular and demonstrable way. It has frequently been observed that the decrease in death rate following these specific improvements is greater than would be expected. For example, a clean water supply may always be expected to lower the mortality of water-borne diseases, chiefly gastro-intestinal diseases. In many instances it has been found that the general death rate is lowered more than can be explained by the typhoid component and that diseases of the respiratory tract are reduced. This may be explained by supposing that diseases other than intestinal may be water-borne, or it may mean that the general vital resistance of the people of the community is raised by more abundant use of a pure water. When a community reaches that stage of sanitary enlightenment and common-sense cleanliness that it demands proper disposal of its wastes and provides for a pure public water, we may expect that other less spectacular sanitary reforms are being practiced, so that there are a number of contributory causes to improved health. Thus the general resistance tonus and the public's hygiene practice is a significant health factor. Providing sufficient and clean public toilet facilities; convenient, numerous and sanitary drinking fountains, and the abatement of the barbaric, disgusting habit of public spitting are plain civic duties, and are factors in the conservation of human life and happiness.

We would recommend:

1. Regeneration and extension of public toilet facilities, especially emphasizing the need of proper care of public toilets. The most perfectly constructed toilet will be unsanitary in a short time if not efficiently cared for. A score card might be used in inspection to give a picture of the conditions and to indicate improvement from time to time. I have devised and used such a score card effectively.

2. The final condemnation of the public drinking cup, especially in schools. One of the lessons in hygiene in schools might well be devoted to teaching children how to make their own paper drinking cups, the teacher furnishing them with clean paper of convenient size and shape throughout the year. Soda fountains are culpable and there should be legislation or action of some kind against the present soda fountain and glass, a public drinking cup.

3. The extension of our anti-spitting and anti-saliva campaign, including the dissemination of information relative to the more direct and dangerous modes of transfer of nasal and oral secretions.

Power Economy in the Southern Indiana Quarry Industry.

G. C. Mance.

The limestone quarry industry of southern Indiana offers a fertile field for research along the lines of conservation. The early operators adopted wasteful methods of production, feeling that the abundance of the deposits would give an unlimited supply of first-grade stone. The tendency has been to continue with the old methods and machinery to the present time. Within the last few years, however, competition has become so keen that many of the operators of the district have begun to realize the wastefulness of the present methods and to look for more efficient ones.

The principal losses accompanying the production of building stone in Monroe County can be grouped under four heads:

(1) Losses of second-grade stone.
(2) Losses of human labor.
(3) Losses of lime, cement and fertilizing materials.
(4) Losses accompanying power production.

The losses due to inefficient methods of power production are probably the greatest and the most in need of remedial action. The method of power production throughout the district is wasteful in the extreme. Power is generated in a large number of separate units distributed over the quarry and there is a great loss of human labor in supplying the coal where it is to be used as well as a great loss of coal due to careless handling. Several quarrymen have made careful tests upon channeling machines, at my suggestion, to determine the amount of coal consumed by the different types of machines during a given run, and it has been found that while the Sullivan or Ingersoll channelers cut faster they consume practically twice the amount of coal in a given period of time as the Wardwell type of channeler, which is widely used throughout the district.

In many of the mills the boilers and engines have been in operation over twenty years and the amount of coal used per horse-power hour is at

The Interior of a Modern Mill. This Mill is Entirely Equipped With Electrical Machinery. The Power is Purchased of a Local Power Company least six times as much as would be necessary with up-to-date machinery and methods in large central plants.

During the last nine months I have visited all the mills and quarries of Monroe County which are at present in operation, and have taken data on the coal consumption and power produced throughout the district with an idea of showing how great these losses are and at least suggesting a remedy for some of them.

From the data taken I have chosen three plants which are representative of the older type and have averaged them so as to avoid giving out the data of any single plant. The data are as follows:

Amount of coal used per month (tons)	135
Cost of coal at the mine at $1.15 per ton	$155.25
Freight on coal at $.55 per ton	74.25
Total cost of fuel	229.50
Horse-power developed, engine rating	75
Hours of running time during the month	240
Coal consumed per horse-power hour (lbs.)	15

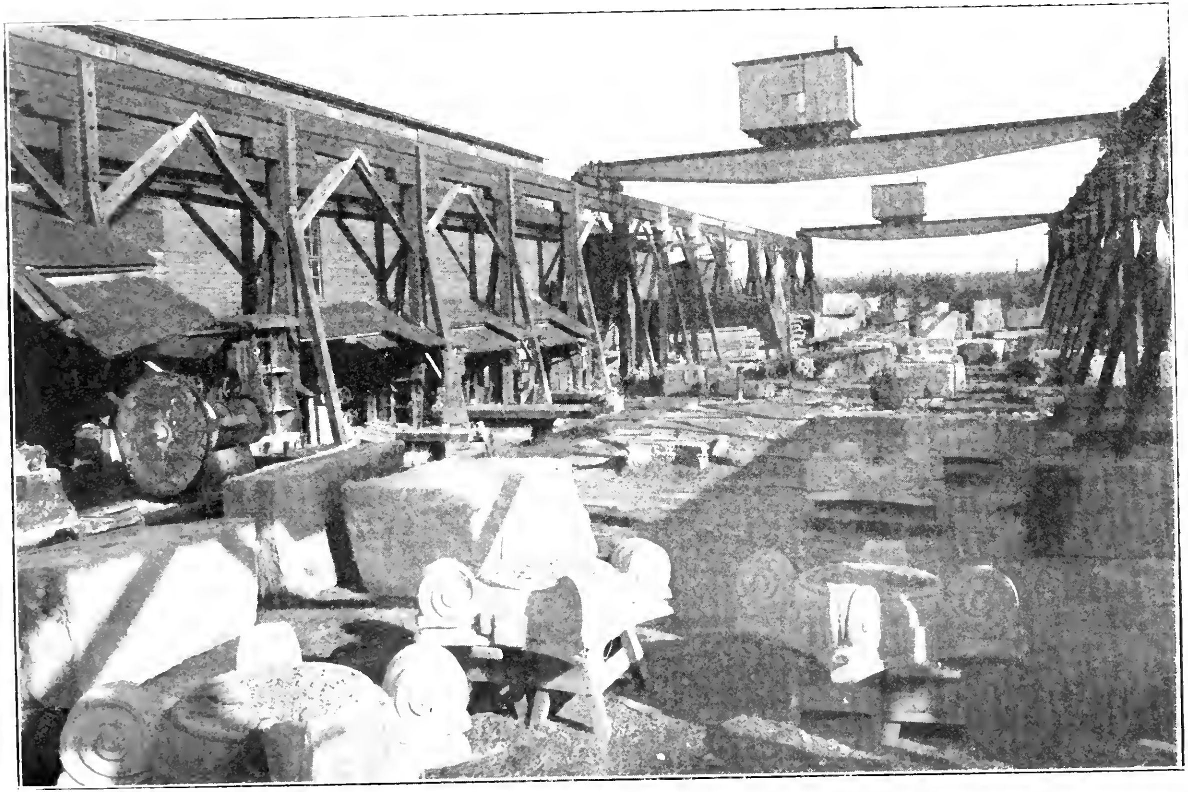
I have also taken the data for three of the more modern type of plants and averaged them to show the great improvement already made toward greater economy. The data are as follows:

Amount of coal used per month (tons)	192
Cost of coal at the mine at $1.15 per ton	$220.80
Freight on coal at $.55 per ton	105.60
Total cost of fuel per month	326.40
Horse-power developed, engine rating	200
Hours of running time during the month	240
Coal used per horse-power hour (lbs.)	8

Although these figures show that a great improvement has already been made in power production, they also show that there are still great possibilities for further reduction in power costs.

The saving of human labor engaged in the production of the power in central plants over the present methods would amount to two-thirds of the number of men now engaged.

In my final paper on the subject I hope to carry out the above figures



This is a Type of the Outdoor Yard. Winter Work is Out of the Question. These Plants are Slowly Disappearing in Favor of the Inclosed Plant.

fully enough to show the actual cost of power by the present methods in use in the district. At present my data on the value of the machinery and plants and the rates of taxation, insurance, etc., on the same is not complete enough to give any but a very approximate figure.

Engaged in the stone industry of the county there are twenty-nine operating companies controlling twenty-six mills and sixteen quarries. They use approximately 5,000 H. P. and 4,000 tons of coal per month in its production.

For convenience in studying the problem of power production of the county I have divided it into three districts as follows:

District No. 1 includes all the plants in and around Elletsville and Stinesville. This district is controlled by six companies running six mills and two quarries. They use approximately 1,000 H. P. and 750 tons of coal to generate the power.

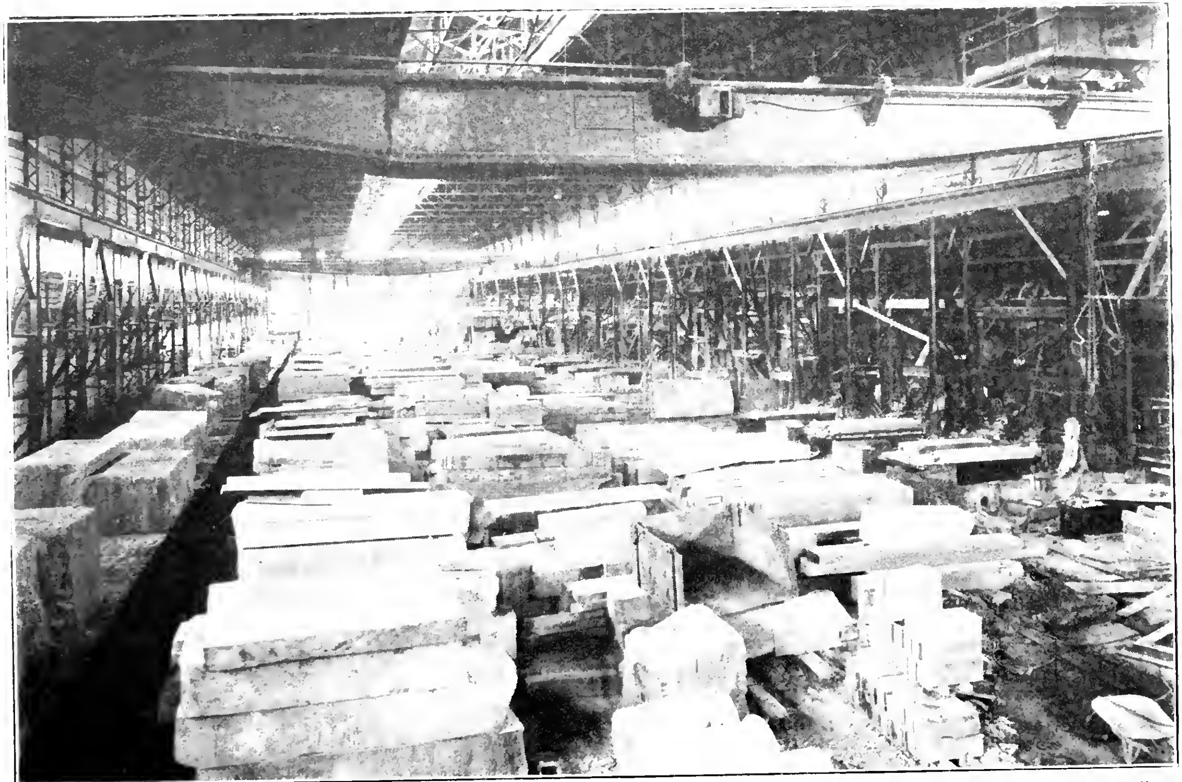
District No. 2 includes the quarries and mills of Bloomington and Hunter Valley. This district is controlled by eleven companies running eleven mills and five quarries. They use 2,000 H. P. and 1,700 tons of coal per month in its production. Two of the plants of this district buy electrical power from the Central Indiana Lighting Co. of Bloomington, and in figuring the coal consumption for the district I have added the amount of coal they would use in the production of their power if they worked under the same conditions as the other operators of the district.

District No. 3 includes the rest of the county, that is, all the mills and quarries around Clear Creek and Saunders Station. In this district there are twelve operating companies running nine mills and nine quarries. They use approximately 2,000 H. P. and consume 1,650 tons of coal.

In looking for improved methods of power production the following possibilities present themelves:

First, each operator can make an effort to produce as much of his power in a single unit as possible, and distribute the power to the different machinery of his plant electrically. This method is becoming more and more common in the stone mills of the county, but very little effort has been made toward the use of electrical machinery in the quarries.

At least two of the operators of the district are using compressed air to drive their quarry machinery, but a careful study of the costs of power production in this form shows that the fuel cost is materially raised. although the advantages of such a system are: Small waste in handling


An Interior View of the Plant of One of the More Up-to-Date Companies. This Plant is Equipped for Night and Day Running, as Well as Winter Work.

coal, less human labor, and a cleaner quarry. As a method of conserving power it cannot be called successful, although the failure in one case may be laid to the fact that the channeling machines used with compressed air are of the old steam types with the air hose introduced into their boilers, thus keeping the faults of the steam channeler and adding to them the line losses of compressed air. This method would be far more economical with modern compressed air channelers.

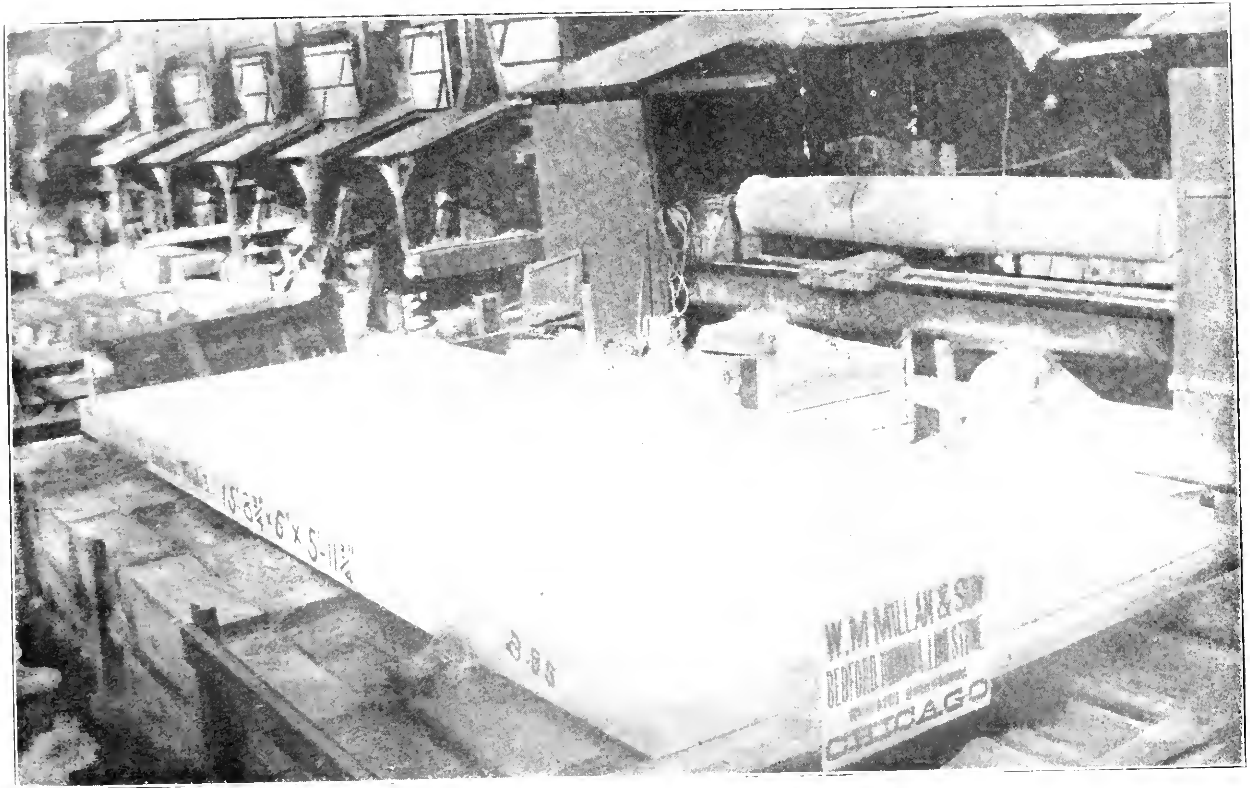
Second, a central plant for each district might be constructed with an idea of handling the coal more easily and having an adequate water supply. These plants could be located so that the cost of distribution of the power by electricity would be a small item, as the districts are reasonably compact and easily reached.

Third, we might consider water power with electrical distribution to the plants. In fact, such a plant is already in existence at Williams, but on account of the uncertainty of their water supply the plant is equipped with a steam auxiliary. Their proximity to the quarries and mills of Lawrence County makes it probable that most of their power will be sold there, as the heavier line losses in distributing to this district would tend to center their interests in the southern part of the stone belt. Other projects have been suggested, but the extremely high first cost of the construction of a water-power plant makes it rather a question of the future than of the present power problem.

Lastly, and probably the most economical solution of the problem is the construction of a large central plant in the coal fields with high tension transmission of the power to the quarry districts and the use of electrical machinery throughout the plants. This plant could be equipped with modern automatically stoked boilers with superheaters and condensing engines; or the plant could be equipped with gas producers and gas engines. An interesting calculation on the subject can be made by taking a single district and showing the possibilities for that district if the operators could unite to solve their power problem.

I have taken District No. 1 and attempted to calculate the cost of such plants from the data available, but, in general, calculations of this kind are only approximately true, as the price of materials is constantly changing and the tendency of contractors is to hide the true costs by unbalanced bidding. This makes it difficult to estimate prices.

The following figures are reasonably correct for a 1,000 H. P. plant:



A Yard in One of the Local Mills, Showing One of the Largest Slabs of Dressed Stone Ever Sent Out of the District.

Steam plant:

2 engines totaling 1000 H. P.	$25,000
Necessary auxiliaries at $8.50 per H. P.	8,500
4 fire-tube boilers, 200 H. P.	5,700
2 400 K. W. generators, 550 volts	9,628
2 16 K. W. exciters, direct current	810
Switchboard equipment, $4.25 per K. W.	3,400
Cost of stack at $3.00 per H. P.	3,000
Foundations for engines and boilers	3,000
Piping and installation	2,000
Total cost of plant without buildings	$63,038

If turbines were used with three 250 H. P. water-tube boilers and superheaters instead of the above equipment, the total cost would be $57,150.

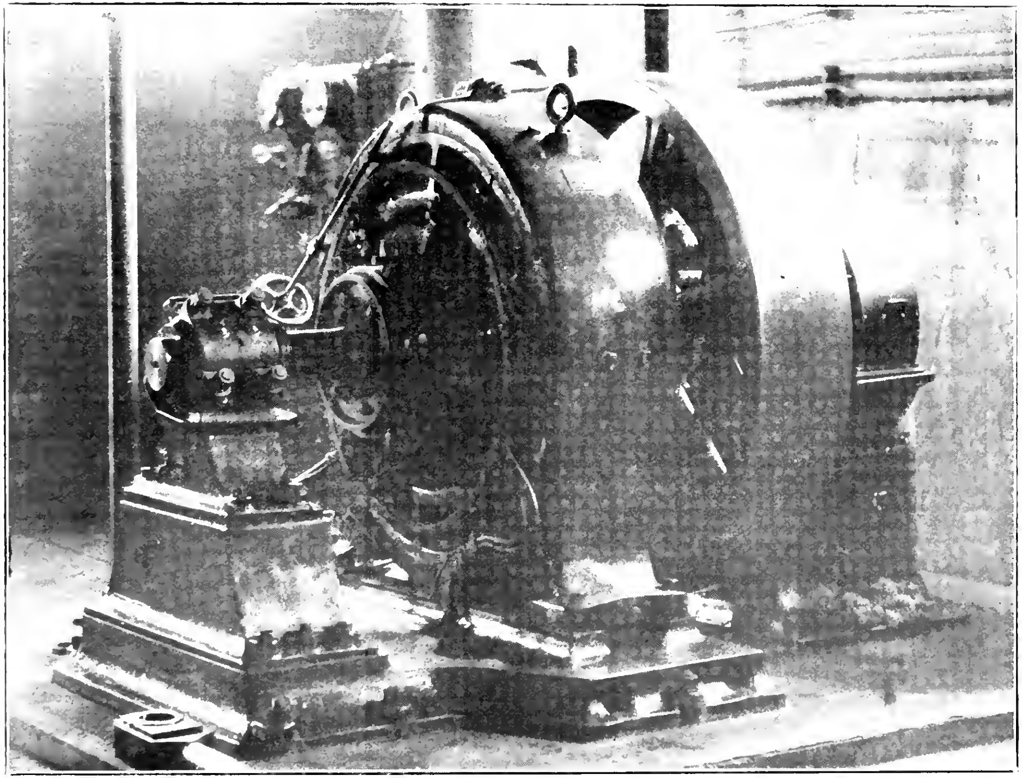
The fixed charges against the steam plant would be as follows:

Interest at 5 per cent. on whole investment	$3,152
Taxes and insurance at 2 per cent	1,251
Depreciation at 10 per cent	6,304
Total fixed charges	$10,717

Operating charges for one year:

Labor	$3,900
Coal at $1 70 per ton, 5,000 tons	8,500
Repairs, 1 per cent. of first cost	630
Oil, waste, etc.	1,650
Total operating cost	$14,680
Total cost of power for the year	25,397

Price per K. W. hour, calculating on a 10-hour run, 308 days, 1.1 cts. The same calculations on a producer-gas plant of the same size offer a comparison which is well worth studying.



A 105 H. P. Fleming Harrisburg Engine Direct Connected to a 75 K. W. Westinghouse Generator. This Engine is Carrying Three Electric Cranes; a Diamond Saw, and the Lights for the Plant. This Outfit is Economical When Carrying a Fairly Constant Load Near Full.

The cost of such a plant would be as follows:

Gas-producers at $23 per H. P.	$23,000
Accessories, including draft equipment, $9 per H. P.	9,000
2 500 H. P. gas engines	38,000
2 400 K. W. generators 550 volts	9,628
2 16 K. W. exciters direct current	810
Switchboard equipment at $4.25 per K. W.	3,400
Foundations for engines and producers	3,000
Total cost of plant without buildings	$84,138

Fixed charges on gas plant:

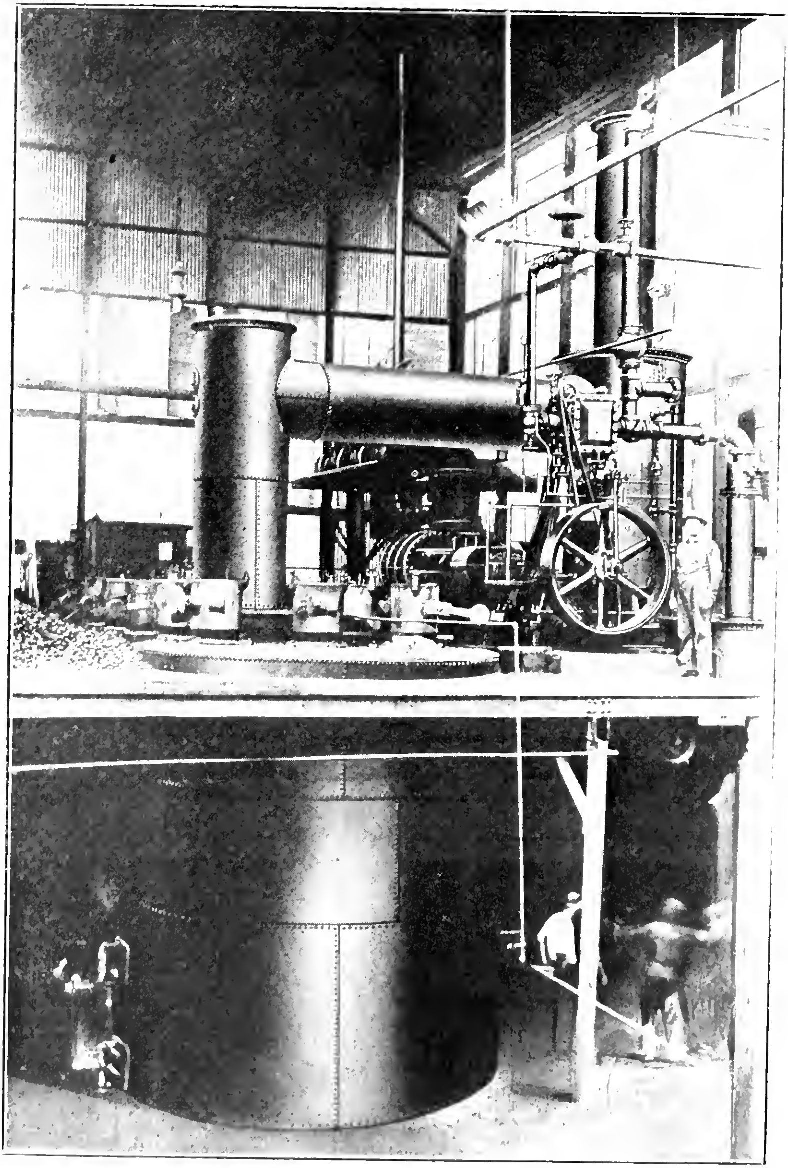
Interest at 5 per cent	$4,207
Insurance and taxes at 2 per cent	1,683
Depreciation at 10 per cent	8,414
Total fixed charges	$14,304

Operating charges on gas plant for one year:

Labor	$3,900
Coal at $1.70 per ton, 1,500 tons	2,550
Oil, waste, etc	1,650
Repairs	630
Total operating cost	8,730
Total cost of power for the year	$23,031

Cost per K. W. hour, 308 days, 10 hrs. per day, .93 cts.

I have placed in the equipment two engines with the idea of showing another economy. The villages of Elletsville and Stinesville do not have an electrical plant for lighting. If such a plant as I have outlined were erected there the over-night run on one of the engines would furnish much-needed power for lights at a very small expense. In fact the power could be developed for an additional .4 of a cent a K. W. hour after the fixed charges have been figured against the day run.



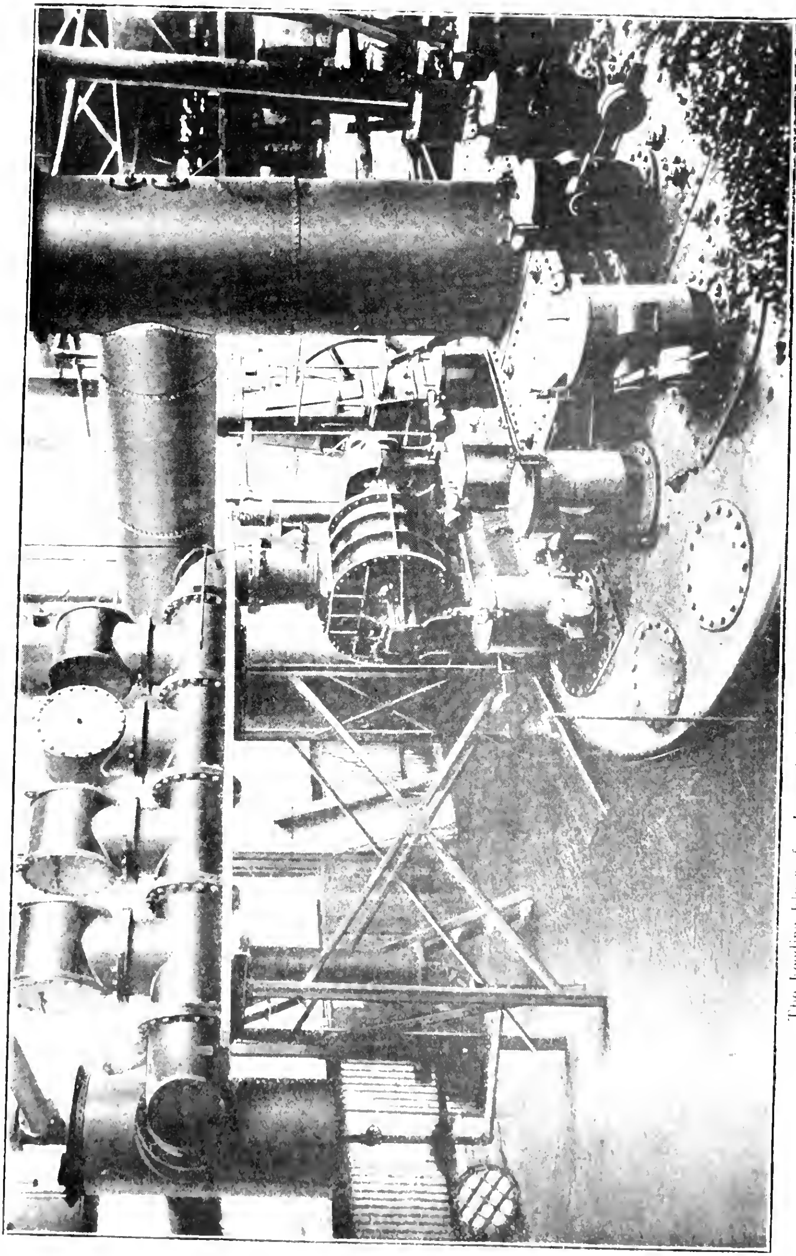
A View of Both Floors of a 1000 H. P. Producer-Gas Plant.

From these figures it will be seen that there is only a slight difference in the cost of power for the two types of machinery, but these figures would diverge in favor of the gas producers as the size of the plant was increased. If the plant were located in the coal fields and the power brought over as high voltage current, the amount of money saved on freight would pay for the transmission line in about eighteen months. In fact, for such a plant the line losses and cost of transformers at both ends of the line would bring the price of power to about the same figure.

Probably the ideal solution for the power question would be to furnish the entire district with power. This plant to be located in the coal fields and be of the by-product recovery type with gas engines and the power transmitted at 33,000 volts. Such a line and voltage would be the cheapest for conditions as they would be in this district.

There are numerous plants in Europe which depend upon the by-products recovered for their profits. A good example is the plant at Dudley Port, South Staffordshire, England, where a Mond by-product plant practically pays for all the fuel used, in the by-products recovered. The two principal by-products are ammonium sulphate and tar. The ammonium sulphate alone returned $2.25 per ton of coal burned, and the tar sells for $0 19 per ton of coal burned.

Ordinary bituminous coal will return 80 to 90 pounds of sulphate of ammonia per ton. Such plants now in operation produce a Kilowatt per hour of power on 1.54 lbs. of coal fired. Since the price of coal is so low in this district the cost of power would be but little over the fixed charges on the investment. This problem of power economy for the quarries begins to be of especial interest over the entire district, and if the issue were met squarely a great saving of money would result, as well as great economy in coal consumption.



The Feeding Floor of a Large Producer-Gas Plant, Showing the Large Floor Space Occupied

Report of the Committee on "A List of the Scientific and Technical Serials in the Libraries of the State of Indiana."

In submitting to the Academy the final results of the work of your committee it seems desirable that some explanations should be made. The former catalogue, published in the Proceedings of 1911, owing to the short time allowed for its preparation, was compiled in such haste as to be very defective both typographically and in its completeness. It is doubtful if anyone realized the size of the task or the difficulties to be encountered when the committee was first organized. The extension of the scope of the list as well as the number of libraries to be included in the present revised list has more than doubled the size of the catalogue and has greatly multiplied the difficulties.

Owing to the wide distribution of the libraries it has not been possible for the committee to inspect the serials of every library, and the work has been largely carried on by correspondence and the cooperation of many librarians. Although this has often put a considerable burden of work upon the librarians or their assistants the committee cannot complain of any lack of genuine interest and hearty co-operation in our undertaking. It is, however, impossible to formulate a practicable set of rules for the guidance of librarians in making out their lists that will provide for all contingencies. The task of correlating the numerous items in these many lists has been extremely difficult and in frequent cases impossible with any degree of certainty. For example, what is probably the same serial appears in two different lists under slightly different titles, as for instance one says "reports," another "transactions," and without the serial at hand the committee can not determine whether these are the same or distinct series. We have tried to eliminate duplication by careful comparison with other catalogued lists. But after the utmost care there still remains a large residue of doubtful matter of this sort, while in some instances we may have identified series that should have been kept distinct. A number of titles have not been found in any of the serial catalogues which we have consulted and the doubt remains in the minds of your committee whether some of these are not incorrectly listed.

It was intended that all volumes should be listed by the volume number when that could be determined and the date of issue given only when the volume number was not known. There has been great lack of uniformity in following this rule, which introduces considerable confusion into the lists. Your committee has no means at hand by which to correlate dates and volumes. Where it has seemed possible we have ventured to substitute volume numbers for dates, but in most cases we have found it necessary to leave the lists unchanged in this particular.

It may be found that some titles are included in the catalogue that have doubtful claim to being recognized as pertaining to serials that are either scientific or technical. As the committee could not be personally acquainted with every serial named we have trusted largely to the judgment of the librarians. A few titles, such as the *Literary Digest*, we have ventured to exclude. The inclusion of such doubtful material, however, does not seem to us a serious fault, on the principle quoted by Bolton from Zuchold that "in a bibliography it is much better that a book should be found which is not sought, than that one should be sought for and not found."

In the prosecution of this work the committee has consulted various catalogues and freely adopted suggestion from many of them. The following may be especially mentioned:

A catalogue of scientific and technical periodicals 1665–1895. Smithsonian miscellaneous collections **40**.

List of serials in the University of Illinois library together with those in other libraries in Urbana and Champaign. University of Illinois Bulletin **9**[2].

List of serials in the principal libraries of Philadelphia and its vicinity. Bulletin of the Free Library of Philadelphia. No. 8.

List of periodicals, newspapers, transactions and other serial publications currently received in the principal libraries of Boston and vicinity.

List of biological serials in the libraries of Baltimore 1901.

List of serials in University of Colorado library. University of Colorado bulletin. **13**[1].

ABBREVIATIONS AND SIGNS.

Ac. Indiana academy of science exchanges deposited in the State Library at Indianapolis. In references under this head parts of broken volumes are listed by means of index figures attached to the volume number.
B. Butler College library, Indianapolis.
D. DePauw University libraries, Greencastle.
E. Earlham College library, Richmond.
Exp. Agricultural Experiment Station, Lafayette.
F. Franklin College library, Franklin.
Ft. W. Fort Wayne public library.
G. Gary public library.
I. U. Indiana University libraries, Bloomington.
L. P. Laporte public library.
M. Muncie public library.
N. D. Notre Dame University libraries, Notre Dame.
N. H. New Harmony Workingmen's Library.
P. Purdue University libraries, Lafayette.
R. P. Rose Polytechnic libraries, Terre Haute.
S. State Library, Indianapolis.
S. N. State Normal School library, Terre Haute.
T. H. Terre Haute. Fairbanks Memorial Library.
W. Wabash College library, Crawfordsville.

Bold faced figures are used to indicate volume numbers. The year date (e. g. **'9**`) is used instead of volume number when the latter is not known.

Plain Arabic figures indicate numbers of a serial that is not issued in volumes; chiefly bulletins.

Indices are used in the Academy (Ac.) lists to indicate numbers of an incomplete volume.

An asterisk (*) attached to a volume number signifies incomplete.

The plus sign (+) after the last volume number signifies that all succeeding numbers are on file and current numbers are received.

The parallels sign (||) indicates that the serial ceased publication with the preceding volume.

Roman numerals indicate numbered series.

o. s. old series.

n. s. new series.

HOWARD J. BANKER.
WILL SCOTT.

LIST OF SCIENTIFIC AND TECHNICAL SERIALS IN THE LIBRARIES OF INDIANA.

Abstracts of physical papers. London, England. P. **3.**

Continued as **Science** abstracts *q. v.*

Academia de ciencias medicas fisicas y naturales de la Habana. Havana, Cuba.

Anales. Ac. **36**$^{1, 18-21, 24}$: N. D. **39+.**

Academia nacional de ciencias. Cordova, Argentine Republic.

Actas. Ac. **5**$^{1-3}$.

Boletin. Ac. **7**$^{1, 3, 4}$, **8**$^{1-3}$, **9, 10, 11**$^{1-4}$, **12**$^{2-4}$, **13**^{1}, **14**$^{1, 2}$, **15**$^{1-3}$, **16**$^{1, 4}$.

Académie des sciences. Paris, France.

Comptes rendus. B. **152, 153:** I. U. 1+: P. **140+:** R. P. **104+.**

Académie impériale des sciences. St. Petersburg, Russia.

Annual report. N. D. **'12.**

Bulletins. Ac. IV. **36**$^{1, 2}$, V. **1-5, 6**$^{1-5}$, **7**$^{1, 2}$, **10**^{5}, **11-14, 15**$^{1-5}$, **16**$^{1-3}$, **22-25:** N. D. VI. **'12+.**

Musée botanique.- Travaux. N. D. **'12.**

Academy of natural sciences of Philadelphia, Pa.

Annual Reports. S. L. **'91-'94.**

Proceedings. Ac. **'58+:** B. **'56-'86, '88-'93, '95+:** I. U. **1+:** N. D. **61+:** S. L. **'67-'90, '99-'04.**

Acadian scientist. Wolfville, Nova Scotia. Ac. **1**^{5}.

Accademia dei Lincei. Rome, Italy. See **Accademia** pontificia dei nuovi Lincei; **Reale** accademia dei Lincei.

Accademia pontificia dei nuovi Lincei. Rome, Italy.

Atti. Ac. **51-57, 58**$^{2-7}$, **59+.**

See also **Reale** accademia dei Lincei.

Acetylene journal. Chicago, Ill. N. D. **7***, **8***, **9-11, 12***.

Acta mathematica. Stockholm, Sweden. I. U. **1+.**

Aeronautics. New York. Ft. W. **12+.**

Agassiz association. See **Wilson** bulletin.

Agassiz companion. Wyandotte, Kan. Ac. **1**$^{2, 3}$, **2**^{2}, **3**^{6}.

Agricultural advertising. Chicago, Ill. Exp. **19***, **20, 21, 22***.

Agricultural gazette. London, England. Exp. n. s. **11-14:** P. **67+.**

Agricultural gazette of New South Wales. Sidney, Australia. Exp. **1-7, 8***, **9***, **10***, **11, 12***, **13-20, 21***, **22+:** N. D. **22+:** P. **16***, **17+.**

Agricultural journal. Tokyo, Japan. Exp. **46-57, 59+.**

Agricultural journal of India. Calcutta. Exp. **1-5***, **6**, **7***, **8+**: P. **2**, **3**.

Agricultural journal of the Union of South Africa. Pretoria. Exp. **1***, **2-4**: N. D. **1+**: P. **1***, **2**, **5***, **6***.

Agricultural news. Barbadoes, West Indies. N. D. **12+**.

Agricultural science. State College, Pa. Exp. **1-8**‖: P. 1-5.

Continued as

Agricultural science journal. State College, Pa. Exp. 2*, 3.

Aircraft. New York. Ft. W. **4+**.

Alabama. Agricultural experiment station. Auburn.

Annual report. Exp. 1+: P. **2**, **4**, **6**, **9**, **11+**.

Bulletin. D. 80, 90: Exp. 1-154, 156, 158+: P. 1-47, 49+: S. L. 149-151, 153, 154, 156-159.

Alabama. Agricultural experiment station. Uniontown.

Annual report. Exp. **1-3**, **11+**: P. 2, 3, **12**.

Bulletin. Exp. 1+: P. 1+.

Alabama. Agricultural experiment station. Tuskegee.

Bulletin. Exp. **1**, **3-16**, **18+**: P. **1**, **3-12**, **15+**.

Farmers' leaflets. Exp. 6, 8-16: P. 7, 8, 10-16.

Teachers' leaflets. Exp. 2.

Alabama. Agricultural exper ment station. Wetumpka.

Annual report. Exp. **4-6**.

Alabama. Agriculture, Department of. Auburn.

Bulletin. Exp. **'06-'08**, **'11+**.

Report of commissioner. Exp. **'92**.

Alabama. Geological survey. D. **'81-'82**.

Alabama. State veterinarian. Auburn.

Report. Exp. **2-4**: P. **1-4**.

Alaska. Agricultural experiment station. Sitka.

Annual report D. **'06+**: Exp. **'00**, **'03+**: P. **'98+**: R. P. **'06**, **'07**: S. L. **'06+**.

Bulletin. D. 2, 3: Exp. 1+: P. 1+: R. P. 1-3: S. N. '02.

A lavoura. Brazil. Exp. **11**. **4***, **5***, **6***, **10*-13***.

Albany (N. Y.), institute.

Transactions. S. L. **4**.

Alberta. Agriculture, Department of.

Annual report. S. L. **'08-'10**.

Alkaloidal clinic. Chicago, Ill. N. D. **10***, **11***, **12*+**.

Continued as **American** journal of clinical medicine *q. v.*

Amateur sportsman. New York. Exp. **45***, **46***.

American academy of arts and sciences. Boston.

Memoirs. P. **13***: R. P. n. s. **1-9**: S. L. **1-4**.

Proceedings. Ac. 34+: P. **40***, **41***: R. P. **1-7, 9-16**: S. N. **34-37**.

American academy of medicine. Easton, Pa.

Bulletin. I. U. 6+.

American agricultural association.

Journal. Exp. 1*.

American agriculturist. New York. Exp. **38-40**: M. **34-49**: S. L. **59, 60, 62, 64-94**.

American amateur photographer. New York. N. D. **19***, **20***.

Combined with **Photo** beacon *q. v.*

American analyst. New York. Exp. **5**.

American annual of photography and photographic times almanac. New York. N. D. **93-96**.

American anthropological association. New York.

Memoirs. S. L. **1, 2***.

American anthropologist. Washington, D. C.; New York. I. U. **1-11**‖; n. s. **1**+: S. L. **1-11**‖; n. s. **1**+.

American antiquarian and oriental journal. Cleveland Ohio; Chicago, Ill. Ac. **3**^{2}, **6**^{5}, **11**^{5}, **14**^{2}: S. L. **16-18**: W. **1-6**.

American antiquarian society. Worcester, Mass.

Proceedings. R. P. n. s. **1, 3***.

Transactions. S. N. **12**.

American apple growers congress. Columbia, Mo.

Transactions. Exp. **1-5**.

American architect and building news. Boston, Mass.; New York. Ft. W. **99, 101**+: G. **103**+: M. **9-12**: N. D. **93***, **94***, **95***, **96***, **97**+: R. P. **21**+.

American association for the advancement of science. Washington, D. C.

Proceedings. E. **20-25, 39, 40, 42, 43, 52, 54-62**: I. U. **2, 4, 6, 15-39, 44-50, 58**+: N. H. **2-6, 20-37, 39-48**: P. **29**+: R. P. **1-41, 43-45, 59-61**: S. L. **1-62**: S. N. **1-44**: W. **36-57**.

American association of geologists and naturalists. See **Association** of American geologists, etc.

American association of nurserymen.

Annual report. Exp. **'05-'11**.

American bee journal. Philadelphia, Pa.; Washington, D. C.; Chicago, Ill. Exp. **1-10, 24-29**.

American blacksmith. Buffalo, N. Y. Ft. W. 12+.

American botanist. Binghamton, N. Y.; Joliet, Ill. D. 1-17: N. D. 15+.

American breeders' association.

Proceedings. Exp. 3, 4: P. 1, 2, 4, 6+.

American builder and journal of art. Chicago, Ill. M. '72.

American carpenter and builder. Chicago, Ill. Ft. W. 7+: G. 7+.

American ceramic society. Columbus, Ohio.

Transactions. P. 1+.

American chemical journal. Baltimore, Md. B. 8+: D. 1+: E. 39+: I. U. 8+: N. D. 17-42, 49+: P. 1+: R. P. 17+: W. 1+.

American chemical society. New York; Easton, Pa.

Chemical abstracts. D. 1+: Exp. 2+: G. 7+: I. U. 1+: N. D. 1, 2, 6*, 7+: P. 1+: W. 1+.

Journal. D. 15+: Exp. 17*, 18*, 20*, 21*, 22*, 23*, 26*, 29+: Ft. W. 35+: G. 32+: I. U. 28+: N. D. 1, 2, 6-16, 18, 21-24, 25*, 26-30, 31*-33*, 34+: P. 1+: R. P. 15+: S. L. 21, 23+: W. 15, 16, 24+.

Proceedings. I. U. 31, 32, 34, 36+.

Review of American chemical research. N. D. 11, 12||: P. 9-12||.

Continued as **Chemical** abstracts *q. v.*

American chemist. New York. R. P. 1-7: W. 1-4.

American city. New York. Ft. W. 2+: G. 1+: I. U. 6+: M. 2+: N. D. 2+: P. 1+: S. N. 1+: T. H. 1+.

American conchology. New Harmony, Ind. N. H. 1*.

American cranberry association.

Proceedings. Exp. '06-'11.

American druggist and pharmaceutical record. New York. N. D. 41*-43*, 44, 45, 46, 47-53, 54*-59*+: P. 14+.

Continues **New** remedies *q. v.*

American electrician. New York. Ft. W. 14-17||: M. 9-14, 16, 17||: P. 8-11, 12*, 13-17||: R. P. 11-17||.

Continued in **Electrical** world *q. v.*

American electro-chemical society. Philadelphia, Pa.

Transactions. P. 1+: R. P. 3.

American engineer. Chicago, Ill. R. P. 9-21.

American engineer and railroad journal. New York. Ft. W. 81-86: N. D. 68, 69*, 79*, 80*: P. 67+: R. P. 71+.

Continues **Railroad** and engineering journal *q. v.*; **National** car and locomotive builder; **American** railroad journal *q. v.*; **Van Nostrand's** engineering magazine *q. v.*

American entomological society. Philadelphia, Pa.
Transactions. S. L. **8-34, 38***.

American entomologist. St. Louis, Mo.; New York. N. H. **1-3**‖.
Volume 2 is known as **American** entomologist and botanist.

American ephemeris and nautical almanac. See **United States**. Nautical almanac office.

American ethnology. See **United States**. Ethnology, Bureau of American.

American farmer. Baltimore, Md. S. L. **1-15**.

American farmer. Indianapolis, Ind. Exp. **24***.

American farmer's magazine. New York. S. L. **11-12**.

American fern journal. Auburndale, Boston, Mass. N. H. **1+**.

American fertilizer. Philadelphia, Pa. Exp. **1*, 2*, 3-4, 5*, 12, 13*, 14-17, 18*, 19*, 20-29, 30*, 31*, 32-38***.

American florist. Chicago, Ill. Exp. **39+**.

American florists and ornamental horticulturists. New York.
Report. Exp. **5-6, 9-11, 13-18, 20-28**.

American forestry. Washington, D. C.
D. **16-18**: Exp. **16, 17***: Ft. W. **17+**: N. H. **16+**: P. **16+**: S. L. **13+**.
Formerly **Conservation** *q. v.*

American forestry association. Washington, D. C.
Proceedings. P. **1-8**: S. L. **'82, '91, '92, '93**.

American forestry congress. Washington, D. C.
Proceedings. Exp. **'92**: P. **4**.

American fruit and nut journal. Petersburg, Va. Exp. **4*, 5, 6***.

American fruits. Rochester, N. Y. Exp. **1, 2*, 3-5, 6*, 7*, 9-11, 12***.

American garden. New York. P. **1-10**.
Continued as **American** gardening.

American gas institute.
Proceedings. P. **1+**: R. P. **2+**.

American geographical society. New York.
Bulletin. Ac. $\mathbf{34}^{1-5}$, $\mathbf{35}^{1-5}$, $\mathbf{36\text{-}40}^{1-12}$, $\mathbf{41}^{1}$: I. U. **34+**: S. N. **34+**.
Journal. Ac. $\mathbf{14}^{6}$, $\mathbf{15}^{7}$, $\mathbf{16}^{5}$, $\mathbf{17}^{1, 2, 4, 5}$, $\mathbf{18}^{2-5}$, $\mathbf{19}^{1-3}$, $\mathbf{20}^{1-4}$, $\mathbf{21}^{1-4}$, $\mathbf{22}^{1, 3, 4}$, $\mathbf{23}^{1-3}$, $\mathbf{26}^{2}$, $\mathbf{30}^{3-5}$, $\mathbf{31}^{1-5}$, $\mathbf{32}^{1-5}$, $\mathbf{33}^{1-5}$: I. U. **1-33**‖: S. N. **28-33**‖.
Continued as the Bulletin *q. v.*

American geologist. Minneapolis, Minn. B. **10-23**: E. **29-36**‖: I. U. **1-36**‖: N. D. **5***, $\mathbf{7}^{1}$, **8, 9, 10*, 11*, 12-14, 17-32, 33*, 34-36**‖: N. H. **1*, 2*, 3*, 4*, 5***: S. N. **12-36**‖: W. **11-26**.
Continued by **Economic** geology *q. v.*

American hay, flour and feed journal. New York. Exp. **3***, **7***, **8**, **9***, **11-13**, **20+**.

American health. New Haven, Conn. P. **1***, **2***.

American Hereford journal. Kansas City, Mo. Exp. **1***, **2+**.

American homes and gardens. New York. G. **7+**: L. P. **1+**: M. **1+**: R. P. **1+**: S. N. **1+**: T. H. **4+**.

Continues **Scientific** American: Building edition *q. v.*

American horticultural society. Greencastle; Indianapolis, Ind.

Transactions. Exp. **1-5**: S. L. **3**, **4**, **6**.

American horticulturist. I. U. **'85-'86**.

American institute of architects. Washington, D. C.

Proceedings. P. **23-28**, **34+**.

Quarterly bulletin. P. **10+**.

American institute of electrical engineers. New York.

Proceedings. Ft. W. **31+**: R. P. **24+**.

Transactions. P. **1-4**, **6+**: R. P. **10-21**, **28+**.

American institute of mining engineers. New York.

Transactions. R. P. **1+**.

American institute of the city of New York.

Transactions. P. **6**.

American inventor. Washington, D. C. N. D. **15***, **16***.

Absorbed **Popular** science news *q. v.*

American journal of anatomy. Baltimore, Md. F. **2**: I. U. **3+**: P. **5+**: S. N. **1+**.

American journal of archaeology. Princeton, N. J.; New York; and Norwood, Mass. D. **1-11**; II. **1+**: E. H. **1-12**, **16+**: I. U. **1-11**; II. **1+**: N. D. **1**, **2**: S. N. II. **1+**: W. **8-11**; II. **1+**.

American journal of clinical medicine. Chicago, Ill. N. D. **13*-19***.

Continues **Alkaloidal** clinic *q. v.*

American journal of conchology. Philadelphia, Pa. P. **1-7**||.

American journal of diseases of children. Chicago, Ill. I. U. **1+**.

American journal of forestry. Cincinnati, O. Ac. **1**[1].

American journal of mathematics. Baltimore, Md. D. **1-16**: B. **25+**: F. **1**, **2**: I. U. **1+**: P. **1+**: W. **15+**.

American journal of medical sciences. Philadelphia, Pa. M. **1-23**, **25-119**, **131+**: N. D. n. s. **57-64**: N. H. **4-6**; n s. **28-164**: T. H. **2-5**, **9**, **19**, **20**, **23**, **25**, **27**, **33**, **38**, **40**, **46**, **49**, **88**, **91**, **92-108**, **115-120**, **122-129**, **137+**.

American journal of microscopy and popular science. New York. Ac. **3**$^{6-12}$, **4**^{1}, **6**^{1}: D. **1**, **2**: R. P. **1-5**.

American journal of pharmacy. Philadelphia, Pa. P. **54, 55, 58+**: R. P. III. **1-18**; IV. **1, 2**.

American journal of physiology. Boston, Mass. D. **15-20**: F. **29+**: I. U. **1+**: P. **13+**: S. N. **1+**: W. **5-7**.

American journal of psychology. Baltimore, Md.; Worcester, Mass. E. **2-6, 12, 14, 16, 17**: F. **2, 3, 19+**: I. U. **1+**: P. **19+**: S. N. **1+**: W. **10-18**.

American journal of public health. New York. See **American** public health association. Journal.

American journal of public hygiene. Boston, Mass.; Columbus, O. Exp. n. s. **1*, 2*, 3-6**: P. n. s. **1-6**.

Continues as **American** public health association. Journal. *q. v.*

American journal of religious psychology. Worcester, Mass. I. U. **1+**: S. N. **1+**.

Volumes 1-4 called **Journal** of religious psychology and education.

American journal of science. New Haven, Conn. B. III. **11-16, 19-50**; IV. **1-23, 25-33**: D. **10, 11**: E. IV. **27+**: Exp. **37*, 38***: I. U. **1-10, 12, 14-50**; II. **1-50**; III. **1-50**; IV. **1-5, 7+**: N. D. **8*, 9*, 11*, 12*, 49, 50***: N. H. I. **45, 47, 49, 50**; II. **1-8, 17-20**; III. **1-12**: P. **1+**: R. P. **1+**: S. N. **100+**: W. **1-150**, n. s. **1-28**.

Called **American** journal of science and arts until 1879. Also known as **Silliman's** journal.

American journal of the medical sciences. Philadelphia, Pa.; New York. D. o. s. **38-41**; n. s. **29-36, 129-133, 135-152**: I. U. **133-138, 140+**.

American machinist. New York. Ft. W. **30+**: G. **32+**: L. P. **36*+**: M. **10+**: N. D. **22+**: P. **5-8, 10-14, 16+**: R. P. **6+**.

American mathematical monthly. Kidder; Springfield, Mo. I. U. **1+**: N. D. **4, 6, 7, 12+**: P. **1-8, 12+**: S. N. **4+**: W. **5+**.

American mathematical society. New York.

Bulletin. D. II. **1-6**: I. U. **1+**: P. II. **1+**: S. N. **1, 3+**: W. **8+**.

Transactions. I. U. **1+**: P. **1+**.

American medical association. Chicago, Ill.; Philadelphia, Pa.

Journal. Exp. **54*, 55+**: I. U. **41+**: M. **1-54, 57+**: N. H. **1-4**: P. **1-3, 9-22, 36, 38, 40+***: T. H. **1+**.

Transactions. N. H. **10, 24, 32**.

American microscopical society. Washington, D. C.; Decatur, Iowa.

Transactions. D. **30+**.

American midland naturalist. Notre Dame, Ind. E. **1**: Exp. **1+**: N. D. **1+**: P. **1, 2*+**.

American miller. Chicago, Ill. Exp. **39+**.

American monthly magazine and critical review. New York. M. **18, 20+:** N. D. **1-3.**

American monthly microscopical journal. Washington, D. C. Ac. **1-4**$^{1-12}$, **5**^{1}, **9**^{4}, **10**^{5}, **19**$^{1, 3-12}$, **20-21**$^{1-12}$, **22**$^{1-5, 7-10, 12}$, **23**$^{1-6}$: D. **1, 10-15, 18-23***, N. D. **8*-10*, 11-18, 21:** P. **2:** R. P. **1-2:** W. **1-5, 13-15.**

American museum journal. New York. N. D. **9+.**

American museum of natural history. New York.

Annual report. Ac. **'70-'89:** N. D. **40+:** S. L. **'90-'92.**

Bulletin. Ac. **1-8:** P. **8:** S. L. **2-11, 13-18.**

Memoirs. I. U. **1:** S. L. **1*, 2*, 3*, 4*.**

American national live stock association. See **National** live stock association.

American naturalist. Salem, Mass.; Philadelphia, Pa.; Boston, Mass. B. **1-6, 11-24, 26+:** D. **1-5, 20+:** E. **1-4, 7, 40+:** F. **1-4, 11-13:** I. U. **10-13, 16+:** M. **1:** N. D. **2, 6, 23, 24*, 25, 26*, 27, 28:** N. H. **1-3:** P. **1-8, 10*, 11+:** S. L. **1+:** S. N. **1-22, 24+:** W. **1+.**

American pharmaceutical association. Chicago, Ill.

Bulletin. N. D. **2-6:** P. **5+.**

Journal. N. D. **1+.**

Proceedings. I. U. **'02-'05:** N. D. **55:** P. **6, 10, 14, 15, 32+:** S. L. **1-40, 42+.**

American philosophical society. Philadelphia, Pa.

Proceedings. Ac. **27-38, 47, 48, 51-156, 157+:** Exp. **30+:** I. U. **5-36, 38:** R. P. **16-23, 27, 28:** S. L. **27-38, 47, 48, 51-156.**

Transactions. N. D. n. s. **34:** N. H. n. s. **1.**

American photography. Boston, Mass. Ft. W. **1+.**

American physical education review. Boston, Mass. G. **17+:** I. U. **1+:** S. N. **1+.**

American polytechnic journal. Washington, D. C. N. H. **1, 2, 4.**

American pomological society. Boston, Mass.

Proceedings. Exp. **15, 16, 18-20, 22-32:** P. **15, 16, 18-20, 22+.**

Bulletin. Exp. **1, 3.**

American poultry advocate. Syracuse, N. Y. Exp. **17*, 18*, 19+.**

American poultry association.

Proceedings. P. **29-33, 37.**

American public health association. New York.

Journal. Exp. n. s. **1+:** F. n. s. **1:** P. n. s. **1+:** S. L. n. s. **2+.**

Formerly **American** journal of public hygiene *q. v.*

Papers and reports. S. L. **1-2, 4-36.**

American quarterly microscopical journal. New York. R. P. **1-3.**

American railroad journal. New York. N. H. **1-6: S. L. 1-6.**

Continued in **American** engineer and railroad journal *q. v.*

American railway bridge and building association.

Proceedings. P. **18+.**

American railway engineering and maintenance of way association. Chicago, Ill.

Bulletin. P. **'02*+.**

Proceedings. P. **1+.**

American railway master mechanics' association. New York.

Annual report. Ft. W. **2-17.**

Proceedings. P. **1-5, 8-17, 20+.**

American road builders' congress.

Reports. P. **1.**

American sheep-breeder and wool-grower. Chicago, Ill. Exp. **30*, 31+:** P. **25+.**

American society for psychical research. Boston, Mass.

Journal. S. N. **1, 2, 4+.**

Proceedings. I. U. **1*:** S. N. **1+.**

American society for testing materials.

Proceedings. P. **1+:** R. P. **2-8.**

American society of agricultural engineers.

Transactions. P. **1+:** R. P. **1+.**

American society of agronomy.

Proceedings. P. **1+.**

American society of civil engineers. New York.

Proceedings. Ft. W. **33+:** P. **3-6, 12-17, 22.**

Transactions. G. **66+:** P. **6-67:** R. P. **43, 44, 60+:** S. L. **2, 29, 30, 49, 52, 54.**

American society of heating and ventilating engineers. New York.

Transactions. P. **1+.**

American society of mechanical engineers. New York.

Journal. G. **34+:** N. D. **32-34.**

Transactions. G. **31+:** N. D. **17, 18:** P. **1+:** R. P. **1+.**

American society of municipal improvements. Cincinnati, O.

Proceedings. P. **14.**

American stock journal. New York. S. L. **1, 2.**

American street railway association. Brooklyn, N. Y.

Report. P. **4-24.**

American sugar industry and beet sugar gazette. Chicago, Ill. Exp. **6*, 7, 8, 9*, 10-12, 13*, 14+**.

American swineherd. Chicago, Ill. Exp. **26, 27, 28*, 29+**.

American telephone journal. New York. P. **5*, 6-18**.

Continued in **Telephony** *q. v.*

American veterinary medical association. St. Paul, Minn.

Proceedings. Exp. **'90-'93, '96+**.

American veterinary review. New York. Exp. **12, 14+**.

American water works association. New York.

Proceedings. P. **18+**.

American wool and cotton reporter. Boston, Mass. Exp. **25*, 26+**.

Analyst (Chem.). London, England. Exp. **13*, 14, 15*, 16-21, 22***; I. U. **1-10**: P. **8+**.

Analyst (Math.). Des Moines, Ia. I. U. **1-10**: P. **1-10**.

Continued as **Annals** of mathematics *q. v.*

Anatomical record. Philadelphia, Pa. I. U. **1+**: P. **1+**: S. N. **1+**.

Anatomischer Anzeiger. Jena, Germany. B. **13-33, 35*, 36*, 37*, 38*, 39*, 40***: I. U. **1-38, 40+**.

Ancona world. Franklinville, N. Y. Exp. **1*-4***.

Annalen der Chemie und Pharmacie (Liebig). Heidelberg; Leipzig, Germany. D. **1+**: Exp. **1-236, 241-300**: P. **293, 295, 297, 299, 301-316, 321+**: W. **285-350**.

Supplement. D. **1-8**: Exp. **1-8**.

Annalen der Physik und Chemie. Halle; Leipzig, Germany. I. U. n. s. **48-72**; IV. **1+**: N. D. **'09+**: P. III. **1+**: S. L. **37+**: W. **16+**.

Beiblatter. I. U. **17+**: N. D. **'09, '10**: P. **31+**.

Annales de chimie et de physique. Paris, France. B. **7-9**: I. U. VI. **28, 30**; VII. **2-30**; VIII. **1+**: N. D. VII. **16-19, 20-30**; VIII. **1-4, 5*-7***.

Annales de géographie. Paris, France. I. U. **7+**: S. N. **8+**.

Annales de la science agronomique française et étrangère. Paris, France. Exp. o. s. **'89, '90**; II. **'03-'05**.

Annales de paléontologie. Paris, France. I. U. **1+**.

Annales des ponts et chaussées. Paris, France. R. P. VI. **15+**.

Annales des sciences naturelles: botanique. Paris, France. Exp. VII. **7, 8**: I. U. VII. **7, 9-20**; VIII. **1-22**; IX. **1+**: W. VII. **19, 20**; VIII. **2-14**.

Annales des sciences naturelles: zoologie et paléontologie. Paris, France. I. U. **7, 8**.

Annales historico-naturales musei nationalis hungarici. Budapest, Hungary. Ac. **1+**.

Annales mycologici. Berlin, Germany. Exp. **1-2, 9+**.

Annales scientifiques de l'école normale supérieure. Paris, France. I. U. I. **1-7**; II. **1-12**; III. **1+**.

Annali della regia scuola superiore di agricoltura in Portici. Naples, Italy. Exp. II. **2-4, 9.**

Annali di botanica. Rome, Italy. N. D. **10+**.

Annali di mathematica pura et applicata. Rome; Milan, Italy. I. U. III. **17+**.

Annals and magazine of natural history. London, England. I. U. VII. **6, 9, 10, 17.**

Annals of botany. London, England. D. **1-7, 14, 17+**: I. U. **1+**: P. **1+**: S. N. **1+**: W. **7.**

Annals of hygiene. Philadelphia, Pa. M. **8.**

Annals of mathematics. Charlotteville. Va.; Cambridge, Mass. D. **1-6**: I. U. o. s. **1-12**; n. s. **1+**: P. H. **1+**: R. P. **1+**: W. **1-12**, n. s. **1+**.
Continues **Analyst** (math.) *q. v.*

Annals of nature and Annual synopsis of new genera and species of animals, plants, etc. Lexington, Ky. N. D. **1**‖.

Annals of science. Cleveland, O. R. P. **1, 2.**

Année biologique. Paris, France. I. U. **1+**.

Année psychologique. Paris, France. I. U. **1+**.

Année scientifique. Paris, France. N. D. **1-9.**

Année sociologique. Paris, France. I. U. **1+**.

Annual of scientific discovery. Boston, Mass. D. **'50-'62, '65, '68-'71**: I. U. **1-6, 10, 16-19, 21**: N. H. **'50-'54, '56, '57, '60, '64, '66-'69, '71**: R. P. **'50-'70**: W. **'51-'70.**

Annual record of science and industry. New York. D. **'71-'73**: N. H. **'71, '72**: W. **'71-'76.**

Annual register. London, England. N. H. **1-153.**

Annual report on the progress of chemistry. B. **5-7**: P. **1+**: W. **1-8.**

Anthropological institute of New York.
Journal. S. L. **1, 2.**

Anthropos. Vienna, Austria. I. U. **6+**.

Aquila. Budapest, Hungary. N. D. **'12+**.

Arbeiten aus der kaiserlichen Gesundheitsamte. Berlin, Germany. I. U. **24-37, 39.**

Arboriculture. Chicago, Ill.; Indianapolis; Connersville, Ind. Exp. **1***, **2, 3, 4***, **5***, **6, 7***, **8**‖: L. P. **2***: P. **1-8**‖.

Architects' and builders' magazine. New York. Ft. W. o. s. 42: G. o. s. 44+: N. D. 3*, 38*-43*.
Continues as **Architecture** and building.

Architectural record. New York. Ft. W. 13+: G. 25+: M. 1+: N. D. 19*-21*, 25*-32*: P. 23+: R. P. 31+: S. N. 1+.

Architectural review. Boston, Mass. G. n. s. 1+: N. D. 11*-17*, 18+.

Architectural review and American builders journal. Philadelphia, Pa. N. H. 1.

Archiv der Mathematik und Physik. Leipsig, Germany. I. U. 1-70; II. 1-17; III. 1+: P. 9+.

Archiv der Pharmacie. Berlin, Germany. I. U. 236, 238+.

Archiv für Anatomie und Physiologie. Leipzig, Germany. I. U. 1+.

Archiv für die gesammte Physiologie des Menschen und der Thiere. Bonn, Germany. D. 27, 28: I. U. 1+: P. 106+.

Archiv für die gesammte Psychologie. Leipzig, Germany. I. U. 1+.

Archiv für Entwicklungsmechanik der Organismen. Leipzig, Germany. I. U. 1+.

Archiv für mikroskopische Anatomie und Entwickelungsgeschichte. Bonn, Germany. I. U. 1+.

Archiv für pathologische Anatomie und Physiologie und für klinische Medicin. Berlin, Germany. I. U. 1+.

Archiv für Rassen und Gesellschaft-Biologie. Berlin, Germany. I. U. 1+.

Archiv für Sozialwissenschaft und Sozialpolitik. Tübingen, Germany. I. U. 32+.

Archiv für Zellforschung. Leipzig, Germany. I. U. 5+.

Archives de Biologie. Ghent, Belgium; Paris, France. I. U. 11, 12, 18, 21*.

Archives de medicine experimentale. Paris, France. I. U. 18+.

Archives de parasitologie. Paris, France. I. U. 10-11, 13+.

Archives de zoologie experimentale et generale. Paris, France. I. U. II. 9, 10.

Archives of comparative medicine and surgery. New York. Exp. 1.

Archives of internal medicine. M. 3-5.

Archives of neurology and psychiatry. London, England. I. U. 1+.

Archives of philosophy, psychology and scientific methods. New York. I. U. 1.

Archives of psychology. New York. I. U. 1+.

Archives of scientific and practical medicine. Philadelphia, Pa. D. 1*||.

Arizona. Agricultural experiment station. Tucson.

Annual report. Exp. 1, 2, 6+: P. 1, 2, 6+: S. L. '09.

Bulletin. D. 34: Exp. 1+: P. 1-39, 41+: S. L. '10+.

Arizona. Horticultural commission.

Annual report. P. 1+.

Arkansas. Agricultural experiment station. Fayetteville.

Annual report. Exp. **1+**: P. **2, 3, 17, 20+**.

Bulletin. Exp. **1+**: P. **1+**.

Arkansas. Geological survey. Little Rock.

Annual report. I. U. **'57-'60, '88-'92**: N. H. **'88**: P. **88-92***: R. P. **'88-'90**: S. N. **'92, '09.**

Report of a geological reconnaissance of the northern counties. N. H. **1, 2.**

Arkansas (State) horticultural society. Little Rock.

Annual report. Exp. **24, 29+**.

Arkiv för botanik. Stockholm, Sweden. N. D. **8+**.

Arkiv för zoologi. Stockholm, Sweden. N. D. **5+**.

Art amateur. New York. M. **7-11, 24, 25**: N. D. **15, 16*, 17-21, 24-30, 35-38**: P. **3-30**: R. P. **17-45**: S. N. **36-48.**

Art interchange. New York. M. **18-23, 39-51.**

Art journal. London, England. P. **4-6.**

Asiatic society of Bengal. Calcutta, India.

Proceedings. Ac. **'85**$^{1-4,\ 6-10}$, **'86**$^{1-4,\ 6,\ 8-10}$, **'87**$^{1-10}$, **'88-'91**, **'92**$^{1-9}$, **'93**$^{2-6,\ 8-10}$, **'94**$^{1-10}$, **'95, '96, '97**$^{1-4,\ 9-11}$, **'98**$^{1-11}$, **'99, '00**$^{1-4}$.

Asiatic society of Japan. Tokio.

Transactions. R. P. **7*, 8*.**

Association française pour l'advancement des sciences. Paris, France. N. D. **'87.**

Association géodésique internationale.

Comptes rendus des séances de l'association.

R. P. **'93+**.

Association of American agricultural colleges and experiment stations.

Proceedings. Exp. **'10+**: P. **2+**.

Association of American geologists and naturalists.

Reports. S. L. **1-3.**

Association of American medical colleges.

Proceedings. I. U. **8, 18+**.

Association of American Portland cement manufacturers. Philadelphia, Pa.

Bulletin. Exp. **10, 18-23, 25+**.

Association of engineering societies. Boston, Mass.

Journal. P. **1+**: R. P. **1+**.

Associazione elettrotecnica italiana. Milan, Italy.
  Atti. P. **1-7.**

Astronomical journal. Boston, Mass.; Albany, N. Y. D. **7+**: I. U. **2+**: W. **13-21.**

Astronomical society of the Pacific. San Francisco, Cal.
  Publications. I. U. **1+.**

Astronomie. Paris, France. I. U. **1-4.**

Astronomische Nachrichten. Kiel, Germany. D. **113-138**: I. U. **55-58, 107, 111, 118, 121-122, 124+.**

Astronomy and astro-physics. Northfield, Minn. D. **11-13**: I. U. **11-13**: W. **11-13.**
  Continues **Siderial** messenger *q. v.* Continued as **Astrophysical** journal *q. v.*

Astrophysical journal. Chicago, Ill. D. **1+**: B. **2-6, 11+**: I. U. **1+**: N. D. **1*, 2, 3*, 24*, 26***: P. **7, 19-27, 29+**: W. **1-6, 17+.**
  Continues **Astronomy** and astrophysics *q. v.*

Atlantic deeper waterways association.
  Proceedings. P. **1-3, 5+.**

Atlantic journal and friend of knowledge. Philadelphia, Pa. N. D. **1.**

Augustana college. Rock Island, Ill.
  Library publications. P. **4-6.**

Auk. Cambridge, Mass.; New York. Ac. **26**[1]: E. **22, 25, 26, 28, 29.**

Australian association for the advancement of science. Sidney, Australia.
  Report. Ac. **7-12.**

Automobile. New York. P. **12+.**

Automobile trade journal. Philadelphia, Pa., P. **9+.**

Ayrshire breeders' association.
  Report. Exp. **'11.**
  Yearbook. Exp. **'11, '13.**

Bacteriological world and modern medicine. Battle Creek, Mich. N. D. **1*.**

Baltimore (Md.). See **Johns** Hopkins hospital; **Johns** Hopkins university.

Barrels and bottles. Indianapolis, Ind. Exp. **10, 11*, 12+.**

Baumaterialienkunde. Stuttgart, Germany. P. **3*, 4, 5, 10-12.**

Bayerische Academie der Wissenschaften. See **Koniglich** bayerische, etc.

Beet sugar gazette. Chicago, Ill. Exp. **1*, 2-3*, 4*.**

Beiträge zur Biologie der Pflanzen. Breslau, Germany. Exp. **1-4.**

Beiträge zur kenntniss der Baumkrankheiten. Berlin, Germany. Exp. **'88.**

Beiträge zur Mykologie. Frankfort, Germany. Exp. **'50-'63.**

Beiträge zur Psychologie und Philosophie. Leipzig, Germany. I. U. **1+.**

Belfast natural history and philosophical society. Belfast, Ireland.

Report. Ac. **'85-'88, '96-'01, '04-'06, '08-'10:** N. D. **'11.**

Berliner astronomisches Jahrbuch. Berlin, Germany. I. U. **'34-'36, '73, '03, '04.**

Berliner klinische Wochenschrift. Berlin, Germany. I. U. **43+.**

Better farming. Chicago, Ill. Exp. **32, 33*, 34+.**

Better fruit. Hood River, Ore. Exp. **1+:** P. **2+.**

Bibliographia physiologica. Vienna, Austria. I. U. III. **1+:** P. **1+.**

Bibliographia zoologica. Leipzig, Germany. I. U. **1-17, 19+.**

Bibliographie geographique annuelle. I. U. **7+.**

Biltmore (N. C.) botanical studies. N. D. **1+.**

Biochemical bulletin. New York. P. **1+.**

Biochemisches Centralblatt. Berlin; Leipzig, Germany. I. U. **4+.**

Biological bulletin. Woods' Hole, Mass. D. **1+:** F. **18-20:** I. U. **1+:** P. **14+:** S. N. **1+:** W. **4+.**

Continues **Zoological** bulletin *q. v.*

Biological society of Washington, (D. C.).

Proceedings. Ac. **1-23*:** I. U. **1.**

Biologisches Centralblatt. Leipzig, Germany. D. **1-30;** I. U. **1+.**

Biologisches Gesellschaft. Christiana, Norway.

Mitteilungen. N. D. **18*.**

Biometrika. Cambridge, England. Exp. **8+:** I. U. **1+.**

Bird lore. Harrisburg, Pa.; New York. E. **1+:** Exp. **1, 2:** F. **12+:** G. **1-3, 4-6, 8, 12+:** M. **12+:** T. H. **9+:** W. **3+.**

Birds and nature. Chicago, Ill. I. U. **1-14:** L. P. **1+:** N. H. **1-16:** S. N. **1-21.**

Blätter für aquarien und terrarien kunde. Magdeburg, Germany. N. D. **24.**

Bollettino della arboricultura italiana. Exp. **5*, 6, 7:** N. D. **5+.**

Boston (Mass.). See **American** academy of arts and sciences.

Boston (Mass.) cooking school magazine. G. **15*, 16+:** P. **18+.**

Boston (Mass.) journal of natural history. R. P. **1-6:** S. L. **2-6.**

Boston (Mass.). Metropolitan water and sewerage board.

Annual report. P. **1-9, 11+.**

Boston mycological club. Cambridge, Mass.

Bulletin. N. D. **3-21.**

Boston society of natural history. Boston, Mass.

Memoirs. Ac. **5**[4]: I. U. **4*:** R. P. **'62-'69.**

Proceedings. Ac. **31**[6], **34**[7]: I. U. **26-33:** R. P. **'34-'57.**

Boston (Mass.). Transit commission.
Annual report. R. P. **5, 8, 10+**.

Boston (Mass.). Water board.
Annual report. P. **16, 17, 19.**

Botanical gazette. Crawfordsville; Bloomington, Ind.; Chicago, Ill. Ac. 14^{1-10}: B. **26-50**: D. **12+**: E. **13-30, 33+**: F. **10-13, 27-32, 53+**: I. U. **13+**: M. **49-52**: N. D. **9*-11*, 12-18, 24*-26*, 27, 28*, 30, 31*, 32, 34*, 42*, 46*, 49*, 55+**: P. **1+**: S. L. **4-13, 15+**: S. N. **1, 2, 4, 6, 8+**: W. **1+**.

Botanical journal. London, England. Ac. 2[illegible], **3+**.

Botanical magazine. London, England. See **Curtis's** botanical magazine.

Botanical magazine. Tokyo, Japan. Exp. **24, 25**: N. D. **12, 13, 15, 18, 27.**

Botanical society of Edinburgh, Scotland.
Transactions. Ac. 22^{1-3}, 23^{1-4}, 24^{1}, **25+**.

Botanische veveening. Nijmegen, Holland. N. D. **'13+**.

Bontanische Zeitung. Berlin; Leipzig, Germany. Exp. **34, 35, 44, 46, 48-65, 67, 68**: I. U. **1-16, 19+**: W. **51-59.**

Botanischer Jahresbericht (Just's). Berlin, Germany. D. **1-32**: Exp. **1-9, 14-17**: W. **1-20.**

Botanischer Verein der Provinz Brandenburg. Berlin, Germany.
Verhandlungen. Ac. **36+**.

Botanisches Centralblatt. Jena, Germany. D. **1+**: Exp. **1-88**: I. U. **1+**: W. **49-60, 89+**.
Beihefte. D. **1+**: Exp. **1-9, 21-28**: I. U. **6-7, 9+**.

Botanisches Institut. Würzburg, Germany.
Arbeiten. Exp. **1, 2.**

Botanisches Staats-Institut. Hamburg, Germany.
Mitteilungen. N. D. **23+**.

Botaniska notiser. Lund, Sweden. N. D. **'09+**.

Brain. London, England. I. U. **12-14, 17+**: S. N. **13, 15+**.

Braithwaite's retrospect of practical medicine and surgery. New York. D. **1, 3-47, 85-87**: N. H. **'84*, 106.**

Brazil. See **Museu** Goeldi.

Breeder's gazette. Chicago, Ill. D. **55**: Exp. **27*, 42*, 43, 44*, 45, 46, 49*, 50*, 51*, 52*, 53, 54, 55*, 56*, 57+**: N. H. **58+**: P. **1+**: S. L. **1-52.**

Brickbuilder. Boston, Mass. G. **18+**: N. D. **13*, 14*, 17*, 18*, 19+**: R. P. **9+**.

Bristol (England) naturalists' society.
Proceedings. Ac. $1^{2,3}$, 2^{1-3}, 3^{1}.

British and foreign medico-chirurgical review. London, England.
Report. N. H. **1-56.**

British annual and epitome of the progress of science. London, England. N. H. **'38.**

British association for the advancement of science. London, England.
Report. N. H. **54-56**: R. P. **'31+**: S. L. **1-59.**

British astronomical association. London, England.
Journal. I. U. 1+.
Memoirs. I. U. **11, 14, 16-17.**

British Columbia. Agriculture, Department of. Victoria.
Annual report. Exp. **'95, '96, '02+**: P. **'94.**
Bulletin. Exp. 11-15, 17, 18, 26, 27, 30, 32, 37-40, 44+: P. 26, 30, 37-40, 42, 44, 45, 47, 49+.

British Columbia dairymen's association. Victoria.
Report. Exp. **'06**: P. **'12.**

British Columbia farmers' institutes. Victoria.
Annual report. Exp. **'00-'03, '05, '09, '11**: P. **'12.**

British Columbia fruit-grower's association. Victoria.
Report. Exp. **'10**: P. **'10, '12.**

British Columbia. Mines, Department of.
Annual report. S. L. **'96-'98, 1900-'04.**

British Columbia poultry association. Victoria.
Report. Exp. **'10.**

British Columbia stock breeders' association.
Annual report. P. **'09.**

British journal of psychology. Cambridge, England. P. 2+.

British journal of tuberculosis. London, England. S. L. 2+.

British medical journal. London, England. I. U. **'06+**: T. H. **'09+.**

British patents, Abridgements of. R. P. **1558+.**

Brooklyn (N. Y.) institute of arts and sciences. Museum.
Science bulletin. N. D. 1+.

Broteria. Revista de sciencias naturaes do collegio de San Fiel. Lisbon, Portugal. N. D. 1+.

Brown university. Providence, R. I. Biological laboratory. Studies. I. U. 1+.

Brussels (Belgium). L'agriculture, Administration de.
Bulletin. Exp. o. s. **18*-23***; n. s. **1*-3*.**

Brussels (Belgium) jardin botanique de l'etat.
Bulletin. N. D. 3+.
Conspectus florae africae. N. D. **1, 5.**

Brussels (Belgium). Observatoire royal de Belgique.
Annales physique. Ac. **3**[1].
Annales astronomique. Ac. **9**[1], **11**[1]: I. U. **1***, **13***: S. L. **6.**

Bryn Mawr (Pa.) college.
Monographs. Ac. **1**[2-4], **5-7, 9**: N. D. reprint ser. **9**+.

Bryologist. Brooklyn, N. Y. N. D. **13**+.

Budapest (Hungary). See **Magyar** botanikai Lapok; **Magyar** Kiralyi termeszet tudományi társulat; **Magyar** madártani központ folyöirata; **Magyar** nemzeti múzeum.

Buenos Aires (Argentine Republic). See **Museo** de la Plata; **Museo** nacional; **Sociedad** cientifica Argentina.

Buenos Aires (Argentine Republic) universidad.
Anales. P. **1-3, 6-15.**

Buffalo society of natural sciences. Buffalo, N. Y.
Bulletin. Ac. **1-4, 5**[1, 2, 5], **6, 9**[3]: Exp. **5***, **6***: P. **1, 2.**

Builder and woodworker. New York. N. H. **18.**

Building age. New York. Ft. W. **32**+: G. **32**+.
Continues **Carpentry** and building *q. v.*

Building management. Chicago, Ill. G. **10**+.

Building progress. N. D. **1*-3***, **4**+.

Buitenzorg (Java). Jardin botanique.
Annales. (Botanical and zoological parts). I. U. II. **1**+.

Bulletin astronomique de l'observatoire de Paris (France). I. U. **14-28**: W. **15-17.**
Continues astronomical section of **Bulletin** des sciences mathematiques et astronomiques *q. v.*

Bulletin des sciences mathématiques et astronomique. Paris, France. I. U. **1-11**; II. **1**+.
Since 1884 the astronomical portion has been published as a separate serial. See **Bulletin** astronomique.

Bulletin of American paleontology. Ithaca, N. Y. I. U. **1, 4.**

Bulletin of pharmacy. Detroit, Mich. N. D. **16*-20***, **23, 24***, **25, 26***, **21***: P. **14**+.

Butchers' and packers' gazette. St. Louis, Mo. Exp. **103***, **104***, **105**+.

Butter, cheese and egg journal. Milwaukee, Wis. Exp. **2***, **3**+.

California academy of sciences. San Francisco, Cal.

Bulletin. Ac. 1[4], 2[5–8].

Occasional papers. Ac. 1-9: I. U. 1, 5.

Proceedings. Ac. II. 1[1, 2], 2, 3[1, 2], 4[1, 2], 5[1, 2], 6; III. bot. 1[1–10], 2[1–11]; geol. 1[1–10], 2[1, 2]; math. and phys. 1[1–8]; zool. 1[1–12], 2[1–11], 3[1–13], 4[1–3]; IV. 1, 3: I. U. II. 5, 6; III. bot. 1+, geol. 1+, zool. 1+: N. D. IV. 1+.

California agricultural experiment station. Berkeley.

Annual report. D. '97-'98: Exp. '88-'04: P. '88-'04.

Bulletin. D. 107, 160, 165, 170, 171: Exp. 3-49, 51-61, 63+: P. 83+.

Reports of the viticultural work. D. '87-'93: Exp. '83-'95: P. '83-'95.

California agricultural experiment station. South Pasadena.

Bulletin. Exp. 2-3, 5-10, 13.

California (state) agricultural society.

Transactions. P. '00, '01, '05-'08, '10-'12. S. L. '58+.

California association of nurserymen.

Transactions. P. 1+.

California conservation commission. Sacramento.

Report. N. D. '12+.

California cultivator. Los Angeles. Exp. 34*, 35*, 36*, 37+.

California dairy association. San Francisco.

Proceedings. Exp. '98.

California. Forestry, State board of.

Biennial report. P. 3.

Bulletin. P. 1.

California fruit growers' convention.

Proceedings. P. 18, 19, 28, 29, 35+.

California. Geological survey.

Report. E. 1, 2.

California. Health, State board of.

Biennial report. P. '84-'96, '98-'10.

Monthly bulletin. P. 5-7.

California. Horticulture, State board of. Sacramento.

Annual report. Exp. '89-'92.

Biennial report. Exp. '85-'86, '93-'98, '01-'02: P. '93-'94.

Bulletin. Exp. 57, 58, 63-67.

Transactions. Exp. '93.

California. Horticulture, State commissioner of.

Biennial report. Exp. '03-'06, '11+: P. '05-'08, '11, '12.

Monthly bulletin. Exp. 1+.

California (State) medical society.
Transactions. N. H. **'72.**

California railroad commission. Sacramento.
Report. N. D. **'12+.**

California registration board.
Report. Exp. **'12.**

California (state) university chronicle. Berkeley. P. **11+.**

California (state) university. Geology, Department of. Berkeley.
Bulletin. Ac. $1^{5-11, 14}$: Exp. **14:** I. U. **1+.**

California (state) university. Lick observatory. Mt. Hamilton.
Bulletin. I. U. **1-4.**
Publications. I. U. **1-3, 5, 8:** N. D. **1-3.**

California (state) university. Physiology, department of. Berkeley. Ac. 3^{14-17}, $4^{1-13, 16, 17}$: I. U. **1+.**

California (state) university. Publications. Berkeley.
Agricultural sciences. Exp. **1*.**
Botany. N. D. **1, 2*, 3*, 4*, 5+.**

California. Ventura county horticultural commissioner. Santa Paula.
Bulletin. Exp. **1, 2.**

California (state) water commission. Sacramento.
Report. N. D. **'12+.**

Camera. Philadelphia, Pa. G. **17+.**

Canada. See also **Alberta; Manitoba; Nova Scotia, Ontario; Prince Edward Island; Quebec; Saskatchewan; Western Canada.**

Canada. Agriculture, Department of. Ottawa.
Bulletins of the central experimental farms. Exp. 1-7, 9-22, 24-29, 31-34, 36-66, 68+: H. 5, 7, 9, 10, 12+: P. 3-6, 11, 12, 14, 16-29, 31-34, 36-66, 68+.
Reports. Exp. **'89-'07, '09+:** P. **'86, '88+.**

Canada. Agriculture, Minister of. Toronto.
Annual report. Exp. **1, 2.**

Canada. Conservation, Commission of. Ottawa.
Report. Exp. **'10, '12+:** P. **1+:** S. L. **'10+.**

Canada. Dairy and cold storage commissioner's branch. Ottawa.
Annual report. Exp. **'06, '07, '09-11:** P. **'06, '10, '11.**
Bulletin. Exp. o. s. 4, n. s. 2, 3, 6, 12, 13, 15, 18, 20, 24, 25, 38: P. n. s. 7, 12, 18, 23, 25, 28, 30.

Canada. Entomologist, Dominion. Ottawa.
Reports. Exp. **'10+.**

Canada. Forestry and irrigation. Superintendent of.

Report. P. **'09-'10.**

Canada. Game commissioners. Toronto.

Report. Exp. **'06.**

Canada. Geological survey.

Annual report. I. U. n. s. **2, 5-16**: N. D. **'04-'11**: P. n. s. **1+**: R. P. **'47-'58**: I. N. **1-7, 9**: S. L. **'63-'08.**

Catalogue of Canadian plants. S. N. **7.**

Contributions to paleontology. N. D. **3+**: S. L. **1*, 2*, 3*, 4*.**

Memoirs. N. D. **1-17, 21, 24, 27, 28, 33, 35+**: S. L. **1+.**

Report of progress. P. **20-27.**

Canada. Geological and natural history survey.

Summary reports. P. **'85-'87, '89, '91, '05, '06.**

Canada good roads association. Toronto.

Report. Exp. **'94.**

Canada horticultural societies of Ontario. Toronto.

Report. Exp. **'06+**: P. **'06+.**

Canada. Horticulturist, Dominion. Ottawa.

Report. Exp. **'10.**

Canada. Inland revenue department, Laboratory of. Ottawa.

Bulletin. Exp. 54-60, 65-71, 82, 83, 85, 95, 97-100, 108, 109, 112, 113, 153, 159, 175, 182, 222.

Report. Exp. **'09.**

Canada. Interior, Department of.

Report of the chief astronomer. I. U. **'05, '09.**

Canada. Interior, Department of. Forestry branch. Ottawa.

Bulletin. Exp. **2-9, 13, 14, 16-31, 33+**: P. **1+.**

Report. Exp. **'96*-'09*, 11*, 12+.**

Canada. International commission on the control of bovine tuberculosis. Ottawa.

Annual report. Exp. **'10.**

Canada. Live stock commissioner. Ottawa.

Bulletin. Exp. **7-9, 11+.**

Canada. Meteorological service.

Annual report. R. P. **'88-'90, '95-'05.**

Canada. Mines, Department of.

Bulletin. S. L. **'09+.**

Report. S. L. **'06-'11.**

Canada. Patent office.

Record. R. P. **24+**.

Canada poultry institutes. Guelph.

Report. Exp. **1-4.**

Canada provincial instructor in road making. Toronto.

Annual report. Exp. **'96-'08.**

Bulletin. Exp. 1, 2.

Canada. Veterinary director-general and live stock commissioner. Ottawa.

Report. Exp. **'07, '08, '10, '11.**

Canada woman's institute. Toronto.

Report. Exp. **'06, '07, '08***, **'09, '10, '11***, **'12+**.

Canada year books. Exp. **'05-'09.**

Canadian department of mines. Ottawa.

Memoirs of geological survey. N. D. **1-17, 21, 24, 27, 28, 33, 35+**.

Canadian entomologist. Toronto; London, Ontario. D. **24-30***: Exp. **21***: P. **39+**: S. N. **21-29.**

Canadian forestry association.

Report. P. **11+**.

Canadian institute. Toronto.

Annual report. Ac. **'86-'91.**

Proceedings. Ac. III. $\mathbf{3}^{2-4}$, $\mathbf{4}^{1, 2}$, $\mathbf{5}^{1, 2}$, $\mathbf{6}^{1, 2}$, $\mathbf{7}^{1}$: n. s. $\mathbf{1}^{1-6}$, $\mathbf{2}^{1-6}$.

Transactions. Ac. $\mathbf{1}^{1, 2}$, $\mathbf{2}^{1, 2}$, $\mathbf{4}^{2}$, $\mathbf{5}^{1, 2}$, $\mathbf{6}^{1, 2}$, $\mathbf{7}^{1-3}$, $\mathbf{8}^{1-4}$, $\mathbf{9}^{1}$.

Canadian record of science. Montreal, Can. Ac. $\mathbf{1}^{3, 4}$, $\mathbf{2}^{1-3, 5, 6}$: I. U. **7-8.**

Canadian science monthly. Kentville, N. S. Ac. $\mathbf{3}^{6, 8-11}$.

Canadian seed growers' association. Ottawa.

Report. Exp. **'04+**: P. **'04+**.

Canal record. (Isthmian canal.) Ancon, Canal Zone. P. **1+**.

Cape of Good Hope. Entomologist report, Government. Cape Town.

Annual report. Exp. **'95-'98.**

Cape of Good Hope agricultural journal. P. **27-29, 37+**.

Cape of Good Hope. Royal observatory.

Report. S. L. **'09+**.

Carnegie institution of Washington (D. C.).

Publications. D. **15**: I. U. **1-19, 21-54, 56-62, 64-79, 81-85, 87-149, 152-158, 160-162, 166, 167, 171, 174, 176+**: N. D. **1+**.: P. **4+**: S. N. **12, 18, 19, 23, 30, 36, 37, 47, 49, 50, 51, 58, 64, 67, 70, 82, 94, 95, 98, 99, 112, 114, 117.**

Year-book. P. **1+**.

Carnegie institution. Marine biological laboratory. Tortugas, Fla.
Papers. S. N. **1, 2.**

Carnegie institute. Pittsburg, Pa.
Annals. Ac. **'01+**: I. U. **1+**: N. D. **1*, 3*, 4*, 5*.**
Annual report. Ac. **'98+**: I. U. **1+**: P. **1+**: W. **1+**.
Celebration of founder's day. Ac. **'98-'00, '02-'05, '07+**: I. U. **1+**.
Memoirs. Ac. **1, 2,** 3^1, 4^{1-7}: I. U. **1+**.
Prize essay contest. Ac. **'99-'04**: I. U. **1+**.

Carpentry and building. New York. Ft. W. **31**||.
Continued by **Building** age *q. v.*

Carlson's breeders' review. Norfolk, Neb. Exp. **1*, 2+**.

Cassier's magazine. New York. F. **39+**: Ft. W. **19, 21+**: G. **35+**: I. U. **28-30**: L. P. **18-26**: M. **41+**: P. **4+**: R. P. **5-33, 36+**: S. N. **13+**: T. H. **7+**.

Cattle specialist. Waukesha, Wis. Exp. **2*, 3***^{6}

Cellule. Lierre, Belgium. I. U. **22+**: N. D. **1+**.

Cement age. New York. N. D. **2*, 7*.**
Continues as Concrete-cement age *q. v.*

Cement era. Chicago, Ill. N. D. **5*.**

Cement world. Chicago, Ill. N. D. **1*, 2*, 3, 4, 5*, 6**: R. P. **2+**.

Central Park menagerie. New York.
Reports. Ac. **'88-'90.**

Central railway club. Buffalo, N. Y.
Proceedings. P. **2+**.

Central states medical monitor. Indianapolis, Ind. P. **5-11*.**

Centralblatt für allgemeine und experimentale Biologie. I. U. **1+**.

Centralblatt für agrikultur Chemie (Biederman). Leipzig, Germany. Exp. **16*, 17-19, 20*.**

Centralblatt für Bakteriologie. Parasitenkunde und Infektionskrankheiten. Jena, Germany. P. **36+**.
Erste Abtheilung. Exp. **1-18**: I. U. **1-30**.
After 30 issued in two series, Referate and Originale.
Referate. Exp. **46+**: I. U. **31-56, 60, 62, 63, 65+**: P. **36+**.
Originale. Exp. **53+**:
Zweite Abtheilung. Exp. **2+**: I. U. **1-20, 22-29, 31+**.

Centralblatt für Electrotechnik. Munich, Germany. R. P. **7-10.**

Centralblatt für Mineralogie, Geologie und Palaeontologie. Stuttgart, Germany. I. U. **1-12.**
A supplement to **Neues** Jahrbuch für Mineralogie *q. v.*

Centralblatt für normale Anatomie und Mikrotechnik. Berlin, Germany. I. U. **1+.**

Centralblatt für Physiologie. Berlin; Leipzig, Germany. P. **19+**: W. **6.**

Charleston (S. C.) museum.

Bulletin. N. D. 8+.

Chemical abstracts. See **American** chemical society.

Chemical engineer. Philadelphia, Pa.; Chicago, Ill. E. **11+**: N. D. **1*, 4-6, 10*, 16*, 17+**: P. 1+.

Chemical engineering and physical chemistry. B. 1+.

Chemical news. London, England. D. **1-61**: N. D. **1-3, 80-95, 97, 98, 99*, 100*, 101*, 104*, 107+**: P. **33+**: R. P. **71+**: S. N. **39-52, 61-63, 68+**: W. **1-6.**

Chemical society of London, England.

Annual report. B. **'10+**: D. **1-6**: Exp. 1+: P. 1+.

Journal. B. **'06+**: D. **24+**: Exp. 1+: N. D. **16-96, 101+**: R. P. 28+: W. **59+.**

Chemiker-zeitung. Cöthen, Germany. Exp. **27+**: I. U. **1-19.**

Beilage. Chemisch-technisches repertorium. Exp. **33, 34.**

Chemisches Centralblatt. Hamburg; Berlin, Germany. Exp. **60, 61**: I. U. 52+: N. D. 77+: P. 47+: R. P. '04+.

Chemist and druggist. London, England. P. **70+**:

Chicago (Ill.) academy of sciences.

Annual report. Ac. **'95-'97.**

Special publications. Ac. **3.**

Bulletin. Ac. **1**$^{1-10}$, **2**$^{2-4}$, **3**$^{1-5}$: N. D. **3.**

Chicago (Ill.). Geological and natural history survey.

Bulletin. Ac. 1-6, 7^{1}: N. D. 1.

Chicago (Ill.) dairy produce. Exp. **13*, 17*, 18+.**

Chicago (Ill.) entomological society.

Memoirs. Ac. 1^{1}.

Chicago (Ill.). Health, Department of.

Biennial report. Exp. **'94-'96.**

Chicago (Ill.) medical journal. D. **27, 28*.**

Chicago (Ill.) university. Hull physiological laboratory. Physiological archives. I. U. **1.**

Chile, Universidad de. Santiago.

Anales. I. U. **103, 108-123, 125+**: P. '82*+.

China. Agriculture and forestry, Department of.

Agricultural journal. Exp. **1*+.**

Christiania, Norway. See **Videnskabs** selskabet.

Cincinnati (O.) lancet and observer. N. H. n. s. **1*, 2, 3*.**

Continued as **Cincinnati** lancet-clinic *q. v.*

Cincinnati (O.) lancet-clinic. D. n. s. **2-4, 5*, 6-8, 9*, 10-12, 13*, 14-16, 17*, 18*, 24*, 27*:** P. n. s. **16-24*.**

Continues **Cincinnati** lancet and observer *q. v.*

Cincinnati (O.) medical and surgical news. D. n. s. **1*, 2*.**

Cincinnati (O.) museum association.

Report. Exp. **19-28.**

Cincinnati (O.) society of natural history.

Journal. Ac. **11,** $\mathbf{12^{1-3}}$, $\mathbf{15^{3,4}}$, $\mathbf{16^{2-4}}$: I. U. **4+:** S. L. **1-10.**

Cincinnati (O.) observatory.

Annual report. I. U. **'70.**

Cincinnati (O.) quarterly journal of science. I. U. **1, 2.**

Cincinnati (O.) university.

Record. N. D. I. **8+:** II. **7+.**

Studies. I. U. II. **3+:** P. II. **1+.**

Circolo mathematico. Palermo, Italy.

Rendiconti. I. U. **1+.**

Civil engineers' and architects journal. London, England. R. P. **1-25.**

Clark university. Worcester, Mass.

Nature study leaflet. P. **1, 2.**

Clemson college. See **South Carolina.**

Cold. Calcium, N. Y. Exp. **1+.**

Coleman's rural world. St. Louis, Mo. Exp. **63*, 64+.**

College of physicians of Philadelphia (Pa.).

Proceedings. N. H. **1789.**

Colorado. Agriculture, State board of. Denver.

Annual report. Exp. **2, 16, 26, 28, 30, 32+:** N. D. **23:** P. **2, 4, ,12-18, 20, 22, 24, 26, 28.**

Colorado. Agricultural experiment station. Fort Collins.

Annual report. Exp. **1+:** N. D. **3, 14, 16, 22, 24, 33, 34:** P. **1, 2, 4+.**

Bulletin. D. **31, 35, 41, 61, 96-99, 101, 103-106:** Exp. **1-179, 181+:** N. D. **100, 150-152, 157, 158, 160-179, 180+:** P. **1+:** S. L. **34, 35, 43, 44, 49-53, 100, 117-119.**

Colorado college. Colorado Springs.

Publication. I. U. **33-35, 39-53:** N. D. science ser. **11+;** social ser. **2+:** P. sci. ser. **13-20, 23-26, 30-32, 39+:** Eng. ser. **1+.**

Colorado (state) engineer.
Biennial report. P. **14.**

Colorado (state) entomologist.
Annual report. P. **3.**

Colorado fruit grower. Grand Junction. Exp. **3-4***.

Colorado. Geological survey.
Bulletin. I. U. **1**+.
Report. I. U. **1**+.

Colorado. Horticulture, State board of. Denver
Annual report. Exp. **13, 14, 16:** P. **2, 5, 7, 11-15, 18, 19, 21**+.

Colorado school of mines. Golden.
Bulletin. P. **1-4***.

Colorado scientific society. Denver, Col.
Bulletin. Ac. **'97**$^{10, 11}$, **'98**^{1}, **'99**$^{3, 4}$, **'00**^{2}.
Proceedings. Ac. **1, 2**$^{1-3}$, **3**$^{1-3}$, **5-9:** I. U. **2-5:** P. **9.**

Colorado university. Boulder, Col.
Studies. I. U. **1**+: N. D. **7**+: P. **1**+.
Journal of engineering. P. **1**+.

Colorado university. Psychology and education, Department of. Boulder, Col.
Investigations. I. U. **1.**

Columbia university. New York.
Ernest Kempton Adams fund for physical research publications. P. **4, 6.**

Columbia university. Botany, Department of. New York.
Contributions. N. D. **14.**
Memoirs. N. D. **1, 2.**
Bulletin. P. **1-20**‖.
Continued as
Quarterly. I. U. **1**+: P. **1**+: W. **1**+.

Columbus (O.) horticultural society.
Report. Exp. **'95, '99-'03:** P. **'87, '95-'00, '03-'09.**

Columbus (O.) medical journal. D. **1-8***.
Continues **Ohio** medical journal. Columbus. *q. v.*

Comité geologique. St. Petersburg, Russia.
Bulletins. Ac. **17**+.
Memoirs. Ac. **2**^{2}, **7, 8**$^{3-4}$, **9**$^{3-5}$, **10**$^{3-4}$, **12**^{3}, **13**$^{2-4}$, **14, 15**$^{1-4}$, **16**$^{1, 2}$ **17**$^{1, 3}$, **18**$^{1-}$, **19, 20**$^{1, 2}$; n s. **1-38, 40-61, 63-69, 71, 75, 78, 81**+.
Supplement to bulletins. Ac. **14-17.**

Comité regional del estado de Durango (Mexico).
Boletino. N. D. **1, 2, 3+.**
Commercial fertilizer. Atlanta, Ga. Exp. **1*, 2+**
Commercial poultry. Marseilles, Ill. Exp. **19***.
Compressed air. Easton, Pa. R. P. **5, 7, 9-14.**
Concrete. Detroit, Mich. Ft. W. **8**||: N. D. **4*-12***.
Continued as **Concrete-cement** age *q. v.*
Concrete-cement age. Detroit, Mich. Ft. W. **1+**: G. **8+**: N. D. **1*, 2***.
Continues **Concrete,** *q. v.*, and **Cement** age, *q. v.*
Concrete review. Philadelphia, Pa. N. D. **3***.
Congrès international des sciences géographiques. See **International** geographic congress.
Congrès scientifique international des catholiques. Fribourg, Switzerland.
Compte rendu. N. D. **'89, '91, '93, '95.**
Connecticut academy of arts and sciences. New Haven, Conn.
Memoirs. Ac. **2, 3.**
Transactions. Ac. **8, 9**², **10+**: N. D. **14, 16+.**
Connecticut. Agricultural experiment station. New Haven.
Annual report. D. **23***: Exp. **'76, '79-'11, '12***: P. **'79+.**
Bulletin. Exp. 1, 17, 21, 23-30, 33-56, 58-67 69, 71+: P. 60 71, 73-77, 79-82, 84, 85, 87, 89+: S. L. '11+.
Connecticut. Agricultural experiment station (Storrs). Mansfield.
Annual report. Exp. 1+: P. '88+.
Bulletin. D. **4**: Exp. 1+: P. 1+.
Connecticut (state) agricultural society.
Transactions. S. L. **'54-'57.**
Connecticut. Agriculture, Board of. Hartford.
Report. Exp. **43**: P. **13, 14, 16+.**
Connecticut. Dairy commissioner. Hartford.
Report. Exp. **7**: P. **2, 3, 6-17.**
Connecticut. Domestic animals, Commissioners on diseases of.
Report. P. **1, 5-7, 9+.**
Connecticut (state) entomologist. Hartford.
Report. Exp. **1-8, 10.**
Connecticut farmer and New England farms. New Haven. Exp. **41*, 42+.**
Connecticut. Fisheries and game, commissioners.
Report. P. **'09, '10.**
Connecticut forestry association.
Bulletin. Exp. **1-6.**

Connecticut. Geological and natural history survey. Hartford. Exp. **11**: I. U. **10-11, 13+**: P. 1+.

Connecticut. Health, State board of. Hartford.

Report. Exp. **'08**: P. '83+.

Connecticut. Highway commissioner.

Biennial report. P. **'97-'00, '05-'08.**

Connecticut pomological society. Milford.

Report. Exp. **'00.**

Connecticut. Railroad commissioners.

Annual report. P. **55-59.**

Connecticut. Shell-fish commissioners.

Report. P. **'09, '10.**

Connecticut society of civil engineers. New Haven.

Proceedings. P. **2, 6, 7, 9**+.

Conservation. Exp. 8*, **9, 10***, **11, 12, 13***, **14***, **15***||: N. H. **14, 15**||: P. **14, 15**||.

Continues **Forestry** and irrigation *q. v.*; continued as **American** forestry *q. v.*

Corn. Waterloo, Ia. Exp. **1**+.

Corn belt meat producers. Des Moines, Ia.

Annual report. Exp. **'09, '10.**

Cornell civil engineer. Ithaca, N. Y. P. **15.**

Continues **Cornell** university—Association of civil engineers. Transactions. *q. v.*

Cornell countryman. Ithaca, N. Y. P. **1***, **2***, **3***, **4-6.**

Cornell university. Association of civil engineers. Ithaca, N. Y.

Transactions. P. **1-14** .

Continues as **Cornel** civil engineer *q. v.*

Cotton seed. Atlanta, Ga. Exp. **7**+.

Country calendar. New York. Exp. **1***||.

Merged in **Country** life in America *q. v.*

Country gentleman. Albany, N. Y. Exp. **3-53, 54*, 55*, 57*, 60*, 62*, 63*, 76*, 77*, 78+**: G. **78+**: S. L. **6-72.**

Country life in America. Garden City, N. Y. Exp. **3-6, 7***, **9***, **11***, **13***, **14-18, 21+**: Ft. W. **7-10, 12-19, 21+**: G. **3+**: P. **2+**.

Craftsman. Syracuse, N. Y. Ft. W. **3-10, 12+**: P. **1+**.

Creamery journal. Waterloo, Ia. Exp. **19***, **20+**: P. **17+**.

Criador paulista. Sao Paulo, Brazil. Exp. **1***, **2***, **3***, **4, 5, 6***, **7+**.

Cuba. Agricultura, industria y commercio, Secretaria de. Santiago de Las Vegas.

Circulars. Exp. **7, 9, 11, 15, 18.**

Cuba. Estacion central agronomica.

Annual report. Exp. **'04, '05.**

Cuba. Horticultural society. Camaguey.

Annual report. Exp. **1.**

Cultivator. Albany, N. Y. N. H. **1-6, 11, 12:** S. L. **1-5;** n. s. **1-8.**

Continued as **Cultivator** and country gentleman. See **Country** gentleman.

Curtis's botanical magazine. London, England. N. D. **1-13, 22, 23:** n. s. **6.**

Dairy record. St. Paul, Minn. Exp. **7***, **11***, **12+:** P. **5***, **6, 7***, **8+.**

Dairymen's association of the province of Quebec.

Annual report. Exp. **'95, '96, '09, '10.**

Dakota farmer. Aberdeen, S. D. Exp. **30***, **31***.

Davenport (Ia.) academy of natural sciences.

Proceedings. Ac. 3^{2-3}, 5^{1}, **6, 7:** N. D. **10.**

Decorator and furnisher. New York. P. **1-16, 19, 20, 22-23, 24***-**31***.

Delaware. See also **Peninsula** horticultural society.

Delaware. Agricultural experiment station. Newark.

Annual report. Exp. **1-19, 21+:** P. **1+.**

Bulletin. Exp. 1+: S. L. '10+: P. 1+.

Special bulletin. Exp. A. B.

Delaware. Agriculture, State board of. Dover.

Report of the secretary. Exp. **1-4:** P. 1.

Delaware (state) grange. Dover.

Proceedings. Exp. **'07-'10.**

Denison university. Scientific laboratories. Granville, O.

Bulletin. Ac. **2-5**, 6^{1}, 9^{2}, **10**, 11^{1-8}, 13^{1-6}, 14^{1-18}, **15**, 16^{1-17}, 17^{1-4}: I. U. **1, 10+.**

Denver (Colo.) municipal facts. Exp. **1***, **2***.

Deutscher amerikanischer Farmer. Lincoln, Neb. Exp. **21***, **22***, **24+.**

Deutsche botanische Gesellschaft. Berlin, Germany.

Berichte. Exp. **1-28, 30*****+:** I. U. **1+:** W. **13-15.**

Deutsche chemische Gesellschaft. Berlin, Germany.

Berichte. D. **7+:** I. U. **1+:** N. D. **29+:** P. **1+:** S. L. **46+:** W. **1+.**

Deutsche dendrologische Gellschaft. Poppelsdorf; Bonn, Germany.

Mitteilungen. N. D. **'11+.**

Deutsche geologische Gesellschaft. Berlin, Germany.

Zeitschrift. I. U. **56+.**

Deutsche Gesellschaft für Natur- und Völkerkunde Ostasiens. Tokio, Japan.

Mitteilungen. Ac. 9^{3} supp. ^{2}, 10^{1-3}, 11^{1-4}, $12^{1,2}$, 13^{1-3}, 14^{1-2}.

Economic geology. Lancaster, Pa.; Urbana, Ill. E. **1+**: I. U. **1+**: N. D. **1+**: S. N. **1+**.

Continues **American** geologist *q. v.*

Edinburgh (Scotland). See **Botanical** society.

Edinburgh (Scotland) mathematical society.

Proceedings. I. U. **1+**.

Edinburgh (Scotland). Royal botanical garden.

Notes. Ac. **22-27, 33.**

Edinburgh (Scotland). Royal observatory.

Annual report. S. L. **'09+**.

Edinburgh (Scotland) veterinary review and annals of comparative pathology. Exp. **1-3**: P. **1-6**.

Egypt exploration fund. London, England.

Archaeological report. I. U. **'02-'09, '11, '12.**

Report of meetings. I. U. **18, 19, 26, 27, 30+**.

Electric journal. Pittsburg, Pa. Ft. W. **3**: G. **10+**: N. D. **1+**: P. **1+**: R. P. **2+**.

Electric railway journal. New York. Ft. W. **32, 33, 35+**: G. **33+**: P. **32+**.

Formed by consolidation of the **Electric** railway review (*q.v.*) and the **Street** railway journal (*q. v.*) continuing the volume numbers of the latter.

Electric railway review. Chicago, Ill. P. **17-19**‖.

Continues **Street** railway review (*q. v.*). Combined in 1908 with **Street** railway journal (*q. v.*) and became **Electric** railway journal (*q. v.*).

Electric age. New York. M. **13, 17-20**: P. **35-39**.

Electrical engineer. London, England. R. P. **1-32***.

Electrical engineer. New York. N. D. **12, 18, 22, 24**: P. **7-26**: R. P. **7-27**‖.

Continues **Electrician** and electrical engineer *q. v.* Combined in 1899 with the **Electrical** world *q. v.*

Electrical review. London, England. R. P. **26+**.

Electrical review. New York; Chicago, Ill. G. **60+**: M. **54+**: P. **2, 4-13, 15, 16*, 17, 18, 20*, 21*, 35*, 36+**: R. P. **31+**.

After 52 called **Electrical** review and western electrician.

Electrical world. New York. D. **3-4, 19+**: E. **16, 17**: Ft. W. **39, 42+**: G. **53+**: I. U. **11+**: M. monthly **18**; weekly **49-55**: N. D. **'95+**: P. **6+**: R. P. **24+**: S. N. **23+**: T. H. **51-55.**

Combined in 1889 with **Electrical** engineer (*q. v.*) and volumes 33-46 were called **Electrical** world and engineer.

Electrician. London, England. D. **28-37**: I. U. **52+**: P. **21*, 22*, 23***: R. P. **47+**.

Electrician and electrical engineer. New York. P. 1-6||.

Continued as **Electrical** engineer *q. v.*

Electrician and mechanic. Boston, Mass. E. 25+: Ft. W. 18+: G. 26+.

Electrochemical and metallurgical industry. New York. See **Metallurgical** and chemical engineering.

Electrochemical industry. New York. See **Metallurgical** and chemical engineering.

Elektrotechnische Zeitschrift. Berlin, Germany. P. 26+: R. P. 6, 7, 12+.

Elgin (Ill.) dairy report. Exp. 18*, 19+.

Elisha Mitchell scientific society of the university of North Carolina. Chapel Hill, N. C.

Journal. Ac. 1-3, 4[1], 5+: N. D. 24+.

Eporium of arts and sciences. Philadelphia, Pa. R. P. n. s. 1.

Engineer. Chicago. P. 39*, 40*, 41*, 43-45||: R. P. 1-28, 41, 69, 70, 97+.

Merged with **Power** (*q. v.*) in 1908 and became **Power** and the engineer

Engineer magazine. M. 40-45.

Engineer. See under **Pennsylvania** state college.

Engineering. London, England. Ft. W. 89+: N. D. 84+: P. 11+: R. P. 3-42, 47+.

Engineering and contracting. Chicago, Ill. G. 29*, 30*, 32*, 33*, 35+: P. 27*, 28+.

Engineering and mining journal. New York. N. D. 90+: I. U. 53+: P. 19-28, 34*, 41, 48*-54, 55, 58*-64*, 67+: R. P. 20-36, 49+.

Engineering association of the South. Nashville, Tenn.

Transactions. P. 10+.

Engineering digest. New York. Ft. W. 1, 3-5||: P. 1-5||.

Continued as **Industrial** engineering and engineering digest *q. v.* Vols. 1 and 2 have title **Technical** literature.

Engineering index. New York. N. D. 27+: P. 1-4.

Engineering index annual. New York. P. '06+.

Engineering magazine. New York. F. 27-32: Ft. W. 11, 12, 33+: G. 36+: I. U. 1+: L. P. 25+: M. 7+: N. D. 4, 15-17, 19, 21, 23, 24, 27, 33-43: N. H. 33-37: P. 1, 2*, 3+: R. P. 2+: S. L. 35+: S. N. 1+: T. H. 2+.

Engineering mechanics. Philadelphia, Pa. N. D. '94, '96, '97: P. 5*, 6, 8-9, 10*-11*, 12-16, 17*, 19-21: R. P. 1-11.

Volumes 5-13 have the title **Mechanics.**

Engineering news. Chicago, Ill.; New York. Ft. W. 62, 64+: G. 51+: N. D. 35+: P. 7-10, 15+: R. P. 13+: S. L. 53-55, 57-60, 67+: T. H. 65+.

Volumes 10-18 have title **Engineering** news and American contract journal. Volumes 19-48 have title **Engineering** news and American railway journal.

Engineering record, building record and sanitary engineer. New York. E. **51-60**: Ft. W. **55+**: G. **54+**: N. D. **41+**: P. **17+**: R. P. **12+**.
Continues **Sanitary** engineer *q. v.*

Engineering review. London, England. N. D. **21***.

Engineering world. Chicago, Ill. P. **1*-5***‖.
Merged with **Engineering** and contracting *q. v.*

Engineers' society of western Pennsylvania. Pittsburgh.
Proceedings. I. U. **22+**.

England, national sheep-breeders' association. London.
Annual report. Exp. **'04-'06**.

English mechanic and world of science. London, England. R. P. **45-77**.

Enseignement mathematique. Paris, France. I. U. **11+**: P. **5+**.

Entomologica Americana. Brooklyn, N. Y. S. L. **1-6**: S. N. **1**.

Entomological news. Philadelphia, Pa. D. **1+**: W. **9+**.

Entomological society of America. Ithaca, N. Y.
Annals. P. **1+**: S. L. **1+**: W. **1+**.

Entomological society of Ontario. Guelph; London, Ont.
Reports. S. N. **'78, '81-'89, '91-'99, '00-'09**.

Entomologiska föreningen. Stockholm, Sweden.
Entomologisk Tidskrift. Ac. 13^{1-4}, **18-25**, 26^{1-4}, **28+**.

Entomologist. London, England. Exp. **25-28, 29*, 30, 31*, 32-37, 38*, 39+**.

Entomologist's monthly magazine. London, England. Exp. 11. **2**.

Ephemeris of materia medica, pharmacy, therapeutics and collateral information. Brooklyn, N. Y. P. **1-3**.

Ergebnisse der Anatomie und Entwickelungsgeschichte. Wiesbaden, Germany. I. U. **1+**.

Ergebnisse der Physiologie. Wiesbaden, Germany. I. U. **1+**: P. **1-5**; S. N. **1+**.

Ernährung der Pflanze. Berlin, Germany. Exp. **8*, 9+**.

Erythea. Berkeley, Cal. N. D. **1, 2**.

Españay americana. Madrid, Spain. N. D. **7*, 8+**.

Essex institute. Salem, Mass.
Bulletin. Ac. 19^{1-3}, 20^{4-12}, **21-23**, $24^{1-3,\ 7-12}$, **25**, 26^{4-12}, 27^{1-6}, **28, 29**, 30^{7-12}.
Report. Ac. **'99, '00**.

Experiment station record. See under **United States.** Experiment station. Office of.

Experimental studies in psychology and pedagogy. Boston, Mass. S. N. **2-4**.

Fancy fruits. North Yakima, Wash. Exp. **1***, **2***.
Farm and orchard. Keyser, W. Va. Exp. **1**+.
Farm and stock. St. Joseph, Mo. Exp. **7, 8, 9***, **10***, **11***.
Farm home. Springfield, Ill. Exp. **35***, **36**+.
Farm journal. Philadelphia, Pa. Exp. **33**+.
Farm life. Chicago, Ill. Exp. **12***, **13**+.
Farm poultry. Boston, Mass. P. **4-19.**
Farm press. See **Better** farming.
Farm progress. St. Louis, Mo. Exp. **8, 9***, **10**+.
Farm sense. Des Moines, Ia. Exp. **1***, **2**+.
Farm stock and home. Minneapolis, Minn. Exp. **25**+.
Farm world. Augusta, Me.; Chicago, Ill. Exp. **3, 4***, **5***, **6**+.
Farmer and breeder. Sioux City, Ia. Exp. **34**+.
Farmer's advocate and home magazine. London, Ont. Exp. **44***, **45***, **46***, **47***, **48**+.
Farmer's cabinet. Philadelphia, Pa. S. L. **1-37.**
Farmer's digest. Columbia, Pa. Exp. **2***, **3, 4***, **5.**
Farmers' guide. Huntington, Ind. Exp. **14***, **15***, **16***, **17***, **18***, **19***, **20, 21***, **22***, **23**+: P. **18**+.
Farmer's national congress of the United States.
Proceedings. P. **18, 20, 22**+: S. L. **'04-'10.**
Farmers' review. Chicago, Ill. Exp. **39, 40***, **41***, **42**+.
Farmers' tribune. Sioux City, Ia. Exp. **32***, **33.**
Farming. New York. Exp. **1***, **2, 3***||: P. **1-3**||.
Merged with **Garden** magazine *q. v.*
Feather. Washington, D. C. Exp. **14**+.
Federation of Jewish farmers of America. New York.
Report. Exp. **'09.**
Field and farm. Denver, Colo. Exp. **24***, **25***, **26***, **27**+.
Field and forest. Washington, D. C. Ac. $\mathbf{2}^{2, 8}$, $\mathbf{3}^{1, 6-8}$.
Field museum of natural history. Chicago, Ill.
Annual exchange catalogue. Ac. **'96-'98.**
Annual report. Ac. **1**, $\mathbf{2}^{3-5}$, **3**, $\mathbf{4}^{1-2}$: W. **1**+.
Publications; anthropological series. Ac. $\mathbf{2}^{1, 3-6}$, $\mathbf{3}^{1, 4}$, $\mathbf{4\text{-}6}^{1}$, $\mathbf{7}^{1}$: N. D **1**+: P. **1**+: W. **1**+.
Botanical series. Ac. $\mathbf{1}^{1-3, 5}$, $\mathbf{2}^{1, 3-7}$, $\mathbf{3}^{2}$: N. D. **1**+: P. **1**+: W. **1**+.
Geological series. Ac. $\mathbf{1}^{1, 3-7}$, $\mathbf{2}^{2-4, 6-10}$, $\mathbf{3}^{1-9}$, **4**+: N. D. **1**+: P. **1**+: W. **1**+.

Ornithological series. Ac. $1^{1, 2, 6}$: P. 1+.

Report series. N. D. 1+: P. 1+: W. 1+.

Zoological series. Ac. $1^{2-8, 11-17}$, 2^{2}, 3^{12-16}, $4^{1, 2}$, $5\text{-}7^{1-13}$, $8\text{-}10^{1-3, 5-8, 11}$: N. D. 1+: P. 1+: W. 1+.

Fire and water engineering. New York. N. D. **29*, 30-33, 35-38, 39*, 40*.**

Fireproof magazine. New York. P. **1*, 2*, 3*, 4*, 7*, 8-11** |.

Flora. Dresden, Germany. N. D. **'11, '12.**

Flora oder allgemeine botanische Zeitung. Regensburg; Marburg, Germany. D. **74-80**: I. U. **86+**.

Flora of California. Exp. **1+**.

Flora of Wyoming.

Report. Exp. **'96.**

Florida. Agricultural experiment station. Gainesville, Lake City.

Annual report. Exp. **'88+**: P. **'88-'91, '93, '95, '96, '98, '00-'03, '05+**.

Bulletin. D. 17, 33, 70-74, 77, 78, 80: Exp. 1+: P. 1+: S. L. 1-6, 9, 10, 12-19, 21-26, 29, 31, 33.

Farmers' institute bulletin. D. 2.

Florida. Agriculture, State board of. Tallahassee.

Biennial report. Exp. **'91-'96, '99-'02, '05-'08**: P. **'95, '96, '11, '12.**

Quarterly bulletin. Exp. **11*, 12*, 13*, 14*, 15, 16, 17*, 18, 19*, 20, 23+**: P. **21, 22*, 23+**.

Florida (state) horticultural society. Jacksonville.

Annual report. Exp. **5, 7.**

Flour and feed. Milwaukee, Wis. Exp. **2, 3*, 4*, 5*, 6-9, 10*, 11*, 12+**.

Flour trade news, hay, grain and feed. New York. Exp. **4*, 5, 6*, 7-10.**

Flying and aero club of America.

Bulletin. G. **1+**.

Folia haematologica. Berlin, Germany. I. U. **3+**.

Folia neuro-biologica. Leipzig, Germany. I. U. **1+**.

Folia serologica. Leipzig, Germany. I. U. **1+**.

Forest, fish and game. See **Georgia** forest association.

Forest and stream. New York. N. H. **1-17.**

Forester. Washington, D. C. P. **4-7** |.

Continued as **Forestry** and irrigation *q. v.*

Forestry and irrigation. Washington, D. C. Exp. **8*, 9, 10*, 11, 12, 13*, 14+**: P. **8-13.**

Continued as **Conservation** *q. v.*

Forest quarterly. Ithaca, N. Y. P. **9+**: W. **3+**.

Forschungen auf dem Gebiete der Agrikulturphysik. Heidelberg, Germany. Exp. **13.**

Fortschrift der Physik. Berlin, Germany. P. 4+.

Fort Wayne (Ind.) medical journal. P. **2, 22, 27, 28***.

Foundry. Cleveland, O. Ft. W. **41+**: G. **34+**: P. **26+**.

France. Agriculture et du commerce, Ministère de l'.
 Bulletin. S. L. **'40-'45.**

France. Agriculture, Ministère de l'. Paris.
 Bulletin. Exp. **'88***, **'89, '90, '91***, **'92***, **'93***, **'94***, **'95***, **'96, '97***, **'98***, **'99***, **'00.**

Franklin institute of Pennsylvania. Philadelphia.
 Journal. N. H. **18***, **27-32**: P. **1+**: R. P. **5-47, 49-51, 86-97, 115+**: S. L. **1-82, 119-128, 130+**.

Fruit belt. Grand Rapids, Mich. Exp. **7***.

Fruit grower. St. Joseph, Mo. Exp. **15***, **16***, **17-19, 20***, **21+**.

Fruitman and gardener. Mt. Vernon, Ia. Exp. **10***, **11***, **12***, **13+**.

Fühlings landwirtschaftliche Zeitung. Stuttgart, Germany. Exp. **60+**.

Furrow. Moline, Ill. Exp. **14***, **16+**.

Garden and forest. New York. P. **1-10**||.

Garden magazine. Garden City, N. Y.; New York. Exp. **1***, **2, 5***, **6***, **7***, **8-12, 13***, **14***, **15+**: P. **1+**.

Gardeners' chronicle. London, England. Exp. **'41-'73**; n. s. **1-26**; III. **1+**.
 First series has no volume numbers.

Gardener's monthly. Philadelphia, Pa. Exp. **17-20, 22, 23.**

Garten flora; Zeitschrift für Garten- und Blumenkunde. Berlin, Germany. Exp. **37.**

Gas engine. Cincinnati, O. P. **1+**: R. P. **4*+**.

Gas power. St. Joseph, Mich. G. **8+**: P. **1-6.**

General electric review. Schenectady, N. Y. G. **15+**: P. **10+**: R. P. **14+**.

Génie civil. Paris, France. P. **46+**.

Geographical teacher. London, England. S. N. **1+**.

Geographical journal. See **Royal** geographical society.

Geographical society of America. See **American** geographical society.

Geographical society of Philadelphia, Pa.
 Bulletin. S. N. **2+**.

Geographische Zeitschrift. Leipzig, Germany. I. U. **5+**.

Geological magazine. London, England. I. U. n. s. dec. **3, 4**; dec. 4, **1-3, 5-11**; dec. 5, **1+**.

Geological society of America. Rochester, N. Y.: New York.

Bulletin. E. **13+**: I. U. **1+**: N. H. **20**: S. N. **1+**.

Geological society of London (England). I. U. **29, 30, 37, 39, 60+**.

Geologisches Centralblatt. Leipzig, Germany. I. U. **1+**.

Georgia. Agricultural experiment station. Experiment.

Annual report. Exp. **1+**: P. **1+**.

Bulletin. D. 68-72: Exp. 1+: P. 1+: S. L. 45, 50, 61, 63-65, 67, 69, 70-73.

Georgia. Agriculture, State board of. Atlanta.

Annual report of the commissioner. Exp. **'76, '81, '82, '84**: P. **'83, '84.**

Publications. Exp. **6-9, 12-14**: P. **9, 11, 12, 18, 22, 24.**

Quarterly bulletin. Exp. 42-46: P. 42-44, 52, 53.

Georgia dairy and live stock association.

Annual report. Exp. **'02, '03, '05. '08, '09.**

Georgia. Entomology, State board of. Atlanta.

Bulletin. D. 1: Exp. 1, 3, 5-19, 31-33, 38+: P. 4, 13, 17, 20, 21, 23, 24, 26, 27, 29-36. S. L. 12-32*.

Georgia forest association.

Forest, fish and game. P. **2, 3.**

Formerly **Southern** woodlands.

Georgia geological survey.

Bulletin. I. U. **1-19, 23, 26+**: P. **24, 25**: R. P. **1.**

Report. P. **'93.**

Georgia (state) horticultural society. Cairo.

Proceedings. Exp. **'98, '02, '08-'10.**

Georgia (state) veterinarian.

Annual report. P. **1.**

Giornale di matematiche di Battaglini. Naples, Italy. I. U. **47.**

Glasgow (Scotland) mechanics' magazine and annals of philosophy. N. H. **1-4.**

Glasgow (Scotland) naturalist. Ac. **1+**: N. D. III. **1+**.

Glasgow (Scotland) philosophical society.

Proceedings. R. P. **19, 20.**

Gleanings in bee culture. Medina, O. Exp. **39***, **40***; P. **36+**.

Goldthwaite's geographical magazine. New York. S. N. **1-6.**

Good health. London, England. I. U. **30-46.**

Good housekeeping. Springfield, Mass. P. **27, 34, 35, 38-42, 44-48, 52, 53,** 55+.

Good roads magazine. New York. Exp. o. s. 2*, 3*, 4; n. s. 4*: P. n. s. 8+.

Called **Good** roads 1892-1895, then merged in **League** of American wheelmen bulletin constituting the old series. In 1902 began a new series under the name **Good** roads magazine which became simply **Good** roads again in 1909.

Gordon memorial college. Khartoum, Africa. See **Wellcome** research laboratories.

Grain dealers' journal. Chicago, Ill. Exp. **16***, **17***, **18***, **19***.

Graphic arts. Boston, Mass. Ft. W. **3+**.

Great American architectural record. M. **1-6.**

Great Britain. Agriculture and fisheries, Board of. Intelligence division

Annual report. S. L. **'08+**.

Great Britain. Government laboratory.

Report of principal chemist. S. L. **'09, '11, '12.**

Great Britain. Meteorological office.

Report. S. L. **'09-'12.**

Greenough's American polytechnic journal is volume 4 of **American** polytechnic journal *q. v.*

Green's fruit grower and home companion. Rochester, N. Y. Exp. 25*, **27***, **28, 29***, **30+**.

Greenwich (England). Royal observatory.

Report. S. L. **'09-'12.**

Grevillea. London, England. Exp. **1-14.**

Guam agricultural experiment station. Island of Guam.

Annual report. Exp. **'10+**.

Guide to nature. B. **1+**: F. **3+**: G. 4*, **5+**: N. D. **1, 2, 3***, **4***, **6.**

Gulf biological station. Cameron, La.

Bulletin. P. 3, 4, 6, 7, 9-11, 13+.

Half-yearly abstract of medical sciences. Philadelphia, Pa. D. **56-58**: N. D. **48-55**: N. H. **1-7, 9, 10-17, 54-58.**

Hamburg (Germany) mathematische Gesellschaft.

Mittheilungen. I. U. **5+**.

Hamilton (Ontario) scientific association.

Journal and proceedings. Ac. 1[1], **11-19, 21+**.

Hampton (Va.) normal and industrial institute.

Hampton leaflets. N. D. n. s. **1*-4***, **5-7.**

Report. Exp. **'91.**

Handbuch der Biochemie des Menschen und der Thiere. Jena, Germany. Exp. **1-4.**

Handbuch der organischer Chemie. Hamburg, Germany. Exp. 3*.

Hardwicke's science gossip. London, England. I. U. **14, 15**: N. H. **16.**

Harvard engineering journal. Cambridge, Mass. P. **2-3, 4*, 5+.**

Harvard university. Astronomical observatory. Cambridge, Mass.

Annals. I. U. **6-34.**

Circulars. I. U. 1, 2.

Harvard university. Arnold arboretum. Ac. **21, 23-25, 27+.**

Harvard university. Jefferson physical laboratory.

Contributions. E. **1+**: I. U. **1-5, 7**: P. **1-4, 6+**: R. P. **1+**: W. **3+.**

Harvard university. Museum of comparative zoology.

Memoirs. S. N. **28*.**

Harvard university. Peabody museum of American archaeology and ethnology.

Annual report. Ac. **'89, '90.**

Memoirs. Ac. 1^{1-5}: I. U. **1-2, 4+.**

Papers. Ac. 1^{1-6}: I. U. **1-2, 4-5.**

Harvester world. Chicago, Ill. Exp. **2*, 3*, 4+.**

Harvey society. New York.

Lectures. P. **'05+.**

Hausfreund und deutscher amerikanischer Farmer. Lincoln, Neb. Exp. **14*, 16+.**

Havana (Cuba). See **Academia** de ciencias medicas fisicas y naturales.

Havana (Cuba) university.

Revista de la facultad de letras y ciencias. P. **3+**: S. N. **3+.**

Hawaii. Agricultural experiment station. Honolulu.

Annual report. Exp. **'01+**: L. P. **'06+**: N. D. **'08+**: P. **'01+**: R. P. **'06, '07**: S. L. **'06, '07, '09-'11.**

Bulletin. Exp. 1+: L. P. 1, 8, 11-13, 15-18, 21-24, 26+: N. D. 16+; bot. ser. 1+: P. 1+: R. P. 1-17: S. L. 1-17, 21, 23-26, 28: S. N. '02+.

Hawaii. Commissioners of agriculture and forestry.

Report. P. **3+.**

Hawaiian forester and agriculturist. Honolulu. Exp. **5.**

Hawaii experiment station of the sugar planters' association. Honolulu.

Annual report. Exp. **'99-'05**: N. D. **'08+.**

Hawaii sugar planters' station. Honolulu.

Annual report. Exp. **'05+.**

Bulletin, agriculture and chemistry series. Exp. 1-11, 13+.

Agriculture and forestry series. Exp. 1+.

Entomological series. Exp. 1*, 6-12.

Pathology and physiology series. Exp. 1+.

Health. New York. S. N. **51+**.

Heating and ventilating magazine. New York. P. **5+**.

Hedwigia, ein Notizblatt für kryptogamische Studien. Dresden, Germany. Exp. **1-23.**

Continued as.

Hedwigia. Organ für Kryptogamenkunde. Dresden, Germany. Exp. **24-44, 51+**.

Hirnanatomische Institute in Zürick (Switzerland). I. U. **1+**.

Annales. I. U. **1+**.

Arbeiten. I. U. **1+**.

Historical and scientific society of Manitoba. Winnipeg.

Reports. Ac. **'97-'06.**

Transactions. Ac. **51-72.**

Hoard's dairyman. Ft. Atkinson, Wis. Exp. **29*, 30*, 33*, 34*, 35*, 36, 37, 38*, 39-41, 42*, 43+**.

Holstein-friesian association of America.

Annual report. Exp. **'85-'87, '89, '90.**

Holstein-friesian world. Ithaca, N. Y.

Annual report. Exp. **1-4, 5*.**

Home and farm. Louisville, Ky. Exp. **35*, 36*, 37*, 38+**.

Horse review. Chicago, Ill. Exp. **43+**.

Horticultural society of London.

Transactions. N. D. **1-4.**

Horticulturist and journal of rural art and rural taste. Rochester, N. Y.; Philadelphia, Pa.; New York. Exp. **15, 16:** N. H. **8-10, 12-15, 19-23.**

Hospodarske listy. Chicago, Ill. Exp. **13*, 14+**.

House and garden. Philadelphia, Pa. G. **17+**.

House beautiful. Chicago, Ill. G. **26+**: P. **11+**.

Housekeeping experiment station. Darien, Conn.

Bulletin. P. **1, 3, 5-11.**

Hygienisches Centralblatt. Leipzig, Germany. I. U. **1+**.

Ice and refrigeration. Chicago, Ill. P. **40+**.

Idaho. Agricultural experiment station. Moscow.

Annual report. D. **'04:** Exp. **'94, '95, '98+**: P. **'94, '01+**.

Bulletin. D. 46, 47: Exp. 1+: P. 1-4, 6, 7, 9+.

Idaho (state) engineer. Boise.

Biennial report. Exp. **'99, '00.**

Idaho (state) farmers' institutes. Moscow.

Biennial report. Exp. **'01, '02.**

Idaho. Mines, State inspector of. Boise.

Annual report. N. D. 8+.

Ideal power. Chicago, Ill. P. **2, 3, 4*, 5.**

Illinois. Agricultural experiment station. Urbana.

Annual report. Exp. **1+.**

Bulletin. D. 98, 100, 101, 119, 120, 123-147, 149-162: Exp. 1+: P. 1+: S. L. 88+*.

Soil report. D. 1+: Exp. 1+: P. 1+.

Illinois (state) agricultural society.

Transactions. D. **6, 7:** S. L. **'53, '54, '59, '60, '65-'83.**

Illinois. Agriculture, Department of. Springfield.

Transactions. D. o. s. **10, 12-19:** Exp. **4, 6-20, 22, 23:** P. **4, 6-14, 24, 25, 27, 30, 37+.**

Illinois (state) bee keeper's association.

Report. Exp. **1+.**

Illinois (state) dairymen's association.

Annual report. Exp. **14-16.**

Illinois, Economical geology of. Springfield. D. **1-3.**

Reprints from the reports of the **Illinois** (state) geological survey (*q. v.*) with additions and emendations.

Illinois (state) entomologist. Urbana.

Report on noxious and beneficial insects. S. N. **'05, '08, '09.**

Report. Exp. **23-27.**

Illinois farmer and farmer's call. Quincy. Exp. **55*, 56, 57*, 58*, 59, 60*, 61+.**

Illinois. Farmers' institute. Springfield.

Annual report. Exp. **3, 11, 13:** P. **1+.**

Bulletin. P. 5, 9, 15+.

Yearbook. Department of household science. P. **'09-'11.**

Illinois (state) food commission. Springfield.

Annual report. Exp. **1, 9:** P. **'00, '01.**

Illinois (state) geological survey. Urbana.

Bulletin. I. U. 1+: P. 3+.

Report. E. **1-8.**

See also **Illinois,** Economical geology of.

Illinois. Health, State board of.

Annual report. P. **'80-'94.**

Illinois. Highway commission.
  Annual report. P. **1.**
  Bulletin. P. **2.**
Illinois (state) horticultural society. Kinmundy.
  Transactions. D. n. s. **2-28, 30, 31:** Exp. n. s. **3-21, 24, 25, 29-32, 34, 45+:** P. n. s. **10, 12-38, 40+.**
Illinois. Horticultural society, Northern. Chicago.
  Transactions. D. **1.**
Illinois. Live stock commissioners, Board of.
  Annual report. Exp. **'90, '92-'97, '09:** P. **25, 26.**
  Bulletin. Exp. **1-3:** P. **1.**
Illinois live stock breeders' association.
  Report. Exp. **'98.**
Illinois (state) mining board.
  Annual coal report. N. D. **31+.**
Illinois. Natural history, State laboratory of. Urbana.
  Bulletin. Ac. $1^{1,2,6}$, $2^{1,3,4,7,8}$, 5^{7-12}, 6^{1}, 7^{1-10}, 8^{1-5}, 9^{1-5}: D. **1, 3, 6:** Exp. **2*, 5*:** I. U. **6-8:** N. D. **7+:** P. **3, 7:** S. N. **1-7.**
Illinois. Natural history, State museum of. Springfield.
  Bulletin. I. U. **3-12**: S. N. **3-12**.
Illinois. Railroad and warehouse commission.
  Report. N. D. **42+.**
Illinois society of engineers and surveyors.
  Annual report. P. **1-7, 9+:** R. P. **11-17.**
Illinois (state) survey.
  Bulletin. N. D. **13, 16.**
Illinois university. Biological experiment station. Urbana.
  Biennial report. Exp. **'95, '96.**
Illinois university. Ceramics, School of.
  Bulletin. P. **1-2, 6+.**
Illinois university. Engineering experiment station.
  Bulletin. G. **6+:** P. **1+:** R. P. **1+.**
Illinois university. Household science, Department of.
  Publications. P. **1+.**
Illinois university. Urbana.
  Studies. P. **1+*.**
Illinois university. Urbana.
  Technograph. P. **6-8, 10+.**

Illinois (state) water survey. Urbana.
Bulletin. I. U. **3-4, 6, 8: P. 1+.**
Nos. 1 and 2 issued by Illinois university.
Illuminating engineer. New York. P. **1+.**
Illuminating engineering society. Easton, Pa.
Transactions. P. **1*, 2*, 3*, 4+.**
Illustrierte flora. Vienna, Austria. N. D. **37+.**
Imperatorskaya akademiya nauk. St. Petersburg. See **Académie** impériale des sciences.
Imperial journal of art, science, etc. Manchester, England. F. **1-4.**
Index medicus. New York; Washington, D. C. I. U. **3+: M. 2-6.**
India. Agricultural experiment station. Aligarh.
Report. Exp. **'02-'12.**
India. Agricultural experiment station. Atarra.
Report. Exp. **'12.**
India. Agricultural experiment station. Partabgarh.
Report. Exp. **'10-'12.**
India. Agricultural experiment station. Cawnpore.
Report. Exp. **'10-12.**
India. Agricultural experiment station. Orai.
Report. Exp. **'10, '11.**
India. Agricultural research institute. Pusa.
Bulletin. Exp. 18. 28-31: P. 4, 13, 15, 16, 19, 20, 23, 25-26.
Report. P. **'09-'11.**
India. Agriculture, Department of.
Annual report. P. **'04-'10.**
Memoirs. Bacteriological series. Exp. **1.**
Botanical series. Exp. **2*, 3*, 4*, 5+: P. 1, 2.**
Chemical series. Exp. **1*, 2*+: P. 1*, 2*, 3*.**
Entomological series. Exp. **2*, 3+: P. 1, 2*.**
India. Inspector-general of forests.
Review of forest administration. P. **'07-'10.**
Indian school journal. Chilocco, Okla. Exp. **10, 12*, 13+.**
Indian engineering. Calcutta, India. N. D. **1-14, 16-30, 31*.**
Indiana academy of science. Indianapolis.
Proceedings. D. **'91-'93, '95-'01, '03+:** Exp. **'91-'11:** F. **'98-'04, '08+:** G. **'04, '05, '08+:** I. U. **7+:** L. P. **'98+:** N. D. **'10+:** N. H. **15+:** P. **7+:** R. P. **'91+:** S. N. **7-9, 11+:** T. H. **'97, '98, '00-'03, '05+:** W. **7+.**

Indiana. Agricultural experiment station. Lafayette.

Annual report. D. **3, 4, 9, 11-20:** Exp. **1+:** P. **1+.**

Bulletin. D. 13-15, 18, 20, 21, 44, 46, 56, 66, 68, 69, 72-74, 77, 78, 80-95 97-109, 111-122. 126. 143-145: Exp. 1+: N. D. 59. 60, 159, 160, 162+: P. 1+.

Indiana (state) agricultural society.

Transactions. N. D. **7, 8, 10.**

Indiana. Agriculture, Department of.

Annual report*. D. **1-14, 18, 21-23, 25-29, 31, 35, 37-48:** Exp. **1-45, 47, 48:** N. D. **40, 41, 47:** P. **1-3, 6, 9, 11-15, 17+:** R. P. **4, 5, 7, 8, 14, 21-24, 37-40, 42-48:** S. N. **10, 13, 15-19, 21-26,** 28+.

*The numbers given are volume numbers and not report numbers.

Indiana (state) breeders' live stock association.

Report. Exp. **4-8:** P. **4+.**

Indiana. Charities, Board of state. Indianapolis.

Annual report. D. **1-8, 10, 12+:** Exp. **18-22.**

Bulletin. D. **32-34, 36-45, 47-59, 61+:** Exp. **72-74, 76, 77, 79, 82.**

Indiana corn growers' association. Lafayette.

Annual report. Exp. **'08+.**

Indiana (state) dairy association.

Annual report. D. **20+:** Exp. **1-13, 15+:** N. D. **22:** P. **7-12, 14+.**

Indiana engineering society. Indianapolis.

Proceedings. I. U. **8-10, 12:** P. **7+:** R. P. **'93-'96, '08, '09.**

Indiana (state) entomologist.

Annual report. D. **1+:** Exp. **1+:** N. D. **1+:** N. H. **1+:** P. **1+:** S. N. **2+.**

Report. Exp. **'03, '04:** P. **'00, '02, '03.**

Indiana farmer. Indianapolis. Exp. **18*, 19*, 20*, 21*, 22*, 23*, 24*, 25*, 26*, 27, 28, 29*, 30*, 31, 32*, 33*, 54*, 55*, 56*, 57*, 58*, 59*, 60, 61*, 62*, 63*, 64*, 65*, 66+:** P. **59+.**

Indiana farmer and gardener. Indianapolis. Exp. **1.**

Indiana. Farmers' institutes. Lafayette.

Report. Exp. **'93, '94, '96, '98, '00-'10:** P. **'93, '96, '98, '00, '02, '04-'10:** S. N. '82+.

Indiana. Fisheries and game, Commissioner of. Indianapolis.

Biennial report. D. **'99+:** Exp. **'97, '98, '01-'08:** N. D. **'08:** N. H. **'92, '99, '00, '09-'10:** R. P. **'99-'04:** S. N. **'00+.**

Indiana forestry association.

Report. Exp. **3, 5, 7.**

Indiana. Forestry, State Board of.

Annual report. D. **3, 5+**: E. **3, 5-9, 11**: F. **3, 6+**: G. **1-3, 5+**: I. U. **3+**: L. P. **2+**: N. D. **6, 8, 11**: N. H. **1+**: P. **3+**: R. P. **3, 5**: S. N. **3, 5+**: T. H. **4+**.

Indiana. Geological survey.

Report. D. **2-4, 7-10**‖: Exp. **1-10**‖: N. D. **7-10**‖: N. H. **1-10**‖: P. **1-7, 8-10**‖: R. P. **1-10**‖:

Report of geological reconnoissance. D. **'62**: N. H. **'39, '62**: P. **'62.**

Indiana. Geology and natural history, Department of.

Bulletin. N. H. **1.**

Report. D. **11-16**‖: Exp. **11-16**‖: N. D. **11-16**‖: N. H. **11-16**‖: P. **11, 12, 14-16**‖: R. P. **11-16**‖.

Continued as

Indiana. Geology and natural resources, Department of.

Annual report. D. **17+**: Exp. **17+**: E. **1-33, 36+**: N. D. **1, 2, 11, 13-18, 21-23, 25-27, 29+**: N. H. **17+**: P. **17+**: R. P. **17+**.

Indiana geographical congress.

Reports. S. N. **3, 6.**

Indiana. Health, State Board of.

Annual report. D. **17-20, 22+**: Exp. **'83-'85, 18, 20, 23, 25-29**: I. U. **5+**: N. D. **5+**: N. H. **10-12, 17+**: P. **1, 2, 4-13, 15-20, 22+**: R. P. **17-20, 22, 23**: S. N. **17-20, 22+**.

Monthly bulletin. Exp. **1, 2*, 3*, 4+**: N. D. **7*-15*, 29+**: P. **1+**: S. N. **1+**.

Quarterly bulletin. Exp. **2*, 3.**

Indiana (state) horticultural society.

Bulletin. P. **1+**.

Transactions. D. **5, 9, 11, 14-16, 18-24, 26, 27, 29-38, 40+**: E. **5, 6, 8, 9**: Exp. **5-26, 28-45, 47, 49, 50**: F. **10, 11, 16, 19-23, 25-27, 29-32, 40+**: G. **47, 49+**: I. U. **10, 11, 13, 19, 21-23, 29, 40+**: L. P. **7, 9, 10, 40+**: N. D. **46, 51**: N. H. **5, 9, 11, 13, 10-49**: P. **6, 9, 11, 15, 16, 20, 22+**: R. P. **'00-'05**: S. N. **30, 40-49**: T. H. **19-21, 50+**: W. **6+**.

Indiana medical association.

Journal. Exp. **3*, 4***: I. U. **1+**: L. P. **'76-'82, '98-'07**: P. **1+**: T. H. **3, 8, 10-15, 17, 18+**.

Transactions. E. **'78, '80, '81, '85, '86**: Exp. **24-27, 31, 33-36, 38-41, 48, 51-53, 55-58**: M. **1-2, 4+**: N. H. **28-36, 38-50.**

Indiana medical journal. Indianapolis. D. **11-13**: I. U. **17-27**: M. **1+**: P. **11-13, 23-25*, 27**: W. **12-27.**

Indiana. Medical registration and examination, State Board of.

Annual report. Exp. **2, 7, 9-14**: F. **2-14**: N. D. **14**: N. H. **1+**: S. N. **1+**.

Indiana medical society.

Transactions. P. **29, 30, 42, 44-46.**

Indiana pharmaceutical association. Indianapolis.

Proceedings. N. D. **27**: P. **'96, '99.**

Indiana. Pharmacy, Board of.

Annual report. F. **9, 11**: N. H. **1, 9, 11**: S. N. **'07, '09.**

Indiana. Railroad commission.

Annual report. P. **1+**.

Indiana state grange. Patrons of husbandry.

Proceedings. P. **28-30.**

Indiana. Statistics and geology, Bureau of.

Annual report. D. **1, 2**: Exp. **1, 2**: N. H. **1, 2**.

Continued by **Geology** and natural history, Department of *q. v.*; and by **Statistics**, Bureau of. *q. v.*

Indiana. Statistics, Bureau of. Indianapolis.

Annual report. D. **3, 4**: Exp. **3-6**.

Continued from **Indiana.** Statistics and geology, Bureau of, *q. v.*; Continued as

Biennial report. D. **2-5, 7+**: Exp. **1+**.

Indiana Tippecanoe farmer. Lafayette. Exp. **1.**

Indiana university. Bloomington.

Studies. I. U. **1+**: L. P. **8*, 10***: N. D. **10*+**: P. **1+**.

Indiana university. Zoological laboratory.

Contributions. D. 1-58, 60-75, 77-97, 99-114: N. D. 60-114.

Indiana (state) veterinarian. Indianapolis.

Annual report. Exp. **'02, '06, '08, '09**: P. **'02, '06, '08, '09.**

Indiana wool growers' association.

Annual report. Exp. **'01.**

Indianapolis (Ind.) medical journal. I. U. **7+**: M. **12, 14+**: P. **12+**: W. **12+**.

Industrial arts index. Minneapolis, Minn.; White Plains, N. Y. G. **1+**.

Industrial engineering and engineering digest. New York. E. **3, 4**: Ft. W. **6+**: G. **5+**: P. **6+**: R. P. **3+**.

Continues **Engineering** digest *q. v.*

Industrial magazine. Cleveland, O. P. **1+**.

Vols. 1-4 have title **Draftsman**; and vol. 5 has title **Browning's** industrial magazine.

Industries. Manchester, England. R. P. **1-15.**

Inland architect and news record. Chicago, Ill. N. D. **44*, 45*, 48*, 49, 50***: R. P. **30-52.**

Continued as **American** architect *q. v.*

Inland printer. Chicago, Ill. Ft. W. **49+.**

Insect life. Washington, D. C. See under **United States.** Entomology, Bureau of.

Institut catholique. Paris, France.

Ensignment superiur libre. N. D. **'81.**

Institut de France. See **Académie** des sciences.

Institut international de bibliographie. Brussels.

Bibliographia physiologica. Ac. 1[1-5], 2[1, 2].

Institut Pasteur. Paris, France.

Annales. I. U. **20+**: S. L. **24+.**

Bulletin. I. U. **3+.**

Institution of civil engineers. London, England.

Proceedings. P. **1+**: R. P. **87+.**

Institution of electrical engineers. London, England.

Journal. P. **18+.**

Continues from Journal 17, of the Society of Telegraph engineers *q. v.*

Institution of mechanical engineers. Birmingham; London, England.

Proceedings. P. **1+.**

Intermédiaire des mathematiciens. Paris, France. I. U. **18+**: P. **15+.**

International apple shippers' association.

Yearbook. Exp. **'08-'10.**

International association for testing materials.

Report. P. **5.**

American section. See **American** society for testing materials.

International catalogue of scientific literature. London, England.

R. P. secs. A, B, C, D, F. **1+.**

International commission on zoological nomenclature.

Opinions. S. L. **1+.**

International congress of applied chemistry. New York.

Report. Exp. **'12.**

International geographic congress.

Report. P. **8**: S. N. **6.**

International independent telephone association.

Proceedings. P. **10, 11.**

International institute of agriculture, economic and social intelligence. Rome, Italy.

Bulletin. Exp. **'11*, '12+**:

International institute of agriculture, agricultural intelligence in plant diseases. Rome, Italy.

Monthly bulletin. Exp. 2*, 3+.

International journal of microscopy and natural science. London, England. D. 2.

International journal of surgery and antiseptics. New York. D. 1*.

Continued as

International journal of surgery. New York. D. 2*, 3, 4*.

International railway congress. Brussels, Belgium.

Bulletin. P. 19+.

International studio. New York. P. 12*, 13, 14*, 15+.

Internationale Monatsschrift für Anatomie und Physiologie. Leipzig, Germany. I. U. 1+.

Internationale Wochenschrift für Wissenschaft, Kunst, und Technik. Berlin, Germany. I. U. 1+.

Internationaler Kongres katholischen Gelehrten zu München, Germany.

Akten. N. D. '01.

Internationales Archiv für Schulhygiene. Leipzig, Germany. I U. 1+.

Interstate association of live stock sanitary boards.

Proceedings. Exp. 4, 5.

Ion. London, England. W. 1.

Iowa academy of sciences. Des Moines.

Proceedings. Ac. 11, 12, 14-18: I. U. 1, 2, 18+: N. D. 2, 5, 7, 9, 10, 12-15, 17+: S. L. 1[4], 3-5, 7, 9, 10.

Iowa. Agricultural experiment station. Ames.

Annual report. Exp. 1, 3: P. 1*, 2*, 3*, 4+.

Bulletins. Exp. 1+: N. D. 107-112, 114-122, 124-127, 129-141, 143+: P. 1+.

Research bulletins. Exp. 1+: N. D. 1-8, 11+: P. 1+.

Iowa (state) agricultural society.

Report. S. L. '61, '62, '65, '67, '72-'74, '76-'82, '84-'89, '95, '96, '98, '99.

Iowa. Agriculture, Department of. Des Moines.

Yearbook. Exp. '04-'11: P. '05+.

Iowa (state) college of agriculture and mechanic arts. Ames.

Bulletin. Exp. 4, 8.

Extension department bulletin. P. 1-5, 7-12, 14+.

Iowa (state) dairy association.

Report. Exp. '91-'96.

Iowa (state) drainage association.
Proceedings. Exp. **1-2, 4-7.**

Iowa (state). Drainage, waterways and conservation commission.
Report. P. **1+.**

Iowa engineer. Ames. P. **1+.**

Iowa. Engineering experiment station.
Bulletin. Exp. **3*, 4*:** P. **4+.**

Iowa engineering society.
Proceedings. P. **1.**

Iowa. Geological survey.
Annual report. E. **6, 7, 9-20:** I. U. **'55-'57, '66-'69, '92+:** N. H. **'55-'57, '66-'69.**
Bulletin. Exp. **1:** P. **1.**
Report survey of **'55-'59.** E. **1*.**

Iowa (state) geologist. Des Moines.
Report. N. H. **1, 2.**

Iowa. Health, State board of. Des Moines.
Biennial report. P. **'80-'97, '99-'03, '08-'10.**

Iowa (state) highway commission. Ames.
Report. Exp. **2, 3.**

Iowa homestead. Des Moines. Exp. **54*, 55*.**

Iowa (state) horticultural society. Des Moines.
Transactions. D. **16:** Exp. **14-19, 25, 27-46:** P. **44:** S. L. **'72-'07*.**

Iowa naturalist. Iowa City. Ac. **1:** N. D. **1+.**

Iowa park and forestry association. Des Moines.
Proceedings. Exp. **'03, '05.**

Iowa (state) university. Iowa City. Engineering society.
Transit. P. **1-3, 5-13, 15.**

Iowa (state) university. Iowa City. Natural history, Laboratories of.
Bulletin. N. D. **5+:** N. H. **4, 5:** P. **2-4.**

Iowa (state) university. Iowa City. Physical laboratory.
Contributions. P. **1*.**

Iowa (state) university. Iowa City. Psychology, Department of.
Studies. I. U. **1-3:** P. **1, 2.**

Ireland. Agricultural technical instruction, Department of. Dublin.
Bulletin. Exp. **1, 4.**
Leaflets. Exp. **1, 4-7, 9-11, 13-37.**

Iron age. New York. Ft. W. **69, 70, 72*, 73*, 75, 76, 78-85, 87+:** G. **83+:** M. **61, 62, 71+:** N. D. **52-56:** P. **67*-71*, 81+.**

Iron and steel institute. London, England.

Carnegie scholarship memoirs. P. 1+.

Journal. G. '76+: P. 75+.

Iron and steel magazine. Boston, Mass. P. **1-11**.

Vols. 1–6 have title **Metallographist**. Combined in 1906 with **Electro-chemical** and metallurgical industry *q. v.*

Iron trade review. Cleveland, O. G. 45+: P. **39-46.**

Irrigation age. Chicago, Ill. Exp. **24, 25, 26***, **27**+.

Jahresbericht über das Gebiet der Pflanzenkrankheiten. Berlin, Germany. Exp. **11.**

Jahrbuch der Chemie (Meyer). Brunswick. P. **1**+: R. P. **3**+.

Jahrbuch über die Fortschritte der Mathematik. Berlin, Germany. I. U. 1+: P. 1+.

Jahrbücher für wissenschaftliche Botanik. Berlin; Leipzig, Germany. I. U. **7-46,** 48+.

Jahresbericht über die Fortschritte der Chemie und Mineralogie. Tübingen, Germany. P. **'22-'74.**

Jahresbericht über die Fortschritte der reinen pharmaceutischen und technischen Chemie, Physik, Mineralogie, und Geologie. Giessen, Germany. I. U. 1+.

Jahresbericht über die Fortschritte in der Lehre von den pathogen Mikroorganismen. Leipzig; Brunswick, Germany. I. U. **1**+.

Jahresbericht über die Leitsungen und Fortschritte auf dem Gebiete der Neurologie und Psychiatrie. Berlin, Germany. I. U. **1**+.

Jahresberichte der deutschen Mathematiker Vereinigung. Leipzig, Germany. I. U. **1-9, 11-14,** 15+.

Jahresberichte über die Fortschritt der Anatomie und Physiologie. Leipzig, Germany. I. U. 1-8.

Jamaica (W. I.). Agriculture, Department of. Kingston.

Bulletin. Exp. **1-5, 6***.

Report. Exp. **'00, '02-'07.**

Jamaica (W. I.). Botanical department.

Bulletin. Exp. 2*, **3, 9***.

Japan. Agricultural experiment station. Hokkaido.

Bulletin. Exp. 1-11.

Report. Exp. **2-4.**

Japan college of agriculture. Tokyo.

Bulletin. Exp. **5, 7,** 8*. P. 7.

Japan. See **Seismological** society of Japan.

Jardin impériale botanique. St. Petersburg, Russia.

Bulletin. N. D. **12+**.

Jersey bulletin and dairy world. Indianapolis, Ind. Exp. **25***, **26***, **27***, **28***, **29***, **30***, **31+**: P. **24+**.

Jewish agricultural and industrial aid society. New York.

Annual report. Exp. **9, 11**: P. **'09+**.

Johns Hopkins hospital. Baltimore, Md.

Bulletin. Exp. **22+**: I. U. **1+**: M. **18-20, 22**: P. **17+**.

Report. I. U. **1+**.

Johns Hopkins university. Baltimore, Md.

Circulars. Ac. **4-21***: D. **1-11**: I. U. **25+**: P. **16+**.

Josselyn botanical society of Maine. Portland.

Bulletin. N. D. **2.**

Journal de l'anatomie et de la physiologie normales et pathologiques. Paris, France. I. U. **40+**.

Journal de l'école polytechnique. See **École** polytechnique.

Journal de mathématique. Paris, France. I. U. **1-20**; II. **1-19**; III. **1-10**; IV. **1-10**; V. **1-10**; VI. **1+**.

Journal de micrographie. Paris, France. R. P. **1.**

Journal de physiologie et de pathologie générale. Paris, France. I. U. **1+**.

Journal de physique. Paris, France. I. U. III. **6-10**; IV. **1-8**; V. **1+**: P. IV. **4+**: W. IV. **2, 4, 5.**

Journal für die reine und angewandte Mathematik. Berlin, Germany. I. U. **1-119, 121+**.

Journal für Landwirtschaft. Göttingen; Berlin, Germany. Exp. **21-24, 28, 31, 37+**.

Journal für praktische Chemie. Leipzig, Germany. N. D. **51***, **52***; W. **1-80.**

Journal für Psychologie und Neurologie. Leipzig, Germany. I. U. **1+**.

Journal of abnormal psychology. Boston, Mass. I. U. **3, 5+**.

Journal of advanced therapeutics. Rahway, N. J. P. **23***, **24***.

Journal of agricultural science. Cambridge, England. Exp. **3+**: P. **2+**.

Journal of agriculture. London, England. S. L. **1-20.**

Journal of agriculture. St. Louis, Mo. Exp. **51***, **52***, **53***.

Journal of analytical and applied chemistry. Easton, Pa. Exp. **2***, **3***: P. **4-7**||: R. P. **4-7**||: W. **1-7**||.

Continued from Vol. 7 as **American** chemical society. Journal. *q. v.*

Journal of anatomy and physiology. London, England. I. U. **38+**.

Journal of animal behavior. Cambridge, Mass. B1+: D. 1+: I. U. 1+: P. 5+: S. N. 1+.

Behavior monographs. B. 1+: I. U. 1+.

Journal of applied microscopy. Rochester, N. Y. B. **2-6**||: N. D. **1***, **2***, **3-6**||: S. N. **4-6**||.

Journal of biological chemistry. New York. I. U. 1+: N. D. 1+: P. 1+: S. L. 2+.

Journal of botany, British and foreign. London, England. Exp. **40-49.**

Journal of botany (Hooker). London, England. I. U. 1+: N. H. **1-4.**

Journal of comparative medicine and surgery. Philadelphia, Pa. Exp. **1-10**||.
Continued by **Journal** of comparative medicine and veterinary archives *q. v.*

Journal of comparative medicine and veterinary archives. Philadelphia, Pa. Exp. **11-24.**

Journal of comparative neurology. Philadelphia, Pa. D. **1-21**: I. U. 1+: S. N. 16+.

Volumes 14-20 were entitled **Journal** of comparative neurology and psychology.

Journal of comparative pathology and therapeutics. London, England. Exp. 23+.

Journal of cutaneous and venereal disease. New York. D. **1***, **2***, **3***.

Journal of economic entomology. Concord, N. H. Exp. 1+: P. 1+: S. L. **1-4**: W. 2+.

Journal of educational psychology. Baltimore, Md. I. U. 1+: P. 1+: S. N. 1+.

Journal of engineering. Boulder, Colo. See under **Colorado** university.

Journal of electricity, power, and gas. San Francisco, Calif.; New York. P. 27+.

Journal of experimental medicine. New York; Lancaster, Pa. Exp. 13+: I. U. **1-6, 8-12,** 14+.

Journal of experimental zoology. Philadelphia, Pa. E. **6**: I. U. **1-12**: P. 1+: S. L. 6+: S. N. 1+: W. 2+.

Journal of genetics. Cambridge, Mass. I. U. 1+.

Journal of geography. Lancaster, Pa.; Chicago, Ill.; New York. I. U. 7+: S. N. 1+.

Journal of geology. Chicago, Ill. B. **7-18**: E. 1+: F. 20+: I. U. 1+: M. **18, 19**: P. **1***, **2***, **3*-5***, **6-14**, **15***, 16+: S. L. 1+: S. N. 1+: W. 1+.

Journal of home economics. Geneva, N. Y. P. 2+.

Journal of hygieo-therapy. Kokomo, Ind. D. **4***, **5***, **6***, **7***: P. **1***.

Journal of hygiene. Cambridge, England. I. U. 1+: P. 6+.

Journal of industrial and engineering chemistry. Easton, Pa. D. **1**+: Exp. **1**+: Ft. W. **4**+: G. **5**+: I. U. **1**+: N. D. **1**+: P. **1**+.

Journal of infectious disease. Chicago, Ill. Exp. **1**+: P. **1**+: S. L. **5**+: T. H. **6**+.

Supplement. Exp. **1-4**.

Journal of materia medica. New Lebanon, N. Y. D. **1***, **13***, **14***, **15***, **20***, **23***, **24***.

Journal of medical research. Boston, Mass. Exp. o. s. **24**+: I. U. n. s. **1-17**, **21**+: T. H. **20-22**, **24-26**.

Journal of medical science. Dublin, Ireland. D. **62**, **66**, **72**.

Journal of medical science. Edinburgh, Scotland. D. **1-3**.

Journal of mental science. London, England. I. U. **40-56**, **58**+.

Journal of microscopical science. See **Quarterly** journal of microscopical science.

Journal of morphology. Boston, Mass.; Philadelphia, Pa. B. **10-20**: D. **1-23**: I. U. **1-17**, **19**+: P. **1**+: W. **17**.

Journal of mycology. Manhattan, Kan.; Washington, D. C.; Columbus, O. D. **1-14**||: N. D. **1-3**, **7***, **8***: S. L. **1-7**: S. N. **1-4**: W. **9-12**.

Continued as **Mycologia** *q. v.*

Journal of nervous and mental diseases. New York. I. U. **27**+: T. H. **36**+.

Journal of pathology and bacteriology. Cambridge, Mass. Exp. **15**+.

Journal of pathology and bacteriology. Edinburgh, Scotland; London, England. I. U. **1**+.

Journal of pharmacology and experimental therapeutics. Baltimore, Md. P. **1**+.

Journal of philosophy, psychology and scientific methods. New York. E. **1-6**: I. U. **1**+: P. **5**+: S. N. **1**+.

Journal of physical chemistry. Ithaca, N. Y. B. **18**+: I. U. **1-15**: P. **6**+.

Journal of physiology. Cambridge, London, England. D. **1-6**, **12**, **16**: I. U. **1**+: P. **32**+.

Journal of race development. Worcester, Mass. I. U. **1**+.

Journal of religious psychology. See **American** journal of religious psychology and education.

Journal of school geography. Lancaster, Pa. S. N. **1**+.

Journal of the board of agriculture. London, England. Exp. **17***, **18**+.

Journal of the veterinary science in India. Madras. Exp. **1-7**.

Journal of tropical medicine. London, England. I. U. **9**+.

Journal russe de botanique. St. Petersburg, Russia. N. D. **'12**+.

Jurjev (Russia) Imperial university.

Acta horti botanici. N. D. **14+**.

Kaiserlich Gesundheitsamte. Berlin, Germany.

Arbeiten. Exp. **1, 3.**

Kaiserlich-königliche zoologische-botanische Gesellschaft. Vienna, Austria.

Verhandlungen. Ac. **38**, $\mathbf{39}^{1-4}$, $\mathbf{40}^{3,4}$, **41-43**, $\mathbf{44}^{1-4}$, $\mathbf{45}^{1-10}$, $\mathbf{46}^{1-3,5,7,9,10}$, $\mathbf{47}^{1-10}$, **49-60**, $\mathbf{61}^{1-10}$.

Kaiserlich-leopoldinische-carolinische deutsche Akademie der Naturforscher. Halle, Prussia.

Abhandlungen. Ac. **68**, $\mathbf{69}^{1,2}$, $\mathbf{70}^{1}$, $\mathbf{73}^{3}$, $\mathbf{77}^{1}$, $\mathbf{79}^{2}$, $\mathbf{81}^{1,3,6}$, $\mathbf{82}^{3,4}$, $\mathbf{86}^{1,2}$, $\mathbf{88}^{3}$, $\mathbf{90}^{1,3,4}$, $\mathbf{92}^{1}$, $\mathbf{93}^{2}$.

Kansas academy of science. Topeka.

Transactions. Ac. **9, 19-22, 24**: E. **13, 15-18**: Exp. **8, 12**: I. U. **20-21, 24, 25, 28, 29, 32-35**: N. D. **20+**: N. H. **21***: R. P. **'87-'90, '99-'02**: S. L. **5, 8-17.**

Kansas (state) agricultural college. Manhattan.

Agricultural education. P. **'10+**.

Kansas. Agricultural experiment station. Lawrence.

Annual report. Exp. **1-5.**

Kansas. Agricultural experiment station. Manhattan.

Annual report. Exp. **1+**: P. **1+**: S. L. **'83-'00.**

Bulletin. D. 75, 127, 129: Exp. 1+: N. D. 180: P. 1+: S. L. '89-'98.

Kansas. Agriculture, State board of.

Annual report. D. **5**[illegible].

Continued as

Biennial report. D. **1, 3-5**: Exp. **9+**: N. D. **4**: P. **1, 3, 10+**.

Quarterly report. Exp. **20***, **21***, **22***, **23***, **24***, **27***, **28+**: P. **26, 27***, **28***, **29, 30***, **31+**.

Kansas (state) entomological commission.

Report. P. **1+**.

Kansas farmer. Topeka. Exp. **47***, **48***, **49***, **50***, **51+**.

Kansas (state). Fish and game, Department of.

Bulletin. P. **1+**.

Kansas (state). Geological survey.

Bulletin on mineral resources. I. U. **1+**: P. **'99, '03**: R. P. **'97-'99.**

Report. E. **1-7, 9**: P. **3, 5, 6**: R. P. **2-5.**

Report of progress. P. n. s. **1.**

Kansas (state) horticultural society. Topeka.

Biennial report. D. **1-3.**

Pamphlets. S. L. **1-4.**

Report. D. **9-16**‖: P. **15.**

Continued as Biennial report *q. v.*

Transactions. Exp. **13-16, 18-22, 24, 27, 28, 30, 31**: S. L. **'78-'10.**

Kansas industrialist. Manhattan, Kan. N. D. **38*, 39*+.**

Kansas live stock sanitary commission. Topeka.

Biennial report. Exp. **'09, '10.**

Kansas university. Lawrence.

Engineering record. P. **1-2.**

Quarterly. Ac. ser. A. **6-10**: ser. B. **6-7**: P. **1-10*.**

Science bulletin. Ac. **1-5, 6**: D. **4*, 7*, 13***: I. U. **1+**: N. D. **1+**: P. **1+**: R. P. **1+.**

Keith's magazine. Minneapolis, Minn. Ft. W. **15+**: G. **23+.**

Kentucky. Agricultural experiment station. Lexington.

Annual report. D. **2-18**: Exp. **1+**: P. **1+.**

Bulletin. D. 93, 124-133, 135, 140, 142-148, 151-158, 161-164 167, 169+: Exp. 1+: P. 1+: S. L. '09+.

Kentucky (state) agricultural society.

Report. S. L. **'56, '57.**

Kentucky. Agriculture, labor and statistics, Bureau of. Frankfort.

Biennial report. Exp. **'04, '05**: P. **'06-'09.**

Kentucky (state) farmers' institute. Louisville.

Annual report. Exp. **'07, '11.**

Kentucky. Forestry and emigration, State board of.

Annual report. Exp. **'78.**

Kentucky (state). Geological survey.

Report of progress. I. U. **'54-'59**: N. D. **'56, '57**: N. H. **1-4**: P. n. s. **1.**

Keramic studio. New York. C. **12+.**

Kew. England. See **Royal** botanic gardens.

Kimball's dairy farmer. Waterloo, Ia. Exp. **7, 8*, 9+.**

Kleinwelt. Zeitschrift der deutschen mikrologischen Gesellschaft. Munich, Germany. N. D. **'09+.**

Königlich-bayerische Akademie der Wissenschaften. Munich, Germany.

Sitzungberichte. Ac. **1-15, '11**$^{1-3}$, **'12**$^{1, 2}$.

Königlich deutsches archaeologisches Institut.

Mittheilungen athenische. I. U. **1+.**

Mittheilungen roemische. I. U. **1+.**

Königlich-preussische Akademie der Wissenschaften. Berlin, Germany.
Abhandlungen. I. U. 1+.

Königlich-sächsische Gesellschaft der Wissenschaften:mathematisch-physische Klasse.

Berichte über die Verhandlungen. I. U. 63+.

Königliche Gesellschaft der Wissenschaften zu Gottingen. Mathematisch-physikalische Klasse.

Nachrichten. I. U. 61+.

Königliche katholische Gymnasium. Culm, Germany.

Jahresberichte. N. D. **10.**

Kongelige norske videnskabers selskab. Trondhjem, Norway.

Skrifter. Ac. **'97-'11.**

Kongliga svenska Vetenskaps-akademie. Stockholm, Sweden.

Arkiv för botanik. Ac. 1^{1-4}, 2^{1-3}, 7+.

Arkiv för kemie, mineralogi och geologie. Ac. 1^{1}, 3^{1-6}, 4^{1-}.

Arkiv för zoologi. Ac. 1^{1}, 4+.

Behang till handlingar. Ac. **12-28.**

Koninklijke natuurkundige Vereeniging in Nederlandsch-Indie. Weltevreden, Dutch East Indies.

Natuurkundige Tijdschrift. Ac. 52, 53, 55+.

Koninklijke akademie von wettenschafpen. Amsterdam, Holland. I. U. 13+.

Kosmos. Stuttgart, Germany. N. D. '13+.

Lake Michigan water commission.

Report. P. 1+.

Lancet. London, England. I. U. 82-87.

The American reprint was issued in New York under the title **London** lancet *q. v.*

Landscape architecture. Harrisburg, Pa. G. 2+.

Landwirthschaftliche Jahrbücher. Berlin, Germany. Exp. **12-26, 40**+.

Landwirtschaftlichen Versuchsstationen. Berlin, Germany. Exp. **17, 36, 37,*** **38, 39***, **40**+: I. U. **35-47, 49**+.

La Plata (Argentine Republic). See **Museo** de la Plata.

Leaflets of botanical observations and criticism (Greene). Washington, D. C. N. D. **1**+.

Leeds (N. Dak.) herbarium.

Bulletin. N. D. **1, 2**‖.

Leland Stanford, jr. university. Hopkins laboratory.

Contributions to biology. Exp. **19, 25, 27, 30**: I. U. **1-32**: P. **1-8, 10-12, 14, 16, 18-30.**

Publications. Ac. **1-6, 9**: Exp. **1-6, 9, 11**+: P. 1+.

Lens. Chicago, Ill. R. P. **1, 2**‖.

Lick observatory. See **California** university.

Liebig. Annual report of progress of chemistry and allied sciences. London, England. R. P. **1-4.**

Lilly scientific bulletin. Indianapolis, Ind. Exp. **I***: N. D. I. 1+.

Lincoln (Neb.) freie press. Exp. **28***, **29**+.

Linnean society of London (England).

Transactions. I. U. II. zoology 4+.

Linnean society of New South Wales. Sidney, Australia.

Proceedings. Ac. **25, 26**$^{1-4}$, **27**$^{2-4}$, **28**$^{1-4}$, **29**$^{1-4}$.

Linnean society of New York.

Abstract of proceedings. Ac. **1-4, 6-11.**

Transactions. Ac. **1.**

Lister institute of preventive medicine. London, England.

Collected papers. Ac. 2-8$^{1-2}$.

Live stock journal. Chicago, Ill. Exp. **48***, **55***, **56***; P. **33-42.**

Live stock journal. London, England. Exp. **33-48, 56-62, 65***, **66**+.

Lloyd library. Cincinnati, O.

Bibliographical contributions. Ac. 1+: Exp. 2-10: N. D. 1+.

Bulletins. Botanical series. Ac. 2: Exp. 2: N. D. 1+: P. 1+.

Materia medica series. N. D. 1+: P. 1+.

Mycological series. Ac. 1-4, 6: Exp. 3-4: P. 1+.

Pharmacy series. Ac. 1+: Exp. 1-5: N. D. 1+: P. 1+.

Polyporoid series. Exp. 1.

Reproduction series. Ac. 1-6: Exp. 1-7.

Mycological notes. Ac. 1-26, 30-35: Exp. 32-37: N. D. 1*-3*: P. 1-11, 14+.

Locomotive engineering. New York. P. 8*, 9*, **10-13**‖: R. P. **10-13**‖.

Continued as **Railway** and locomotive engineering *q. v.*

Locomotive firemen's and enginemen's magazine. Terre Haute, Ind.; Peoria, Ill. P. **46**+: R. P. **10, 12**+.

London (England). See **Lister** institute.

London (England). Agriculture and fisheries, Board of.

Annual report. Exp. **'04, '05, '08.**

Leaflets. Exp. 18, 29, 66, 78, 97, 100, 144, 146, 160-190, 192-194, 196-206, 208-226, 228, 233, 241, 242, 245, 246, 248-255, 257+.

London (England) horticultural society.

Transactions. N. D. **1-4.**

London (England) journal of arts and sciences. N. D. **1-4**, 8, **9, 12, 13.**

London lancet. New York. N. H. **1-14; n. s. '52-'58.**
American reprint of the **Lancet,** London. *q.*

London mathematical society.
Proceedings. I. U. I. **1-35; II. 1+.**

London (England) medical and surgical journal. D. **1-8.**

London (England) microscopical society.
Transactions. R. P. **1-3.**

London physical society.
Proceedings. I. U. **1+**: P. **19+.**

Long Island agronomist. Medford, N. Y. Exp. **1+**: P. **5+.**

Louisiana. Agricultural experiment station. Baton Rouge.
Annual report. Exp. **1+**: P. **1-6, 10, 12+.**
Bulletin. Exp. o. s. 1-8, 10-28; n. s. 1+: P. 1+: S. L. 106-112, 115-116, 124.

Louisiana. Agriculture, Commissioner of.
Biennial report. P. **2, 9, 12, 13.**

Louisiana conservation commission.
Report. P. **'10.**

Louisiana. Crop pest commission. Baton Rouge.
Biennial report. Exp. **'06-'09**: P. **'04-'07.**

Louisiana geological survey.Baton Rogue.
Bulletin. Exp. 1, 3-8: P. 1-5, 7-8.
Report. P. **'99, '02.**

Louisiana. Gulf biologic station. Cameron.
Bulletin. P. **3, 4, 6, 7, 9-11, 13-15.**

Louisiana (state) horticultural society. Baton Rouge.
Annual report. Exp. **'04-'08.**

Louisiana (state) museum. New Orleans.
Bulletin. Ac. 1: Exp. 1: N. D. 1, 2, 4+.
Report. Ac. **'10, '12**: N. D. '08, '10+.

Louisiana planter and sugar manufacturer. New Orleans. Exp. **3*, 4-8, 9*, 10-12, 13*, 14*, 15*, 16, 17*, 18*, 19*, 20*, 21*, 22, 23, 24*, 25*, 26, 27, 28*, 29*, 30, 31*, 32, 33*, 34, 35*, 36*, 37-40, 41*, 42*, 43-45, 46*, 47*, 48*, 49*, 50+.**

Louisiana society of naturalists.
Proceedings. N. D. **'00.**

Louisiana state university. Baton Rouge.
Farmer's library circulars. P. **1.**

Louisville (Ky.) medical monthly. P. 2*, 3*.

Lowell observatory. Flagstaff, Ariz.

Annals. I. U. **'98, '00, '05.**

Lumière électrique. Paris, France. P. n. s. **1+**.

Continues **Eclairage** électrique *q. v.*

Lyon (France), Université catholique de. N. D. n. s. **6-9.**

Machinery. New York. Engineering edition. Ft. W. **13+**: G. **7***, **8+**: L. P. **15***, **16***, **18***, **19+**: P. **10+**: R. P. **3+**.

Magazine of art. London, England. P. **3-13, 14***.

Magyar botanikai Lapok. Budapest, Hungary. N. D. **10+**.

Magyar királyi természéttudományi társulat. Budapest, Hungary.

Megbizásából. Ac. **1-3.**

Magyar madártani központ folyŏirata. Budapest, Hungary.

Aquila. Ac. **5+**: N. D. **'12+**.

Magyar memzeti múzeum. Budapest, Hungary. Ac. **1-3.**

Maine. Agricultural experiment station. Orono.

Annual report. Exp. **'85+**: P. **'88+**.

Bulletin. D. 28, 32, 35, 36, 42, 46, 113, 115-118, 136, 138: Exp. o. s. **1-26**: n. s. 1+: P. 1+.

Official inspection bulletin. Exp. **1+**: P. **1+**.

Maine. Agriculture, Commissioner of.

Annual report. P. **1+**: S. N. **1+**.

Bulletin. P. 8*, 9*, 10*, 11+.

Maine. Agriculture, state board of.

Annual report. P. **1-45.**

Maine. Cattle commissioners.

Report on contagious diseases of animals. P. **'02-'08.**

Maine dairymen's association.

Annual report. Exp. **9-11**: P. **13.**

Maine (state) entomologist.

Annual report. P. **1-6.**

Maine forest commissioner.

Report. P. **4, 5, 7, 8**: S. N. **4, 5, 7.**

Maine. Health, State board of. Augusta.

Annual report. Exp. **8-10, 12-15**: P. **1-15**

Bulletin. Exp. *1, 2+.

Report of sanitary inspector. Exp. 8*, **9, 10, 11-15***.

Maine. Highway, Commissioner of.

Annual report. S. N. **'05-'09.**

Maine (state) horticulturist.

Annual report. P. 1+.

Maine. Inland fisheries and game, Commissioner of.

Report. P. '02, '06+: S. N. '02, '06, '08.

Maine (state) pomological society. Turner.

Transactions. Exp. '95, '99, '01.

Maine. Sea and shore fisheries, Commissioners of.

Report. P. '02+: S. N. '03-'08.

Maine. Water storage commission. Augusta.

Report. N. D. 1+: P. 1+.

Malvern (England) college natural history society.

Report. N. D. 9+.

Man. London, England. I. U. 8+.

Manchester (England) microscopical society.

Annual report and transactions. N. D. '11+.

Manchester (N. H.). Water commissioners, Board of.

Annual report. N. D. 4+.

Manitoba. See **Historical** and scientific society of Manitoba; **Winnipeg.**

Manitoba agricultural college. Winnipeg.

Bulletin. Exp. 1-5.

Manitoba horticultural and forestry association. Winnipeg.

Annual report. Exp. '98, '02-'06, '08, '09.

Manual training magazine. Chicago; Peoria, Ill. Ft. W. 10+: G. 10+: I. U. 6+: L. P. 10+: N. H. '11+: P. 9+: S. N. 1+: T. H. 9+.

Marconigraph. New York. Ft. W. 1+.

Marine biological laboratory. Woods Hole, Mass.

Lectures. I. U. 1-7: S. N. '93-'99.

See **Biological** bulletin.

Market growers' journal. Louisville, Ky. Exp. 1, 2, 3*, 4-7, 8*, 9+

Maryland agricultural college. College Park, Md.

Quarterly. Exp. 1-3, 5-21, 23-37, 46-48, 50+.

Maryland. Agricultural experiment station. College Park.

Annual report. Exp. 1+: P. 1+.

Bulletin. D. 58, 60: Exp. 1+: P. 1+: S. L. '98-'09.

Special bulletin. Exp. '89-'90.

Maryland. Geological survey.

Report. E. 1-6, 9: I. U. 1: P. 1+.

Maryland (state) horticultural society. College Park.

Annual report. Exp. 2-4, 6-13.

Maryland. Statistics and information, Bureau of. Baltimore.

Annual report. Exp. **'10-'11.**

Maryland weather service. Baltimore, Md.

Report. E. **2**: Exp. **2**: P. n. s. 1+: S. N. n. s. 1+.

Special publications. N. D. **3.**

Massachusetts agricultural college. Boston, Mass.

Annual report Exp. **'92-'94, '97-'01, '04.**

Massachusetts. Agricultural experiment station. Amherst: Hatch station.

Annual report. Exp. **1**+: N. D. **19-22, 24**+: P. **2, 3,** 8+.

Bulletin. Exp. 1+: N. D. 100-106, 108, 110-121, 123-135, 138+: P. 1+.

Massachusetts. Agricultural experiment station. State station.

Annual report. Exp. **1-25**: P. **1-12.**

Bulletin. Exp. 5, **7-56**: P. 1-45, 47-49, 51, 52, 54-56.

Meteorological observations. Exp. 1+: P. 234+.

Special bulletin. Exp. 1-6.

The Hatch station and the State station were combined in 1896.

Massachusetts agricultural society.

Reports. N. D. **1**+.

Massachusetts. Agriculture, State board of.

Annual report. Exp. **'53**+: N. D. **10, 11**+: P. **'55, '86-'69**: R. P. **4, 29.**

Bulletin. Exp. 1+: P. 1+.

Crop report bulletin. Exp. 23+.

Nature leaflets. Exp. 1+.

Massachusetts. Cattle commissioners, Board of. Boston

Annual report. Exp. **'99-'01.**

Massachusetts (state) forester.

Bulletin. P. **1, 3-5.**

Report. P. **5**+.

Massachusetts fruit growers' association.

Annual report. Exp. **12-17.**

Massachusetts. Health, State Board of.

Annual reports. R. P. **1-11, 23**: P. **1-7, 11,** 18, 20-29, 32+.

Massachusetts. Highway commission.

Report. P. **1, 4, 7-14, 17**+.

Massachusetts horticultural society. Boston.

Transactions. Ac. **'92**[2], **'93**[1, 2], **'94**[1, 2], **'95**[1-3], **'96**[1-3], **'97**[1, 2], **'98**[1, 2], **'99**[1, 2], **'00**[2], **'03**[2], **'04**[1, 2], **'05**[1, 2], **'06-'09, '10**[1, 2], **'11**[1], **'12**[1]+: Exp. '88, **'89, '90, '91**+: P. '83 **'95.**

Massachusetts. Zoological and botanical survey. Commissioner of.
Report. N. D. '41: N. H. '41.
Master car builders' association. New York.
Proceedings. P. 1-6, 9, 11, 13-24, 26-37, 39+.
Materia medica or Pharmacology and therapeutics. Springfield D. 1*.
Mathematical gazette. London, England. I. U. 1+: S. N. 4+.
Mathematical magazine. Washington, D. C. I. U. 1: W. 2.
Mathematical messenger. Ada, La.; Tyler, Tex. I. U. 4-7.
Mathematical monthly. Cambridge, Mass. I. U. 1-3: P. 1-3: R. P. 1-3.
Mathematical questions and their solutions. London. England. I. U. 1-75; n. s. 1+.
Mathematical review. Worcester, Mass. I. U. 1*, 2*.
Mathematical visitor. Erie, Pa. I. U. 1, 2.
Mathematico-physical society of Tokyo, Japan.
Journal. I. U. '11.
Mathematische Annalen. Leipzig, Germany. R. P. 1+: P. 1+: I. U. 1+.
Mathematische und naturwissenschaftliche Berichte aus Ungarn. Budapest, Hungary. Ac. 1-12, 14-26$^{1-3}$: I. U. 1+.
Mathésis, recueil mathématique. Ghent, Belgium. I. U. 1-17, 19+.
Mechanics. See **Engineering** mechanics.
Mechanics. N. D. 13, 14, 16, 18, 19.
Mechanics' magazine. London, England. N. H. 1-15, 19, 20.
Mechanics' magazine and register of invention and improvement. New York. N. H. 1-4.
Medical adviser. London, England. N. H. 1-5.
Medical age. Detroit, Mich. D. 1*, 2*, 3*, 4-6, 7*, 8, 9*.
Continues from **Michigan** medical news *q. v.*
Medical and surgical journal. Edinburgh, Scotland. D. 33-36, 38-52.
Continued as **Medical** journal *q. v.*
Medical and surgical journal. London, England. D. 1-8.
Medical and surgical monitor. Indianapolis, Ind. I. U. 7+: S. N. 8-10.
Medical and surgical reporter. Burlington, N. J.; Philadelphia, Pa. D. 24*, 27*, 39*, 45*, 46*, 47, 57*, 58*, 62*: P. 50-53*.
Medical brief. St. Louis, Mo. D. 4*, 5-12, 13*, 14-19, 20*, 21*: P. 14-24*.
Medical gazette. New York. D. 8*, 9*, 10*.
Medical gleaner. St. Louis, Mo. D. 1.
Medical investigator. Bloomington, Ind. I. U. 1.
Medical journal. Edinburgh, Scotland. D. 1, 2*, 3, 5, 7, 8*, 9, 10, 11*, 12*.

Medical monitor. See **Central** states.

Medical news. Philadelphia, Pa. D. **31-35**, **36***: I. U. **52-55**: N. D. **27-30**: N. H. **30***, **31***, **32***, **37*-39.**

Vols. 1-37 were called **Medical** news and library; vols. 38-39 **Medical** news and abstract.

Medical news and library supplement. Philadelphia, Pa. D. 379-383.

Medical record. New York. Exp. **77+**: I. U. **24, 25, 29-36, 43-56**: M. **13-41.**

Medical review of reviews. New York. Exp. **15, 16**: P. **7-12***.

Medical science. See **Journal** of Medical science; also **Monthly** journal of medical science; also **Quarterly** journal of medical science.

Medical standard. Chicago, Ill. P. **17, 18***.

Medical world. New York; Philadelphia, Pa. D. **1***, **3*-6***, **7, 8, 9***: P. **8, 11, 13, 14***.

Mennonitische Rundschau. Scottsdale, Pa. Exp. **33***, **34***, **35***, **36*+**.

Merck's bulletin. New York; London, England. P. **2-4***.

Merck's annual report on medical preparations. New York. N. D. **10+**: P. **4, 6+**.

Meriden (Conn.) scientific association.

Transactions. Ac. **1-6.**

Messenger of mathematics. London; Cambridge, England. D. **1-22**: I. U. n. s. **1-23**: R. P. **1+**: S. N. **26-36.**

Continues **Oxford,** Cambridge and Dublin messenger of mathematics *q. v.*

Metal industry. New York. Ft. W. **2+**.

Metallographist. Boston, Mass. See **Iron** and steel magazine.

Metallurgical and chemical engineering. New York. D. **2+**: E. **7+**: G. **7+**: I. U. **1+**: N. D. **3+**: P. **1+**: R. P. **1+***.

Vols. 1 and 2 have title **Electrochemical** industry and vols. 3-7 have title **Electrochemical** and metallurgical industry.

Mexico. Secretaria de fomento, colonizacion e industria de la Republica Mexicana. Mexico City.

Boletin del instituto geologico. Ac. **10-15.**

Mexico City (Mexico). See **Museo** nacional.

Mexico (City) instituto medico nacional.

Anales. Ac. $\mathbf{11^{1-3}}$, $\mathbf{12^{1, 2}}$.

Mexico. Estacion agricola experimental de Ciudad Juarez.

Bulletin. Exp. **1+**.

Mexico rubber planters' association.

Yearbook. Exp. **'07, '08.**

Meyer brothers' druggist. St. Louis, Mo. N. D. **23*-33***: P. **12, 15, 17, 18, 22, 28+**.

Michigan academy of science. Lansing.

Bulletin. P. **1-3***.

Report. I. U. 7+: N. D. 1+: P. 1+: S. L. **'94-'00, '02**+.

Michigan agricultural college. Zoology and physiology, Department of.

Special bulletin. N. D. **'12**+.

Michigan. Agricultural experiment station. East Lansing.

Annual report. Exp. **1-5,** 8+.

Bulletin. D. 45, 76, 125, 146-147, 218, 222-224, 232, 250-252, 258,+: Exp. 1+: N. D. 260, 267+: P. 1-144, 146+.

Elementary science bulletins. Exp. 1+: P. 1, 2, 4+.

Special bulletins. D. 7, 29, 32, 44, 54, 59+: Exp. 2, 4-5, 7+: P. 1+.

Technical bulletins. D. 5-7, 11+: Exp. 1+: P. 1+.

Michigan. Agriculture, State board of. Lansing.

Annual report. D. **15-17,** 25, 26, 28-30, 35-37, 39, 49+: Exp. **3-7, 9-11, 14-20, 23-31,** 33+: P. 6, **7, 10-14, 17-19,** 23, 25-37, 39+: R. P. 25, 26, **28-30.**

Biennial report. Exp. **1.**

Continues **Michigan** (state) agricultural society *q. v.*

Michigan (state) agricultural society. Lansing.

Transactions. Exp. **1, 3-8, 11:** P. **'50, '52, '58, '59:** S. L. **'52, '57.**

Continued by **Michigan.** Agriculture, State board of. *q. v.*

Michigan (state) association of farmers' clubs. Metamora.

Annual report. Exp. **'05-'12.**

Michigan. Dairy and food commissioner.

Report. P. **'03, '05**+.

Michigan dairy farmer. Detroit. Exp. **2*, 3, 4***, 5+.

Michigan dairymen's association.

Annual report. Exp. **7-9, 12:** P. **15.**

Michigan fish commission. Lansing.

Bulletin. Exp. **2.**

Michigan engineering society.

Michigan engineer. P. **1-2, 4-5, 11-29:** R. P. **'94-'96.**

Michigan. Forestry commission.

Report. Exp. **'88:** P. 1+*.

Michigan. Geological survey. Lansing.

Report. E. **'01, '03-'06:** N. D. **'06:** N. H. **1:** S. N. **'07.**

Michigan. Health, State board of. Lansing.

Annual report. Exp. **4, 13-18, 20-22, 24-28:** P. **1-33,** 35+: R. P. **'85.**

Michigan (state) horticultural society. Lansing.

Annual report. D. **10-21**: Exp. **10-16, 18-21, 36-41**: P. **10-18, 40+**: S. L. **10+**.

Prior to 1880 known as the **Michigan** (state) pomological society *q. v.* The volume numbers of the reports are continuous.

Michigan. Live stock sanitary commission. Stanton.

Biennial report. Exp. **2-13.**

Mich gan (state) pomological society. Lansing.

Annual report. D. **3, 5-9**‖: Exp. **3-9**‖: P. **2, 6, 8, 9**‖: S. L. **1-9**‖.

In 1880 the society took the name of the **Michigan** (state) horticultural society *q. v.*

Michigan medical news. Detroit. D. **1***, **2***, **3***, **4, 5***.

Continued in **Medical** age *q. v.*

Michigan university. Clinical society.

Transactions. I. U. **1+**.

Michigan university. Engineering society.

Technic. P. **2, 3, 5, 7-22.**

Michigan university. Museum of natural history. Ann Arbor.

Report. S. L. **'12.**

Michigan university. Botany, Department of.

Bulletin. N. D. n. s. **7***.

Michigan (state) veterinarian. Lansing.

Biennial report. Exp. **6.**

Microscope, The. Washington, D. C. N. D. **6***, **7, 8*-10***, **11, 12***; n. s. **1***, **2***, **3, 4***.

Microscopical bulletin and science news. Philadelphia, Pa. Ac. 6^{3-6}, 7^{1}, 14^{2}, 15^{2}, 17^{4}, $18^{1,2}$: N. D. **2*-8***, **9, 10, 11***, **1 ***, **24***.

Milchwirtschaftliches Zentralblatt. Leipzig, Germany. Exp. **6, 7, 41+**.

Milch Zeitung. Leipzig, Germany. Exp. **18, 39, 40.**

Milwaukee (Wis.). Public museum.

Reports. Ac. **'98+**.

Mind. London, England. B. n. s. **10+**: I. U. o. s. **1-16**; n. s. **1+**: P. n. s. **17+**: S. N. **1+**: W. **5-18.**

Mind and body. Milwaukee, Wis. G. **17+**: I. U. **1-16, 18+**: S. N. **1-13, 15+**.

Mineral industry. New York. I. U. **1-6**: P. **9-15**: W. **12.**

Mining and engineering world. New York. Ft. W. **38+**.

Minnesota academy of natural sciences. Minneapolis.

Bulletins. Ac. 2^{1-5}, 3^{3}: P. **3***.

Minnesota. Agricultural experiment station. St. Paul.

Annual report. D. **12**: Exp. **'93+**: P. **'88, '94-'96, '98+.**

Biennial report. Exp. **'88-'92.**

Bulletin. D. 39, 46, 51, 89-91: Exp. 1+: P. 1+.

Minnesota (state) agricultural society. Hamlin.

Annual report. Exp. **'00-'07, '09, '10.**

Minnesota and Dakota farmer. Brooking, S. D. Exp. **3*, 4, 5*.**

Minnesota dairymen's association.

Annual report Exp. **'93, '01**: P. **03, '04.**

Minnesota (state) entomologist.

Minnesota insect life. P. **1+.**

Minnesota. Fire warden, Chief.

Annual report. S. N. **'99, '00, '02.**

Minnesota (state) food and dairy commission. St. Anthony Park.

Biennial report. Exp. **5, 7.**

Minnesota. Forestry commissioner.

Report. P. **1-2, 4-8, 11, 12, 14, 16.**

Minnesota. Geological and natural history survey.

Minnesota botanical studies. Exp. **1+**: N. D. **1+**: P. **1+.**

Minnesota plant studies. Exp. **1-4**: N. D. **1+**: P. **1+.**

Report. E. **1-5**: N. D. **1, 3, 5, 8+**: N. H. **4, 5, 8, 11**: P. **1-4.**

Minnesota. Health, State board of.

Annual report. P. **'74, '75. '78-'86.**

Minnesota (state) horticultural soc ety. St. Paul.

Report or Transactions. D. **'66-'73, '82-'85, '87-'89, '92-'94**: Exp. **'84 '86-'89, '92, '95-'01**: S. L. **'92, '94, '95.**

Minnesota northeast experiment farm.

Report. Exp. **'06.**

Minnesota. Stallion registration board. St. Anthony Park.

Bulletin. Exp. **1-3**: P. **1+.**

Minnesota university. Minneapolis.

Minnesota botanical studies. Exp. **1+**: N. D. **4+**: S. N. **1, 2.**

Minnesota university. Society of engineers.

Yearbook. P. **1, 4, 5, 8-17.**

Minnesota university. Sea side station.

Postelsia. D. 1: I. U. **1, 2**: P. **1, 2.**

Minnesota. Waterways commission.

Reports. P. **1+**.

Miramichi (New Brunswick) natural history society.

Proceedings. N. D. **4, 6+**.

Mississippi. Agricultural experiment station. Agricultural college.

Annual report. D. **12, 13**: Exp. 1+: P. **1-8, 10, 13, 15+**.

Bulletin. D. 50, 66, 73, 76, 79-80, 83: Exp. 1-37, 39-45, 47, 49-84, 86-96 98-152, 15 +: P. 1+: S. L. **'09-'10***.

Technical bulletins. Exp. 1, 2: P. 1+.

Mississippi. Geological survey.

Bulletin. P. **8**.

Mississippi river power company.

Bulletin. N. D. **1-7**.

Mississippi valley horticultural society.

Transactions. D. **1, 2**: P. **1**, 2.

See **American** horticultural society.

See **American** horticultural society.

Missouri. Agricultural experiment station. Columbia.

Annual report. Exp. **'88, '96-'04, '10+**: P. **'96-'99, '01-'03**.

Bulletin. D. o. s. 6: Exp. o. s. 1-8, 10-12, 14, 19, 21-24, 29-35; n. s. 1+ P. o. s. 4, 5, 24-35; n. s. 1+: S. L. '99-'11.

Research bulletin. Exp. **1+**: P. 1+.

Missouri agricultural farmer. Columbia. Exp. **5***, **6, 7***, 8, **9***, **10+**.

Missouri. Agriculture, State board of. Crescent.

Annual report. Exp. **16-20**: R. P. **'89-'90**: P. **13, 15, 20, 35-41, 43+**.

Missouri botanical garden. St. Louis.

Reports D. **5-8, 10+**: E. **1-12, 14**: Exp. **2+**: G. **1-11**: I. U. **1-21, 23+**: N. D. **1+**: S. L. **1+**.

Missouri (state) corn growers' association.

Annual report. Exp. **'11**.

Missouri farmer and breeder. Columbia. Exp. **2***, **3***.

Missouri. Food and drug inspection, Department of.

Bulletin. P. **3**.

Report. P. **'09-'10**.

Missouri (state) fruit experiment station. Mountain Grove.

Biennial report. P. **'03+**.

Bulletin. Exp. 1-5, 7-8, 10+: P. 1, 5-21.

Missouri. Geological survey (organized 1853). Jefferson City.

Annual report. N. D. **1+**: N. H. **1, 2**: S. N. **10**.

Missouri. Geology and mines, Bureau of.

Biennial reports to the general assembly. P. '(1-'08.

Report. E II. **1-10:** P. I. **3;** II. 1+.

Missouri. Horticulture, St te board of.

Annual report. Exp. **1-5:** N. D. 1+: P. **1-3:** S. L. '07, '09, '10.

Missouri (state) horticultural society.

Proceedings. Exp. **68-72.**

Report. D. **'83, '87, '90, '91, '95-'97:** Exp. '80, **'81** '83-'88, **'89, '91, '93, '95, 97-'01, '06-'11:** P. '80, '81, '83-'87, '92, '95, **'99, 01-'06:** S. L **'86, '94, '03, '04.**

Missouri pharmaceutical association. St. Louis.

Proceedings. N. D. **10-'11.**

Missouri university. Columbia.

Bulletin. Medical series. S. L. 1+.

Science series. N. D. 1+: P. 2+: S. L. 1*,2*.

Studies. P. 1, 2: R. P. 1, 2.

Social science series. R. P. 1.

Science series. I. U 1+: P. 1+.

Mittheilungen über dungungsversuche. Berlin, Germany. Exp. **1, 2.**

Modern electrics. Detroit, Mich. G. 5+.

Modern medicine. N. D. 2*.

Modern miller. St. Louis, Mo. Exp. **34*, 35*, 36+.**

Molkerei Zeitung. Berlin, Germany. Exp. **20, 21*, 22+.**

Molkerei Zeitung. Hildesheim. Exp. **25*, 27+.**

Monatshefte für Mathematik und Physik. Vienna, Austria. I. U. **20+.**

Monde des plantes. Le Mans, France. N. D. II. **14+.**

Monist. Chicago, Ill. I. U. 1+.

Moniteur du jardin botanique de Tiflis (Russia). N. D. 25+.

Montana. Agricultural experiment station. Bozeman.

Annual report. D. **10, 11:** Exp. 1+: N. D. **19:** P. 1+: S. L. **'02-'04, '06-'09, '11.**

Bulletin. D. 52, 54, 55: Exp. 1+: P. 1+: S. L. '07+*.

Montana college of agriculture and mechanic arts. Bozeman.

Bulletin. N. D. 89+.

Science studies. N. D. **1:** P. 1*.

Montana (state) entomologist. Bozeman.

Annual report. Exp. **1-9.**

Montana. Health, State board of.
Biennial report. P. **'11, '12.**
Bulletin. P. '12+.

Montana. Horticulture, State board of. Missoula.
Biennial report. Exp. **1, 2, 4, 6**: S. L. **'00, '04, '06, '08.**

Montana (state) horticultural society. Missoula.
Proceedings. Exp. **10, 12, 13.**

Montana. Sheep commissioners, Board of.
Annual report. P. **'09**+.

Montana university. Missoula.
Bulletin biological series. P. 15.

Montevideo (Uruguay). See **Museo** nacional.

Monthly abstract of medical science. Philadelphia. D. **1*, 2, 3*, 4*, 5***: N. H. **1, 3*, 4, 6*.**
Continued in **Medical** news *q. v.*

Monthly evening sky map. New York. M. 4+.

Monthly journal of medical science. Edinburgh, Scotland. D. **8-12, 14, 15.**

Monthly microscopical journal. London. R. P. **1-18**||: W. **1-18**||.
Continued as **Royal** microscopical society, Journal, *q. v.*

Montreal (Can.) horticultural society.
Annual report. Exp. **'77-'83, '85-'87.**

Morphologisches Jahrbuch. Leipzig, Germany. I. U. **1**+.

Motor. New York. Ft. W. **16, 18**+: G. **19**+.

Muhlenbergia. Reno, Nev. N. D. **5**+.

Münchener medicinische Wochenschrift. Munich, Germany. I. U. **53**+.

Munich (Germany). See **Königlich** bayerische etc.; **Ornithologische** Gesellschaft.

Municipal engineering. Indianapolis, Ind. G. **36**+: N. D. **12, 14**: P. **2**+: R. P. **22-29, 33**+.
Continues **Paving** and municipal engineering *q. v.*

Municipal journal and engineer. New York. Ft. W. **30, 32**+: G. **34**+: M. **10**+: R. P. **28**+.

Museo de la Plata. Buenos Aires, Argentine Republic.
Anales. Ac. H. $1^{1,2}$.
Revista. Ac. **11-17**: N. D. **18**+.

Museo de la Plata. La Plata, Argentine Republic.
Anales. Seccion paleontologica. Ac. **5.**
Seccion botanica. Ac. **1.**

Museo nacional. Buenos Aires, Argentine Republic.

Anales. Ac. III. 4+.

Communicaciones. Ac. 1^{5-10}.

Museo nacional de historia natural. Mexico City, Mexico.

La naturaleza. Ac. 7^{16-18}; II. $1^{1-3, 5, 6, 9, 10}$, $2^{10, 11}$, 3^{1-10}; III. $1^{1, 2}$. : N. D. III. 1:+.

Museo nacional. Mexico City, Mexico.

Anales. Ac. $4^{1, 2}$.

Museo nacional. Montevideo, Uruguay.

Anales. Ac. **2, 3;** II. 1[illegible], 4[illegible]: N. D. 7+.

Museu Goeldi de historia natural et ethnographia. Para, Brazil.

Boletin. Exp. **4-6:** N. D. **6**+: P. **4**[illegible], **5***.

Museu nacional. Rio Janiero, Brazil.

Archives. Ac. **11-15.**

Museu paulista. Sao Paulo, Brazil.

Revista. Ac. **4-8.**

Museum news. Brooklyn, N. Y. S. L. **3**+.

Muséum national d'histoire naturelle. Paris, France.

Annals. N. H. **1.**

Archives. I. U. **5.**

Bulletin. Ac. **11**+.

Museum of foreign literature, art and science. Philadelphia, Pa. N. H. **19-20. 22-23, 39, 47-48, 56-57, 65:** W. **2, 4-7, 12, 23-24.**

Museum of natural history. Springfield, Mass.

Reports. Ac. **'95, '96, '08, '10-'12.**

Mycologia. Lancaster, Pa. D. **1**+: Exp. **1**+: I. U. **1**+: S. N. **1**+: W. **1-2.**

Mycologisches Centralblatt. Jena, Germany. Exp. **1**+.

Mysore. Agriculture, State department of. Bangalore.

Bulletin. Exp. **1, 2.**

Entomological series. Exp. **1, 2.**

General series. Exp. **1, 2.**

Mycological series. Exp. **1.**

Report of the agricultural chemist. Exp. **2-7, 9.**

Naples (Italy). See **Zoologische** Station.

Napoli (Italy) Università. Orto botanico.

Bullettino. N. D. **1**+.

Nashville (Tenn.) journal of medicine and surgery. N. H. **9-11, 12***.

Nassauischer Verein für Natürkunde. Wiesbaden, Germany.

Jahrbuecher. Ac. **'99**+.

Natal (South Africa) agricultural journal. Maritzburg. Exp. **7-9, 11-13, 14*, 15*.**

Natal (South Africa). Agriculture, Department of. Maritzburg.

Annual report. Exp. **'02, '04-'06.**

Natal (South Africa). Entomologist.

Report. Exp. **1, 2, 5.**

National academy of sciences. Washington, D. C.

Annual. P. **'63-'66.**

Biographical memoirs. I. U. **2, 3, 5+**: P. **6**: T. H. **2-5.**

Memoirs. I. U. **2+**: N. D. **8*, 10***: N. H. **6, 8**: P. **1+**: R. P. **10+**: S. L. **2-10**: S. N. **3, 10+**: W. **1+.**

Report. P. **'63, '82+**: S. N. **'83-'89, '91, '94, '03, '07.**

National association of boards of pharmacy.

Proceedings. N. D. **'11**: P. **5+.**

National builder. Chicago, Ill. N. H. **44+.**

National conservation association.

Bulletin. P. **3.**

National conservation commission.

Bulletin. P. **4.**

National conservation congress.

Addresses and proceedings. S. L. **'09-'11.**

National creamery buttermaker's association. Elgin, Ill.

Annual report. Exp. **'00, '02.**

National dairy union. Chicago, Ill.

Annual report. Exp. **'94.**

National druggist. St. Louis, Mo. P. **18-22, 24, 26-31, 36+.**

National eclectic medical association. Rochester, N. Y.

Transactions. S. L. **'70, '71.**

National electric-light association. New York.

Proceedings. P. **'85-'90, '91, '93+.**

National engineer. Chicago, Ill. S. L. **14*, 15+.**

National farmer and stockgrower. St. Louis, Mo. Exp. **21-26.**

National fertilizer associations. Middle west soil improvement committee. Chicago, Ill.

Bulletin. Exp. **1-5.**

National fruit grower. St. Joseph, Mich. Exp. **10*, 14*.**

National geographic magazine. Washington D. C. E. **15+**: Ft. W. **18*, 19+**: G. **17+**: I. U. **8, 10-14, 16+**: M. **20+**: N. D. **18+**: P. **18+**: S. N. **1+**: T. H. **7+.**

National hay and grain reporter. Chicago, Ill. Exp. **14*, 15+.**

National hay association.

Annual report. Exp. **9-11.**

National grange of the patrons of husbandry. Tippecanoe City, O.

Circulars. Exp. 1, 3-7.

Journal of proceedings. Exp. **'07, '09, '10.**

National irrigation congress.

Proceedings. S. L. **'91+:** S. N. **12.**

National live stock association.

Annual report. Exp. **'98+:** P. **2, 5-6, 8+.**

National live stock journal. Chicago, Ill. Exp. **3*, 5, 6*, 7, 8*, 10-12:** S. L. **'71-'88.**

National museum. Melbourne, Australia.

Memoirs. Ac. **1-3.**

National nurseryman. Rochester, N. Y. Exp. **15*, 16, 17*, 18, 19*, 20+.**

National nut growers' association. St. Louis, Mo.

Proceedings. Exp. **2, 3, 5, 6, 8.**

National poultry organization society. London, England.

Quarterly journal. Exp. **4*, 5*, 6*, 7+.**

National stockman and farmer. Pittsburg, Pa. Exp. **18-20, 32*, 33+.**

Naturae novitates. Berlin, Germany. N. D. **27*, 29*, 32*, 34+.**

Natural history society of Glasgow (Scotland).

Transactions. Ac. $5^{2, 3}$, $6^{1, 2}$, 7^{3}, 8^{2}.

Natural history society of New Brunswick. St. Johns, New Brunswick.

Bulletin. Ac. 4^{5}, $5^{1, 5}$, 6^{1-3}: N. D. **6+.**

Natural science. London and New York. D. **1:** I. U. **1-15:** S. N. **1-15.**

Naturalist. London, England. N. D. **'96-'98, '00.**

Naturaliste canadien. Quebec, Canada. Ac. $24^{6-9, 12}$, **25-28**, $29^{1-, 5-12}$, **30, 31**, $32^{1-3, 5-10, 12}$, **33-35**, $36^{1, 2, 4-11}$, **37**, $38^{1-4, 6, 8-12}$, 39^{1-9}: N. D. **7, 9, 10-13, 15-17, 20, 21, 23, 24, 26, 36+.**

Nature. London and New York. B. **13-46, 48+:** D. **37+:** Exp. **39, 40*, 41, 86+:** F. **50-58:** I. U. **1+:** N. D. **53-71:** N. H. **1-50:** P. **1+:** R. P. **1+:** S. N. **1+:** T. H. **1+:** W. **1+.**

Nature. Paris, France. R. P. **1+.**

Nature notes. London, England. N. D. **8.**

Nature study review. New York. F. **6+:** G. **1+:** N. D. **5+:** P. **4+:** S. N. **1+:** W. **1+.**

Naturen. Bergen, Norway. N. D. **37+.**

Naturforschende Gesellschaft. Basel, Switzerland.
Verhandlungen. Ac. 8^{3}, $9^{1, 3}$, $10^{1, 3}$, **11-19**, 20^{1-3}, **21, 22.**

Naturforschende Gesellschaft. Bern, Switzerland.
Mittheilungen. Ac. 1073, 1769.

Naturforschende Gesellschaft. Luzern, Switzerland.
Mittheilungen. I. U. **1, 2.**

Naturforschende Gesellschaft in Zurich (Switzerland).
Vierteljahrschrift. Ac. 43^{1-4}, $44^{1, 2}$, 45+: N. D. 57+.

Naturforschender Verein in Brunn (Austria).
Verhandlungen. N D. 4†.

Naturfreund. St. Petersburg, Russia. N. D. '12+.

Naturhistorische Gesellschaft zu Hannover (Germany).
Jahresbericht. Ac. **44-59.**

Naturwissenschaftlich medizinischer Verein in Innsbruck (Austria).
Berichte. Ac. **14, 15, 17, 18, 27-33.**

Naturwissenschaftlicher Verein zu Bremen (Germany).
Abhandlungen. Ac. 14^{3}, $15^{2, 3}$, 16^{1-3}, $17^{1, 2}$, $18^{1, 2}$, 19^{3}, $20^{1, 2}$, 21+: N. D. 21+.

Naturwissenschaftlicher Verein. Frankfort-on-the-Oder, Germany.
Helios. N. D. '13+.

Naturwissenschaftlicher Verein in Hamburg (Germany).
Abhandlungen. Ac. 19^{3-5}.
Verhandlungen. Ac. III. **10-18.**

Naturwissenschaftlicher Verein für Schwaben und Neuburg. Augsburg, Germany.
Berichte. Ac. **33-40.**

Natÿrkundig Tÿdschrift. See **Koninklÿke** natuurkundige Vereeniging in Nederlandsch-Indie.

Nautilus. Boston, Mass. N. D. 15+.

Nebraska. Agricultural experiment station. Lincoln.
Annual report. Exp. 1+: N. D. 26+: R. P. **16, 19, 21, 23**: S. L. **'91+***.
Bulletin. D. 19, Exp. 1, 2, 4-45 46*, 47-132, 134+: N. D. 123-130, 135+: R. P. 38+: S. L. '91+*.
Research bulletin. D. 1: Exp. 1: N. D. 1+: P. 3.

Nebraska. Agriculture, State board of. Lincoln.
Annual report. Exp. **'83-'91, '93-'03, '05-'10.**

Nebraska dairymen's association.
Annual report. Exp. **11, 15, 17-25.**

† Contains Gregor Mendel's original paper on plant hybrids.

Nebraska farmer. Lincoln. Exp. 42*, 43*, 44*, 45+.

Nebraska. Farmers' institute convention. Lincoln.

Annual report. Exp. '06, '09.

Nebraska (state) horticultural society. Lincoln.

Annual report. Exp. '85, '86, '89-'93, '95, '97, '00+: F. '72: P. '11+: S. L. '89, '90, '92-'98.

Nebraska horticulture. Lincoln. Exp. 1*, 2*, 3+.

Nebraska university. Lincoln.

Studies. I. U. 3, 4: N. D. 8, 10, 11+: P. 1-4*: R. P. 2+.

Neues Jahrbuch für Mineralogie, Geologie, und Palaeontologie. Stuttgart, Germany. I. U. 9+.

Beilage. I. U. 6-32.

Neurologisches Centralblatt. Leipzig, Germany. I. U. 1+.

Nevada. Agricultural experiment station. Reno.

Annual report. Exp. 1+: P. 4, 5, 14, 16+.

Bulletin. D. 28, 35: Exp. 1+: P. 1-11, 13+: S. L. '08*, '09*.

Nevada. Health, State board of.

Biennial report. P. '03+.

Nevada public service commission. Carson City.

Report. N. D. 2+.

Nevada railroad commission. Carson City.

Report. N. D. 5+.

Nevada university. Reno.

Studies. I. U. 1+: P. 1+.

New Albany (Ind). medical herald. P. 15, 16*.

New England association of chemistry teachers

Annual report. Exp. 28.

New England farmer. Boston. S. L. 1-14.

New England zoological club. Cambridge, Mass.

Proceedings. Ac $1^{1-37,\ 59-64}$.

New Hampshire. Agricultural experiment station. Durham.

Annual report. Exp. 1-4, 6+: P. 2+.

Bulletin. D. 23: Exp. 1+: N. D. '13+: P. 1+: S. L. '10+.

Nature leaf study. Exp. 1-4.

Scientific contributions. Exp. 1+: N. D. 5+: P. 1+.

Technical bulletin. Exp. 1+: P. 2-6.

New Hampshire (state) agricultural society.

Transactions. Exp. '50-'52, '55-'58: S. L. '50-'52, '57-'59.

New Hampshire. Agriculture, State board of. Concord.
 Annual report. Exp. **5, 7, 9-16**: P. **2, 5-18, 21+**.

New Hampshire. Forestry commission.
 Report. P. **'85, '99, '01-'04, '09+**.

New Hampshire forests, Society for the protection of.
 Report. P. **7, 8**.

New Hampshire. Health, State board of. Concord.
 Annual report. P. **'84, '85, '87-'06**.
 Sanitary bulletins. Exp. **5***.

New Hampshire horticultural society. Durham.
 Annual report. Exp. **'07, '08**: P. **'07+**.

New Jersey. Agricultural experiment station. New Brunswick.
 Annual report. Exp. **1-29, 31+**: P. **1+**.
 Bulletin. Exp. 2-244, 246+: P. 11, 14, 19 20, 22-24, 26, 27, 29-36, 38+: S. L. '98-'02*.
 Reports of the soil chemist and bacteriologist. Exp. **'92, '06-'09**.
 Special bulletin. Exp. A-R, T: P. A, C, E, G, I-T.

New Jersey. Agriculture, State board of. Trenton.
 Annual report. Exp. **6, 15**.

New Jersey. Forest Park reservation commission.
 Report. P. **1+**.

New Jersey. Geological survey.
 Annual report. E. **'84-'90, '92-'09, '11+**: N. D. **'84-'90, '93+**: N. H. **1, 2**: R. P. **'69-'71, '75, '77-'82, '85-'90**: S. N. **'88-'95**.
 Bulletin. N. D. 3+: R. P. 2+.
 Final report of the state geologist. E. **2-4**: N. D. **5, 7+**.
 Water supply report. N. D. **'94**.

New Jersey. Health, State board of. Trenton.
 Annual report. Exp. **22-35**: P. **11, 20+**.

New Jersey (state) horticultural society. Riverton.
 Report. Exp. **12-14, 19, 32-36**: P. **27-29**.

New Jersey (state) live stock commission. New Brunswick.
 Annual report. Exp. **1, 2**.

New London Mechanics' register and magazine of science and the useful arts. London, England. N. H. **1, 2**.

New Mexico. Agricultural experiment station. Mesilla Park.
 Annual report. Exp. **1+**: P. **1+**.
 Bulletin. Exp. 1+: N. D. 3, 13, 29, 30, 11, 56, 59+: P. 1+.

New Mexico university. Albuquerque.

Bulletin. Biological series. Ac. $3^{12, 13}$, 4^{1}.

Catalogue series. Ac. **16-18, 20.**

Educational series. Ac. $1^{3, 4}$.

Geological series. Ac. 3^{1}.

Language series. Ac. 1^{1-4}.

Physics series. P. 1^{1}.

New Orleans (La.). Sewerage and water board.

Report. P. **15+.**

New phytologist. London, England. Exp. **10+**: I. U. **4-8, 10+.**

New preparations. Detroit, Mich. D. **1*, 3.**

Continued as **Therapeutic** gazette *q. v.*

New remedies. New York. D. 5, **6*: P. 7-12** : R. P. **1, 2.**

Continued as **American** druggist and pharmaceutical record *q. v.*

New South Wales agricultural gazette. N. D. **24+**: P. **16+.**

New South Wales. Agriculture, Department of. Sydney.

Bulletin. Exp. 1-4.

Farmers bulletin. Exp. 4-6, 11-13, 15-17, 19, 20, 27-31, 33, 35, 36, 38-40, 43, 45-47, 59, 62+.

Science bulletin. Exp. 1-6, 8: N. D. 7.

New South Wales. Agriculture and forests, Department of. Sydney.

Annual report. Exp. **'94, '95, '98, '00, '07.**

New South Wales. Botanic gardens and government domains. Sydney.

Annual report. Exp. **'07-'11.**

New South Wales. Geological survey.

Mineral resources. S. L. **6+.**

New South Wales. Mines and agriculture, Department of. Sydney.

Annual report. Exp. **'95.**

New York City. See **American** institute; **Central** Park managerie.

New York (city) academy of medicine.

Transactions. P. II. **3-10.**

New York (city) academy of sciences. New York.

Annals. Ac. $3^{9, 10}$, $4^{1-8, 10-12}$, **5-9,** 10^{1-12}, **11,** 13^{1-3}, 14^{1-4}, 15^{1-3}, **17+.**

Transactions. Ac. 2^{1-8}, **3, 4,** 5^{1-8}, **6-8,** 9^{1-8}, 10^{1-6}, 11^{3-5}.

New York (state). Agricultural experiment station. Geneva.

Annual report. Exp. 1+: N. D. **1, 2, 3:** P. 1+.

Bulletin. D. n. s. 86, 94, 100, 101, 119, 120, 122-125, 130, 131, 133, 136, 138-140, 143, 144, 159, 161-164, 167, 170, 172: Exp. 1+: P. 1+.

Meteorological observatory. Exp. **'71-'80, '89, '90, '92*, '93*, '95*, '97*, '04*, '05, '06, '07*, '08*, '09, '10, '11, '12*+.**

Technical bulletin. Exp. 1+: P. 1+.

New York (state). Agricultural experiment station (Cornell). Ithaca.

Annual report. Exp. **1-10, 12+**: P. **1-5, 7-15, 16+.**

Continued in Medical news *q. v.*

Bulletin. D. 142, 148, 155, 157, 163, 164, 168, 170, 172, 176, 180, 185-187, 190, 192, 193, 207, 208, 219 227, 233, 234, 239, 240, 249-251 254. 255: Exp. 1-318, 321, 323, 326+: N. D. 94, 227: P. 1+.

Cornell rural school. Exp. **1*, 2+.**

Memoirs. P. **1+.**

New York (state) agricultural society. Albany.

Transactions. D. **9, 27**: Exp. **8-13, 15-34, 43-46, 51-52**: P. **10, 14, 25-27, 29, 30, 32-34, 57-59.**

New York (state). Agriculture, Department of. Albany.

Annual report of the commissioner. Exp. **2*, 3-10, 15-19**: N. D. **'11**: P. **5-7, 9, 11, 12, 15+.**

Bulletin. Exp. 1, 2, 6, 9, 12, 14, 18, 21-29: P. 8, 9, 12-14, 16-18, 20-27, 29-35, 37-39, 41, 45+.

New York (state). Barge canal. See **New York** (state). Consulting engineers, Advisory board of.

New York (city) botanical garden. New York.

Bulletin. Ac. 7+: Exp. 1+: N. D. **21.**

Contributions. P. 90, 95.

Journal. Exp. **1*, 2*, 3***: P. **3*.**

Memoirs. I. U. **4.**

New York (state) college of agriculture. Ithaca.

Bulletin. N. D. 2, 12, 29, 37, 41, 42, 226, 229, 307.

New York (state). Consulting engineers, Advisory board of.

Bulletin. R. P. 1+.

Report on barge canal. P. **1, 3+**: R. P. **'07.**

New York (state). Dairy commission. Albany.

Annual report. Exp. **4, 6-8**: P. **7, 9.**

New York (state) dairymen's association.

Annual report. Exp. **6, 9, 11, 13, 30-34.**

New York eclectic medical and surgical journal. New York. D. **5*, 6, 7, 8*.**

New York (state) engineer and surveyor.

Annual report. P. **'00-'04**: R. P. **'03, '05+.**

New York (city) entomological society. New York.
  Journal. Ac. $8^{1, 3, 4}$, 9^{1-4}, 10^{1-2}.

New York (state) entomologist.
  Report. Exp. **1, 2, 4-26:** P. **1-2, 4-13, 15-26.**

New York (state) farmers. New York.
  Proceedings. Exp. **'82-'13:** S. L. **'93+.**

New York (state) farmers' institute. Albany.
  Annual report. Exp. **'00, '01, '07-'10:** P. **'01, '03-'05, '07+.**

New York (state). Forest commission. Albany.
  Annual report. Exp. **'94.**

New York. Forest, fish, and game commission. Albany.
  Annual report. Exp. **'98, '07-'10:** N. H. **1-6:** P. **'02-'06.**
  Bulletin. P. **2, 3, 5.**

New York. Forest preserve board.
  Annual report. N. H. **4.**

New York (state) fruit growers' association.
  Annual report. Exp. **4-6, 8-10, 12+.**

New York (state). Geological survey.
  Annual report. P. **4-6, 9:** R. P. **'83.**

New York (city). Health department. Research laboratory.
  Annual. P. **'02+.**
  Collected studies. I. U. **1+.**

New York (state). Health, Board of.
  Annual report. P. **'80-'05, '07+:** R. P. **'90.**
  Monthly bulletin. P. **'07+.**

New York (city) mathematical society. New York.
  Bulletin. D. **1-3**‖: I. U. **1-3**‖: P. **1-3**‖.
    Continued as **American** mathematical society *q. v.*

New York medical journal. New York. D. **12, 13, 14*, 15*, 16*, 17, 18*, 19-25:** I. U. **78:** P. **51-63, 74, 79-86*:** T. H. **41-54, 67-70, 90+.**

New York (city) microscopical society. New York.
  Journal. Ac. $1^{1, 4-9}$, $2^{1, 4-7, 9, 9a}$, **3**, 4^{3-4}, 5^{1-3}, 6^{2-4}, $7^{1, 2, 4}$.

New York state museum. Albany, N. Y.
  Annual report. Exp. **'94, '95*, '96, '97*, '98:** I. U. **22, 23, 39, 41, 45-62:** P. **20, 27-28, 41-43, 49*+:** R. P. **13, 15-31.**

Bulletin. D. 38, 47, 54, 67, 68, 70, 75, 86, 94, 105, 116, 429, 450: Exp. 5, 13, 20, 23, 26, 27, 31, 36, 37, 46, 47, 53, 59, 64, 72, 74, 76, 79, 86, 97, 103, 104, 109, 110, 124, 129, 134, 136, 141, 147, 155, 156: I. U. 44, 69, 80, 85: N. D. 158, 450, 470, 492, 493, 495, 496, 514+: P. 40, 49-62, 64+.

Memoirs. N. D. **14***.

New York produce review and American creamery. New York. Exp. **23***, **29***, **30***, **31***, **34**+.

New York (state). Public service commission—First district. New York City.

Report. P. **'07**+: R. P. **'08**+.

New York (state). Public service commission—Second district. Albany.

Report. N. D. **6**+: P. **'07**+.

New York railroad club.

Proceedings. P. '88+*: R. P. **11, 12.**

New York (state) science teachers' association.

Proceedings. S. N. **'07**+.

New York state reservation commission of Niagara. Albany, N. Y.

Report. N. D. **1-14, 17, 20**+.

New York tribune farmer. New York. Exp. **9***, **10***, **11***, **12**+.

New York (state) veterinary college. Ithaca.

Abstracts of work done in laboratory. P. **1**+.

Report. Exp. **'08-'11.**

New York (state). Weather bureau.

Annual report. R. P. **'93-'96.**

New York (state). Water supply commission.

Annual report. P. **4**+.

Contract drawings and specifications. R. P. **1**+.

New Zealand. Agriculture, Department of. Wellington.

Annual report. Exp. **2-4, 7**+: P. **13**+.

Bulletin. Exp. n. s. 1-6, 8, 9, 11-15, 17, 20, 21, 23+.

Journal. Exp. **1**+.

New Zealand. Biology, Division of. Wellington.

Bulletin. Exp. 13, 14, 20, 22, 23.

New Zealand. Biology and horticulture, Division of.

Annual report. Exp. **12-17**: P. **'02-'09.**

Bulletin. Exp. 3-19.

Technical papers. Exp. 1.

New Zealand. Biology and pomology, Division of.

Annual report. Exp. **4, 5, 8, 10.**

New Zealand. Chemistry, Division of.
Annual report. Exp. **'03, '05, '07, '09.**
Bulletin. Exp. 1, 2.
New Zealand. Dairying, Division of.
Annual report. Exp. **'94, '95, '04, '05.**
Bulletin. Exp. 7-14.
New Zealand. Live stock and meat, Division of.
Annual report. Exp. **'10.**
New Zealand. Poultry, Division of.
Annual report. Exp. **'06.**
New Zealand. Veterinary science, Division of.
Bulletin. Exp. 8, 12, 13, 15.
New Zealand dairyman farmers' union. Wellington.
Journal. Exp. **13***.
New Zealand experimental station. Wellington.
Annual report. Exp. **'05, '08, '09.**
Niles national register. Washington, D. C. N. H. V. **4-11.**
Norske videnskabers selskab. See **Kongelige** norske, etc.
North American notes and queries. Quebec, Canada. Ac. **1**$^{1, 2}$.
North Carolina. Agricultural experiment station. West Raleigh.
Annual report. Exp. 2+: P. **2-6, 7,** 9+: R. P. **16-19, 23, 26-29.**
Bulletin. D. 93, 94, 99, 100, 103, 105, 108, 138, 141, 144, 145, 174: Exp. 57+: P. 57+: R. P. 23-31, 93-194.
Meteorological reports. Exp. 5-9: P. 4, 7-8.
Special bulletins. Exp. 2, 6, 7, 9, 11, 12-15, 17, 19-22, 25-27, 29, 32, 35, 37, 38, 42-46, 51+.
Technical bulletins. Exp. 1-7: P. 2-7.
North Carolina. Agriculture, State board of. Raleigh.
Bulletin. Exp. 21*, 22, 23*, 24*, 25*, 26*, 27*, 28*, 29*, 30-32, 33*, 34+: P. 23+.
North Carolina. Crop pest commission. Raleigh.
Circular. Exp. 10, 11, 18, 19, 22, 23, 25, 26.
North Carolina farmers' institute. Raleigh.
Annual report. Exp. **'05-'07, '09, '11, '12.**
North Carolina. Geological and natural history survey.
Report. N. D. **'67.**
North Carolina. Health, State board of. Raleigh.
Bulletin. Exp. **2*, 3*, 4*, 16***.

North Carolina student farmer. West Raleigh. Exp. 1*, 2*.

North Dakota. Agricultural experiment station. Fargo.

Annual report. Exp. 1+: P. 1-9, 11+.

Biennial report. Exp. 7+.

Bulletin. D. 52: Exp. 1+: N. D. 87-89, 91, 94+: P. 1+.

Reports Dickinson sub-experiment station. Exp. 1+.

Reports Williston sub-experiment station. Exp. 1+.

North Dakota. Agriculture and labor, Commissioner of. Bismarck.

Biennial report. Exp. 5, 7: P. 10+.

North Dakota magazine. P. 2*, 4*.

North Dakcta better farming association.

Bulletin. Exp. 10, 12.

North Dakota (state) dairymen's association.

Annual report. Exp. 1, 16.

North Dakota. Geological survey.

Biennial report. I. U. 4+: P. 2+.

North Dakota (state) live stock association.

Annual report. Exp. 1-3.

North Dakota school of forestry.

Bulletin. P. 1.

North Dakota. Stallion registration board.

Bulletin. P. 1+.

North Dakota university. Fargo.

Quarterly journal. N. D. 1, 2*, 3+: P. 1.

Nor:h Jersey society for the promotion of agriculture.

Proceedings. Exp. '11, '12.

Northwest fruit growers' association.

Proceedings. Exp. 7, 8.

Northwest horticulturist. Seattle, Wash. Exp. 20', 21*, 22, 23, 24*. 25+.

Northwestern agriculturist. Minneapolis, Minn Exp 23*, 24*.

Northwestern dairyman. St. Paul, Minn. Exp. 1*, 2, 3*.

Nouvelles annales de mathématiques. Paris, France. I. U. 9+.

Nova Scotia farmers' association.

Proceedings. Exp. 14, 15.

Nova Scotian institute of natural science. Halifax.

Proceedings and transactions. Ac. 7-11, 12^{1-2}, 13^{1-2}

Nuova notarisia. Modena, Italy. N D. 24+.

Nuovo giornale botanico italiano. Florence, Italy. N. D. '12+.

Nut grower. Waycross, Ga. Exp. 1*, 2*, 3*, 4*, 5*, 7-11, 12*+.

Nyt magazin for natur widenskaberne. Christiania, Norway. N. D. 49+.

Nyt Tidskrift für Mathematik. Copenhagen, Denmark. I. U. 21+.

Oberlin (O.) college.

Laboratory bulletin. Exp. 1-6, 8-10: P. 3, 11-15.

Wilson bulletin. Ac. 14+: Exp. 4-12, 14-29: P. 14+.

Observatory. London, England. D. 8+: I. U. 7, 11-14, 23+: W. 16, 19, 21, 22.

Observer. Portland, Conn. N. D. 2*, 3, 4*-8*.

Continued as **Popular** science news *q. v.*

Obstetric gazette. Cincinnati, O. D. 1*, 2*, 3, 4*, 5, 6, 7*, 8, 9: P. 10-12*.

Obstetrical journal of Great Britain and Ireland with an American supplement Philadelphia, Pa. D. 5*, 6*: N. H. 1-7.

Ohio (state) academy of science. Columbus.

Annual report. Ac. '00-'06: I. U. 5.

Proceedings. N. D. 5*.

Special papers. Ac. 3-13.

Ohio (state) agricultural college. Columbus.

Agricultural extension bulletins. Exp. 1*, 2*: N. D. 1*, 2*+.

University bulletin. Exp. 6*, 8*, 15*, 17*: N. D. 8*+.

Ohio agricultural station. Columbus

Bulletin. S. L. '97*+.

Ohio. Agricultural experiment station. Wooster.

Annual report. Exp. 1+: P. 1+.

Bulletin. D. H. 3, 5-7, 12, 19-22, 25, 28-47, 49, 51-60, 62-70, 72-74, 76-88, 90, 91, 93-109, 111-122, 124-148, 150-155, 157-215, 218-224, 226-237, 240-248, 250+: Exp. 1-40, 42-238, 240-248, 250-252, 256+: P. 1+.

Technical series. Exp. 1*: P. 1.

Ohio. Agriculture, State board of.

Annual report. D. 33: Exp. H. 6, 9, 12-52, 54, 57, 59-61: P. 5, 6, 18, 21-29, 31, 33-36, 55, 56, 58-63.

Official bulletin. P. 1-3.

Ohio cultivator. Columbus. S. L. 1, 2, 6, 10, 11.

Ohio. Dairy and food commissioner. Springfield.

Annual report. Exp. 10, 18.

Ohio (state) dairymen's association.

Annual report. Exp. 7, 13.

Ohio engineering society.

Proceedings. P. 4-10, 12-13, 15-22, 25-28.

Ohio farmer. Cleveland. Exp. **123, 124*, 125, 126*, 127+**: S. L. **37-112.**

Ohio. Farmers' institutes. Columbus.

Annual report. Exp. **6, 17**: P. **7-17.**

Ohio (state) forestry bureau.

Report. **2, 3, 5**: I. U. **3, 4**: P. **4.**

Ohio. Geological survey.

Bulletin. P. IV. **1+**: R. P. **1+.**

Report. D. **1-4, 6, 7**: E. **1-3, 7**: N. D. **2**: R. P. **'69, '70, '73-'75**: T. H. **1-4, 6.**

Report. (Third organization.) E. **1**: I. U. **1-6. 9-13, 16+.**

Ohio. Health, State board of. Columbus.

Annual report. Exp. **22**: P. **'86-'88, '91-'94, '96, '99+.**

Ohio. Highway department.

Annual report. P. **'00-'10.**

Ohio (state) horticultural society. Columbus.

Report. Exp. **23, 24, 29, 32-34**: S. L. **'90, '91, '94-'96.**

Ohio mechanics' institute. Cincinnati.

Quarterly journal. P. **1-5.**

Ohio medical journal. Columbus, O. D. **1*.**

Continued as **Columbus** medical journal *q. v.*

Ohio medical recorder. Columbus, O. D. **1*, 2*, 3*, 4*, 5.**

Ohio naturalist. Columbus, O. Exp. **1+**: N. D. **1+.**

Ohio (state) railroad and public utilities commission. Columbus.

Report. N. D. **'12+**

Ohio society of surveyors and civil engineers.

Annual report. R. P. **'94.**

Ohio (state) topographic survey.

Report. P. **'03.**

Oil, paint and drug reporter. New York. Exp. **64+.**

Oklahoma academy of science. Norman.

Proceedings. Ac. **'09, '10.**

Oklahoma. Agricultural experiment station. Stillwater.

Annual report. Exp. **1+**: P. **3, 6, 8+**: S. L. **'00-'06*.**

Bulletin. Exp. **1-98, 100+**: P. **1+**: S. L. **'99-'09*.**

Oklahoma. Agriculture, State board of. Guthrie.

Biennial report. Exp. **1**: P. **1, 2.**

Oklahoma. Agriculture, Territorial board of. Guthrie.

Biennial report. Exp. **1, 2**: P. **2.**

Oklahoma (state) dairymen's association.

Annual report. Exp. **1, 3, 4.**

Oklahoma farm journal. Oklahoma City. Exp. **18, 19*, 20+.**

Oklahoma (state). Geological survey.

Bulletin. I. U. **7, 8**: P. **1-3, 5+.**

Circular. P. **1+.**

Oklahoma university.

Research bulletins. N. D. **1+**: P. **1+.**

Ontario. See also **Canada** horticultural societies; **Poultry** association of Ontario; **Vegetable** growers' association.

Ontario agricultural and experimental union. Toronto.

Annual report. Exp. **19+**: P. **8-10, 19+**: S. L. **'04+.**

Ontario agricultural college and experimental farm. Toronto.

Annual report. Exp. **5-13, 16-22, 24+**: P. **7, 8, 10, 12, 14, 18-26, 28+**: S. L. **'04+.**

Bulletin. Exp. 6, 9, 11-13, 15-17, 19-21, 23-32, 36-41, 43, 48-75, 77, 80-88, 90-95, 97-105 107-140, 142-169, 171, 172, 174-184, 186-209, 211+.

Ontario agricultural societies and associations of fairs and exhibitions. Toronto.

Annual report. Exp. **'02, '06, '08+**: P. **'08+.**

Ontario. Agriculture, Department of. Toronto.

Annual report. Exp. **'88-'93, '94*, '95-'04, '08, '09.**

Bulletin. S. L. **'96+*.**

Report of fruit branch. P. **'08+.**

Ontario bee keepers' association. Toronto.

Annual report. Exp. **'00, '02-'08, '11+**: P. **'08-'10.**

Ontario butter and cheese association. Toronto.

Annual report. Exp. **'97-'99.**

Ontario corn growers' association. Toronto.

Annual report. Exp. **1+**: P. **1+.**

Ontario dairymen's association. Toronto.

Annual report. Exp. **'92, '94, '96, '01+**: P. **'92+.**

Ontario entomological society. Toronto.

Annual report. Exp. **17, 27, 28, 30+**: P. **9, 12, 20, 22-24, 27-32, 37+.**

Ontario. Farmers' institutes, Superintendent of.

Report. Exp. **'91+**: P. **'94+.**

Ontario. Fruit experiment station.

Annual report. Exp. **6+**: P. **1+.**

Report of fruit branch. Exp. **1+**: P. **1+.**

Ontario fruit growers' association. Toronto
Annual report. Exp. **32-40, 42+**: P. **14+**.
Ontario. Horticultural societies.
Annual report. P. **1+**.
Ontario hydro-electric power commission. Toronto.
Report. N. D. **1+**.
Ontario. Industries, Bureau of. Toronto.
Annual report. Exp. **'91+**.
Bulletin. Exp. 24 30 31, 36-41, 43-45, 47-51, 53-69, 71-87, 89-93, 95, 96, 98, 100+: P. 43, 47, 48, 50-52, 54-79, 87+.
Ontario land surveyor's association.
Proceedings. P. **6-26**.
Ontario live stock association. Toronto.
Report. Exp. **'95, '96, '98+**: P. **'95, '00+**.
Ontario municipal and railway board. Toronto.
Report. N. D. **4+**.
Ontario natural science bulletin. N. D. **4**.
Ontario registrar of live stock. Toronto.
Report. Exp. **'01-'04**.
Ontario sheep-breeders' and swine-breeders' association. Toronto.
Report. Exp. **'91-'94**: P. **'90-'94**.
Ontario. Special investigation on horse-breeding. Toronto.
Report. Exp. **'06**.
Ontario vegetable growers' association.
Annual report. P. **1+**.
Ontario veterinary college. Toronto.
Report. Exp. **'09-'11**.
Operative miller. Chicago, Ill. Exp. **16***, **17***: P. **9-16**.
Orange Judd farmer. Chicago, Ill. Exp. **47-49, 50*, 51, 52*, 53+**: S. L. **2-43**.
Orange Judd northwest farmstead. Minneapolis, Minn. Exp. **36***.
Orange River Colony. Agriculture, Department of. Bloemfontein.
Annual report. Exp. **1, 3, 4**.
Bulletin. Exp. 8, **17**, 19, 20, 23.
Oregon (state) agricultural college. Salem; Corvallis.
Bulletin. Exp. 67.
Extension bulletin. Exp. 1, 2, 7.
Report. Exp. **'06-'08**: S. L. **'76-'95**.

Oregon. Agricultural experiment station. Corvallis.
Annual report. Exp. **'89-'92, '96.**
Bulletin. Exp. **1+**: P. **2+**: S. L. **'09-'10.**

Oregon agriculturist. Portland. Exp. **18*, 19*.**

Oregon (state) conservation commission. Salem.
Report. N. D. **'12+**: P. **'09+.**

Oregon. Dairy and food commission.
Biennial report. P. **'08-'10.**

Oregon. Desert land board.
Report. P. **5.**

Oregon. (State) engineer.
Report. N. D. **2+**: P. **2+.**

Oregon (state) horticultural society. Portland.
Annual report. Exp. **21, 25.**

Oregon. Horticulture, State board of. Salem; Portland.
Biennial report. Exp. **2, 3, 5-11**: S. L. **'98, '02, '04, '06.**

Oregon (state) medical society.
Proceedings. S. L. **'77-'79, '81, '83-'85, '91.**

Oregon. Stallion registration board.
Annual report. P. **1+.**

Oregon (state) university. Eugene.
Bulletin. P. n. s. **3***: N. D. **3*, 4*, 10*.**

Ornithologische Gesellschaft in Bayern. Munich, Germany. Ac. **5+.**

Ornithologischer Verein. Munich, Germany.
Jahresbericht. S. L. **'01, '02.**

Ornithologisches Jahrbuch. Halle, Austria. Ac. **9, 12, 13, 15, 17, 19, 21+**

Osterreichische botanische Zeitschrift. Vienna, Austria. N. D. **63+.**

Ottawa (Canada) naturalist. Ac. **1-15***: N. D. **25+.**

Oxford, Cambridge and Dublin messenger of mathematics. Cambridge, England. D. **1-5**‖: I. U. **1-5**‖.
Continued as **Messenger** of mathematics *q. v.*

Pacific dairy review. San Francisco, Cal. Exp. **12*, 13, 14*, 15*, 16*, 17+**

Pacific pharmacist. San Francisco, Cal. N. D. **2*-6*.**

Pacific rural press. San Francisco, Cal. Exp. **74*, 75*, 76*, 77-80, 81*, 82+**

Page's weekly. London, England. P. **1+.**

Paginas illustradas. San Jose, Costa Rica. Ac. **2, 3, 11, 12, 14, 15, 18, 30, 34-37, 47, 50-53.**

Palermo (Italy). See **Circolo** matematico.

Para (Brazil). See **Museu** Goeldi.

Paris. See **Académie** des sciences; **École** polytechnique; **Muséum** national &c.

Park and cemetery and landscape gardening. Chicago, Ill. Exp. **15***, **16**, **17***, **19***, **20***, **21***, **22+**.

Pavia (Italy) università. Instituto botanico. N. D. **'09+**.

Peabody academy of science. Salem, Mass.

Annual report. S. L. **'72.**

Peabody museum of American archaeology and ethnology. See **Harvard** university.

Peninsula horticultural society. Dover, Del.

Transactions. Exp. **'88-'94, '96, '97, '99-'06**: P. '88, **'91-'94, '96, '97, '02, '03, '07+**.

Pennsylvania. Agricultural experiment station. State College.

Annual report. Exp. **'86+**: P. **'86-'90, '92+**.

Bulletin. D. 17, 20: Exp. o. s. 1-16; n. s. 1+: P. n. s. 2+.

Pennsylvania (state) agricultural society.

Report of transactions. Exp. **1**: S. L. **7, 9.**

Pennsylvania. Agriculture, Department of.

Annual report. Exp. **1, 2, 4***, **5, 6, 7***, **8-17**: P. **2, 3***, **4***, **5+**.

Bimonthly bulletin. Exp. **1***, **2.**

Bulletin. Exp. 3, 6, 8, 10, 11, 17, 19, 21-24, 27-32, 34-38, 40, 41, 43-49, 51, 52, 54-69, 71-77, 79-81, 83, 84, 86-100, 102-107, 109-162, 164-167, 169, 171, 172, 174-210, 212+: P. 14, 16, 20, 21, 26, 36, 39, 52-69, 71-101, 103, 106, 107, 109+.

Monthly bulletin. Exp. 1*, 2*, 3*, 4*, 5-7, 8*, 9+.

Zoological bulletin. P. 5.

Zoological quarterly. Exp. **1***, **2***, **3***.

Pennsylvania. Agriculture, State board of.

Annual report. Exp. **2-11, 15-18, 32, 34+**: P. **7, 11-16.**

Pennsylvania. Dairy and food division.

Bulletin. P. **1***, **2***, **3+**.

Annual report. Exp. **'05.**

Pennsylvania dairy union. State College.

Annual report. Exp. **8, 11.**

Pennsylvania. Factory inspector.

Annual report. Exp. **'10, '11.**

Pennsylvania farmer. Philadelphia. Exp. **31***, **32+**.

Pennsylvania. Fisheries, Department of.
Annual report. Exp. **'08-'11.**
Bulletin. Exp. 8.

Pennsylvania forestry association.
Annual report. Exp. **'01, '02, '05-'11.**

Pennsylvania (state) forestry department.
Report. P. **'01, '02, '05-'09.**

Pennsylvania. Game commissioner.
Annual report. Exp. **'09, '11.**
Bulletin. Exp. 1, 2.

Pennsylvania. Geological survey.
Report. P. **1-3**: R. P. **'74-'86.**

Pennsylvania. Health, State board of. Harrisburg.
Annual report. Exp. **4**: P. **'86-'01.**
Bulletin. Exp. 14-31, 34, 36-39.

Pennsylvania. Health, Commissioner of.
Annual report. P. **'05-'09.**

Pennsylvania (state) hospital for the insane. Pathological laboratory. Norristown.
Annual report. Exp. **10.**

Pennsylvania (state) live stock breeders' association.
Proceedings. Exp. **6, 7, 12.**

Pennsylvania. Live stock sanitary board.
Circular. Exp. 12: P. 12, 16, 18.

Pennsylvania. Mines, Department of.
Annual report. Exp. **'09-'11.**

Pennsylvania. Pharmaceutical examination board.
Annual report. Exp. **23, 24**: N. D. **23.**

Pennsylvania. Public charities, Board of.
Annual report. Exp. **'09-'11.**

Pennsylvania state college. School of engineering.
Engineer. P. 2*, **3***.

Pennsylvania. Topographic and geologic survey commission.
Preliminary report. Exp. **5.**
Report. Exp. **'08-'10.**

Pennsylvania university. Botanical laboratory. Philadelphia.
Contributions. I. U. 4+: N. D. 2+.

Pennsylvania university. Zoological laboratory. Philadelphia.
Contributions. I. U. **10, 11***, **13, 17**: P. **1***.

Pennsylvania. Water supply commission.
Report. P. **'08, '09.**

Periodico cientifico del museo nacional de historia natural y de la sociedad Mexicana de historia natural. See **Sociedad** Mexicana de historia natural.

Peru. Cuerpole de ingeniaros de minas. Lima.
Boletin. S. L. 1-21, 25-54, 56-59, 62-74, 76+.

Pharmaceutical era. Detroit, Mich. N. D. **28*-43***, **45***: P. **1-8, 13-21, 23, 25+***.

Pharmaceutical journal and transactions. London, England. P. **41-45.**

Pharmaceutical record. New York. P. **5-10, 12-15**‖.
Merged with **American** druggist *q. v.*

Philadelphia (Pa.). See **Academy** of natural sciences; **Geographical** society.

Philadelphia (Pa.). Health, Bureau of.
Annual report. P. **'96-'08.**

Philadelphia (Pa.) medical journal. P. 8.

Philadelphia (Pa.) museums.
Annual report. N. D. **'04, '05, '07. '08, '10**: P. **'04, '05, '07, '08, '10, '11.**

Philippine agricultural review. Manila. Exp. **1***, **2***, **4***, **5***, **6+**: N. D. **1+**: P. **1+**.

Philippine Islands. Agriculture, Bureau of.
Bulletin. Exp. 22, 23.

Philippine Islands. Ethnological survey.
Publications. P. **1***, **4***.

Philippine Islands. Forestry, Bureau of. Manila.
Annual report. Exp. **'02, '04.**
Bulletin. Exp. 1.

Philippine Islands. Laboratories, Bureau of government. Manila.
Bulletin. S. N. 1-3, 8, 15, 17-28, 30-36.

Philippine Islands. Science, Bureau of. Manila.
Annual report. Exp. **4, 5**: N. D. **1+**.
Bulletin. Exp. 1, 2, 4-6, 8, 13-20.
Mineral resources. Exp. **'07-'11.**

Philippine journal of science. Manila. Exp. **1, 2, 3***, **4+**: N. D., 00: P. (all ser.) 3+.
Supplements. Exp. **1-5.**

Phillips academy. Archaeology, Department of. Andover, Mass.
Bulletin. N. D. 1+.

Philosophical magazine and journal of science. London, England. I. U. IV. **1-50; V. 1-50; VI. 1-8, 10+**: N. D. **'09**: N. H. I. **34, 39, 41-43***: P. V. **25+**: R. P. V. **1-4, 14+**: W. VI. **5+**.

Photo-beacon. New York. Ft. W. **19**: N. D. **7, 8, 9*, 10*, 12*, 13-19.**
Continues in **American** amateur photographer *q. v.*

Photo era. Boston, Mass. Ft. W. **28+**: G. **29+**. R. P. **6-8, 24+**: T. H. **17+**.

Photographic bulletin, Anthony's. New York. R. P. **'00***.

Photographic times. New York. L. P. **39*,40***: R. P. **17-42***.

Photo-miniature. New York. G. **81+**: I. U. **1+** : R. P. **1-3, 10+** : T. H. **1+**.

Phrenological journal and science of health. New York. N. D. **50, 51, 54-57**: N. H. **50-68**.

Physical review. New York. D. **1+**: E. **24+**: I. U. **1+**: N. D. **'09+**: P. **1+**: R. P. **1+**: S. N. **8-13**: W. **19+**.

Physical society of London.
Proceedings. I. U. **1+**: P. **19+**.

Physikalische Zeitschrift. Leipzig, Germany. N. D. **'09+**: R. P. **6+**.

Physiologie vegetale. Geneva, Switzerland. Exp. **1-5**.

Physio-medical journal. Indianapolis, Ind. M. **1**.

Phytopathology. Ithaca, N. Y. D. **1+**: I. U. **1+**: W. **1+**.

Plant world. New York, Tucson, Ariz. Ac. **6**[1-8], **7**[3], **8**[4], **13**[1]: Exp. **13, 14, 15*, 16+**: I. U. **8+**: P. **11+**: W. **8-12**.

Plön (Germany) biologische Station. Forschungsberichte. Stuttgart. I. U. **1+**.

Plough-boy. Albany, N. Y. S. L. **1-4**.

Plumbers' trade journal. New York. Ft. W. **62+**.

Polytechnic engineer. Brooklyn, N. Y. P. **10, 12**.

Pomological and fruit growing society of the province of Quebec.
Annual report. Exp. **'09**.

Pomona college journal of entomology. Claremont, Cal. Exp. **1*, 2*, 3*, 4***: N. D. **1+**.
Continues as **Journal** of entomology and zoology.

Pontificia accademia roma dei nuovi Lincei. Rome, Italy. See **Accademia** pontificia dei nuovi Lincei.

Popular astronomy. Northfield, Minn. B. **11-14, 16, 17*+**: D. **11, 12*, 20+**: E. **1+**: F. **10+**: I. U. **1+**: N. D. **1+**.

Popular electricity. Chicago, Ill. E. **4**: Ft. W. **2+**: G. **3*, 4*, 5+**.

Popular mechanics. Chicago, Ill. F. **15**+: Ft. W. **14**+: G. **12**+: L. P. **9**+: M. **11**+: N. H. **15**+: S. L. **15**+: T. H. **11**+.

Popular science index. M. **1-8.**

Popular science monthly. New York. B. **1**+: D. **1**+: E. **1-12, 15-19, 24-29, 31, 32, 34, 36, 37, 40, 41, 43-65, 67**+: F. **1-55, 63**+: Ft. W. **1, 2, 46**+: G. **74**+: I. U. **1**+: L. P. **1**+: M. **1**+: N. D. **1-62, 65**+: N. H. **1**+: P. **1**+: R. P. **1**+: S. L. **1**+: S. N. **1**+: T. H. **1**+: W. **1**+.

Supplement. N. D. **1-18.**

Popular science news. New York. W. **21-24.**

Popular science review. London, England. R. P. **1-13**: S. L. **1-20**||.

Portefeuille éeonomique des machines de l'outillage et du matérial. Paris, France. R. P. **12.**

Portland society of natural history. Portland, Me.

Proceedings. Ac. $2^{4, 5, 8-9}$.

Porto Rico. Agricultural experiment station. Mayaguez.

Annual report. D. **'06-'08, '10**+: Exp. **'01, '04**+: R. P. **'06, '07**: S. L. **'06-'08, '10-'11.**

Bulletin. D. 1, 2, 5-8, 10+: Exp. 1, 2, 4+: P. 1+: R. P. 1-8: S. L. 1-8, 10: S. N. '02+.

Porto Rico sugar planters and producers' association. Rio Piedras.

Annual report. Exp. **2.**

Bulletin. Exp. 3.

Portugal. Commissão dos trabalhos geologicos. Lisbon.

Communicacoes. Ac. **1-5**, 6^{1}.

Post graduate. New York. P. **19-21***.

Postelsia. See under **Minnesota** university.

Poultry association of Ontario. Toronto

Report. Exp. **'94, '01.**

Poultry digest. New York. Exp. **3*, 4, 5*, 6*.**

Poultry fancier. Chicago, Ill. Exp. **14*, 15*, 16*.**

Poultry world. Hartford, Conn. Exp. **1-10.**

Power. New York. Ft. W. **27**+: G. **30**+: N. D. **20**+: P. **13, 20**+: R. P **14**+: T. H. **24.**

Power boating. Cleveland, O. Ft. W. **10**+.

Practical dairyman. Rutherford, N. J. Exp. **2*, 3.**

Practical druggist and pharmaceutical review of reviews. New York. P. **29.**

Practical engineer. Chicago, Ill. Ft. W. **13**+: N. H. **13**+: R. P. **13-16.**

Practical farmer. Philadelphia, Pa. Exp. **96*, 97*, 98, 99, 100*, 101-104, 105*, 106**+.

Prairie farmer. Chicago, Ill. Exp. 79*, 80*, 83*, 84+.

Praktische Chemie. Leipzig, Germany. Exp. 37-40.

Prince Edward Island. Agriculture, Department of.

Annual report. Exp. '05, '10: P. '04.

Prince Edward Island dairy association.

Annual report. Exp. '11.

Prince Edward Island. Forestry commissioners.

Report. P. '04.

Prince Edward Island fruit growers' association.

Annual report. Exp. '02-'04, '06+.

Princeton (N. J.) university.

Contributions to philosophy. P. 1*.

Contributions to psychology. P. 1*, 2*.

Producer and consumer. See **Farm** sense.

Progressive farmer and home builder. Phoenix, Ariz. Exp. 1*, 2*, 3+.

Progressive farmer and southern farm gazette. Memphis, Tenn. Exp. 24*, 25*, 26*, 27+.

Progressive medicine. Philadelphia, Pa. I. U. 9+.

Psyche. Cambridge, Mass. Ac. 4*, 5*, 6*, 7*: S. N. 2-4.

Psychological bulletin. New York; Lancaster, Pa. E. 1+: I. U. 1+: N. D. 2+: P. 5+: S. N. 1+: W. 1+.

Psychological clinic. Philadelphia, Pa. G. 1+: I. U. 1+: P. 1+: S. N. 1+: W. 1-3.

Psychological index. New York. N. D. 5-7, 9+.

Psychological monographs. New York. I. U. 1+: S. N. 1+.

Psychological review. New York; Baltimore, Md. D. 1+: N. D. 6, 8, 12+: P. 15+: S. N. 1+: W. 5+.

Psychologische Arbeiten. Leipzig, Germany. I. U. 1+.

Psychologische Studien. Leipzig, Germany. I. U. 1+.

Psychotherapy. New York. I. U. 1+.

Public service journal. See **Stone** and Webster public service journal.

Purdue agriculturist. Lafayette, Ind. Exp. 4+: P. 1+.

Purdue engineering review. Lafayette, Ind. P. 1+.

Purdue university. Lafayette, Ind.

Leaflets on nature study. Exp. '98: P. 1-24||.

Purdue university. Agricultural extension, Department of.

Annual report. P. 1+.

Bulletins. P. 2-13, 17+.

Pure products. New York. Exp. **1***, **2+**: P. **4+**.

Quarterly journal and review. Cincinnati, O. N. H. **1**.

Quarterly journal of medical science. Dublin, Ireland. D. **6-8, 16-26**.

Quarterly journal of microscopical science. London, England. B. **22-25**: D. n. s. **34-36, 38**: I. U. n. s. **32-45**: R. P. o. s. **1-8**; n. s. **1-14**.

The old series was called **Journal** of microscopical science.

Quarterly journal of pure and applied mathematics. London, England. D. **1-25**: I. U. **1-41, 43+**: R. P. **1+**: W. **28**.

Quebec. See **Dairymen's** association of the province of Quebec; **Pomological** and fruit growing society of the province of Quebec.

Quebec. Agricultural experiment station, Department of.

Annual report. Exp. **'91**.

Quebec. Agriculture, Minister of.

Annual report. Exp. **'09**.

Quebec. Lands and forests, Department of.

Report. P. '08, '09.

Queensland (Australia). Agriculture, Department of. Brisbane.

Agricultural journal. Exp. **1***, **2***, **3**, **6***, **7***.

Annual report. Exp. **'89-'94**.

Botany bulletin. Exp. 8, **9, 11, 12**.

Bulletin. Exp. I. 1-17. 20-25; II. 1-4.

Queensland museum. Brisbane, Australia.

Annals. Ac. **6-9**: N. D. **10+**.

Memoirs. N. D. **1+**.

Quekett microscopical club. London, England.

Journal. R. P. **1-5**.

Radium. Paris, France. I. U. **1+**.

Railroad and engineering journal. New York. R. P. **61-68**.

Continued as **American** engineer and railroad journal *q. v.*

Railroad car journal. New York. P. **7***, **8-11**.

Vol. 11 has title **Railroad** digest.

Railroad digest. See **Railroad** car journal.

Railroad gazette. New York. Ft. W. **34***, **35, 36, 37***, **38, 40, 44**||: P. **5-44**||.

Combined with **Railway** age (*q. v.*) and continued as **Railway** age gazette *q. v.*

Railway age. Chicago, Ill. Ft. W. **40-45**||: P. **22-45**||.

Combined with **Railroad** gazette and continued as **Railway** age gazette *q. v.*

Railway age gazette. New York; Chicago, Ill. Ft. W. **48, 50+**: G. **46+**: P. **45+**: R. P. **17+**: T. H. **50+**.

Continues **Railroad** gazette *q. v.*

Railway and engineering review. Chicago, Ill. N. D. **38-46**: P. 33+.

Railway and locomotive engineering. New York. Ft. W. 22+: G. 25+: P. **14**+: R. P. **14-16***.

Continues **Locomotive** engineering *q. v.*

Railway machinery. New York. P. n. s. **1***, **4-5**, **6***, 7+.

Railway master mechanic. Chicago, Ill. P. **17***-**22***, 23+.

Railway signal association. Bethlehem, Pa.

Journal. P. **11**+.

Proceedings. P. **1**+.

Real academia de ciencias naturales y artes. Barcelona, Spain.

Boletin. Ac. 1^{16-30}, $2^{1, 3-11}$, 3^{1-3}.

Memorias. Ac. **3**, $4^{1, 2, 6-40}$, 5^{1-27}, 6^{1-33}, 7^{1-17} 8^{1-21} 9^{1}, $10^{1, 3-12}$+.

Real academia de ciencias exactas, fisicas y naturales Madrid, Spain.

Annario. Ac. **'89**, **'08**, **'11-'13**.

Memorias. Ac. **12**, 13^{1-3}, **14**, 15^{1-3}, 18^{1}, **20**, 21^{2}, **22-25**, $26^{1, 2}$.

Revista. Ac. 1^{1-8}, 2^{2-9}, **3**, 4^{1-6}, $5^{1-4, 7-12}$, 6+.

Reale accademia dei Lincei. Rome, Italy.

Atti. Rendiconti dell'e sedute solenni. Ac. **'01**+.

Reale accademia dei Lincei. Rome, Italy. Classe di scienze fisiche, matematiche e naturali.

Atti. Rendiconti. Ac. **9-22**: I. U. V. 20+.

See also **Accademia** pontificia dei nuovi Lincei.

Note.—"The Accademia dei Lincei, celebrated in the 17th century, was revived in 1801, but again expired in 1840. It was renewed, under the auspices of Pope Pius IX, in 1847 as Accademia pontificia dei nuovi Lincei, and up to 1870 had issued 23 vols. of Atti. Then the academy changed its name to Reale Accademia dei Lincei, but a portion continued to act under the former title. Each body continued the series of Atti. In 1875 the Reale Accademia enlarged its scope, and formed two classes, one for physical and mathematical sciences, the other for moral and historical sciences. It has published five series of Atti." Bulletin No. 8 of the Free Library of Philadelphia.

Reale orto botanico e Giardino. Palermo, Italy.

Bolletino. N. D. **11**+.

Records of the past. Washington, D. C. N. H. **5-7**, **8***.

Registered pharmacist and drug clerk's journal. Chicago, Ill. P. **10**, **11***.

Reliable poultry journal. Quincy, Ill. Exp. **3***, **4**, **9-11**, **12***, **13**, **14***, **15-17**, **19**+: Ft. W. **14**, **16**+.

Rennes (France) université.

Travaux scientifiques. I. U. **1**+.

Repertorium novarum specierum. Berlin, Germany. N. D. **1**+.

Beihefte. N. D. 1+.

Retrospect of practical medicine and surgery. New York. See **Braithwaite's** retrospect.

Review of medicine and pharmacy. Detroit, Mich. D. **10, 11***.

Revista de agricultura tropical. Mexico City. Exp. **1***, **2***.

Revista industrial y agricola de Tucuman. Argentine Republic. Exp. **1***, **2***, **3***.

Revista montserratina. Barcelona, Spain. N. D. **4***, **5**+.

Revue bretonne de botanique pure and appliquee. Rennes, France. N. D. **7**+.

Revue de horticulture Belge et etrangere. Ghent, Belgium. N. D. **'13**+.

Revue de l'ingénieur et index technique. Brussels, Belgium. G. **1-19.**

Revue de mathématiques spéciales. Paris, France. I. U. **20**+.

Revue de mécanique. Paris, France. P. **16**+.

Revue des questions scientifiques. Louvain; Paris, France. N. D. I. **1-10, 15-28**: II. **1, 2, 3*, 4*, 5-11, 12*, 13, 14*, 15*, 16, 17*, 18-20**; III. **1-11, 12*, 13+.**

Revue générale dulait. Lierre, France. Exp. **8**+.

Revue internationale der gesammte hydrobiologie und hydrographie. I. U. **1**+.

Revue philosophique de la France et de l'étranger. Paris, France. I. U. **1-42, 49**+.

Revue semestrielle des publications mathématiques. Amsterdam, Holland. I. U. **1-18.**

Rhode Island. Agricultural experiment station. Kingston.

Annual report. D. **12, 13**: Exp. **1**+: S. L. **'03, '04, '07, '09.**

Bulletin. Exp. 1+: S. L. '02-'09*.

Rhode Island. Agriculture, State board of.

Annual report. Exp. **14-17, 21.**

Bulletin. Exp. 1, 2, 7, 9-13.

Farmers' institute report. Exp. **'11.**

Rhode Island. Birds, Commissioner of.

Annual report. P. **'11.**

Rhode Island. Conservation commission.

Bulletin. P. 1+.

Rhode Island. Inland fisheries, Commissioners of.

Report. P. **11.**

Rhode Island. Metropolitan park commissioners.

Report. P. **5, 6.**

Rhode Island. Public roads, State board of.
  Annual report. P. 3+.
Rhode Island. Public utilities commission. Providence.
  Report. N. D. '12+.
Rhode Island. Shell fisheries, Commissioners of.
  Annual report. P. **'91, '92, '94, '95, '99, '00, '05**+.
Rhodora. Boston, Mass. N. D. **11**+.
Rider and driver. New York. Exp. **41*, 42, 43*, 44, 45*, 46**+.
Rio de Janeiro (Brazil). See **Museu** nacional.
Rochester (N. Y.) academy of science.
  Proceedings. Ac. **1**^{1}, **2**$^{1-4}$, **3**$^{1-3}$, 4+: I. U. 1+.
Rochester (England) naturalist. N. D. **101**+.
Rose technic. Terre Haute, Ind. R. P. **1**+.
Rothamsted experiment station. Herts, England.
  Annual report. Exp. **'08-'12.**
  Memoirs on agricultural chemistry and physiology. Exp. **1-6.**
  Memoranda of origin and results of field and other experiments. Exp. **'88-'90, '93, '95-'01.**
  Memoranda of Rothamsted experiments. Exp. **'96-'05.**
Royal agricultural society of England. London.
  Journal. Exp. II. **12-15, 25**; III. **2-11.**
Royal Asiatic society of Great Britain and Ireland. London.
  Journal. Ac. **21**$^{3-6}$, **22, 23**$^{1-2}$, **24**^{1}, **25, 26, 30, 31**: I. U. **'11**+.
Royal astronomical society. London, England.
  Memoirs. I. U. **41, 47-49, 53-57, 59**+.
  Monthly notices. I. U. **1-69.**
Royal botanic gardens. Edinburgh, Scotland.
  Notes. Exp. **'08-'12.**
Royal botanic gardens. Kew, England.
  Bulletin of miscellaneous information. Exp. **'00*-'10***: N. D. **'09**+.
Royal botanic society of London (England).
  Quarterly record. Ac. **3-10*.**
Royal geographical society of London.
  Geographical journal. D. **42**: S. N. **1**+: T. H. **1**+.
  Proceedings and monthly record of geography. S. N. **12-14.**
Royal geological society of Cornwall. Penzance, England.
  Transactions. Ac. **13**$^{2-8}$.
Royal horticultural society of London (England).
  Journal. Exp. **26**+.

Royal institute of Great Britain.

Proceedings. N. H. 9*, 12*.

Royal Irish academy. Dublin, Ireland.

Proceedings. N. D. 31.

Royal Irish society.

Proceedings. I. U. II. sei. 1.

Royal Jersey agricultural and horticultural society. St. Helier, Island of Jersey.

Annual report. Exp. '96.

Royal microscopical society. London, England.

Journal. D. '89, '91-'95: I. U. '88-'93: P. '82+: R. P. I. 1-II. 1: W. '92-'03.

Royal philosophical society of Glasgow (Scotland).

Proceedings. Ac. 29+.

Royal physical society of Edinburgh (Scotland).

Proceedings. Ac. sessions 115-120, 122-124, 128.

Royal sanitary institute. London, England.

Journal. P. 29+.

Royal society of Canada. Montreal.

Transactions. I. U. I. '82-'94: II. '95-'06; III. 1+: P. II. 8*, 9*; III. 1.

Royal society of Edinburgh (Scotland).

Proceedings. Ac. 21+: R. P. 11-27.

Transactions. I. U. 35*: R. P. 1+.

Royal society of London (England).

Philosophical transactions. I. U. 1-18; II. 90+: P. 158+: R. P. 1+: S. L. 1-131, 133-180.

Proceedings. I. U. ser. A. 1+; ser B. 1+: R. P. 7+: S. L. ser A. 53. 79-83; ser B. 79-82: W. 72-75; ser A. 76-84; ser B. 76-81.

Royal society of New South Wales. Sidney, Australia.

Journal. Ac. 19-45: I. U. 20-21.

Royal society of Queensland. Brisbane, Australia.

Proceedings. Ac. 13-22.

Rudder. New York. Ft. W. 17, 18*, 19+.

Rugby school natural history society. Rugby, England.

Report. N. D. '12+.

Rural affairs. Albany, N. Y. Exp. 1-9: P. 1-5.

Rural life. Rochester, N. Y. Exp. 28, 29, 30*.

Rural New Yorker. New York. Exp. '75*, '80*, '81*, '84, '86*, '87-'90, '91*, '92*, '93*, '96*, '97*, '98*, '07*, '08*, '09*. '10+: P. 63+: S. L. '64-'07.

St. Louis (Mo.) academy of science.

Transactions. Ac. $4^{3,4}$, 5^{1-4}, 6^{1-18}, 7^{1-20}, 8^{1-10}, 9^{1-9}, 10^{1-11}, 11^{1-11}, 12^{1-10}, 13^{1-9}, 14^{1-8}, 15^{1-6}, 16^{1-8}, $17^{1,2}$, 18^{1-6}, 19^{1-11}, 20^{1-7}, 21^{1-5}+: I. U. 1*, 2, 4, 13+: N. D. 8*, 9*, 10*: N. H. 2*: P. 6*, 14*.

St. Louis (Mo.) railway club.

Proceedings. P. 1+.

St. Petersburg (Russia). See **Academie** imperiale des sciences; **Comité** geologique; **Jardin** imperiale botanique.

Sanitary engineer. New York. P. 2*, 3-16*.

Continued as **Engineering** record, building record and sanitary engineer *q. v.*

São Paulo (Brazil). Agricultura, commercio e obras publicas, Secretaria da.

Boletin. Exp. o. s. 27*, 28*, 29*; n. s. 1*-3*, 4, 5, 6*, 7-9, 10*, 11+.

São Paulo (Brazil). See **Museu** paulista; **Sociedad** scientifica.

São Paulo (Brazil). Instituto agronomico em Campinas.

Annuario. Exp. '90, '92-'95.

Boletin. Exp. 9*, 10.

Sarawak museum. Sarawak, Borneo.

Journal. Ac. 1^{1}, 2: N. D. 1+.

Report. Ac. '10, '11: N. D. 9+.

Saskatchewan. Agriculture, Department of. Regina.

Annual report. Exp. '10.

School arts book. Worcester, Mass. P. 11+: S. N. 4-8, 10+.

School of mines quarterly. New York. I. U. 12+.

School of science and mathematics. Chicago, Ill. E. 9+: F. 13+: I. U. 3+: N. D. 1, 8, 13+: P. 1+: S. N. 1+.

Schweizerische botanische Gesellschaft. Bern, Switzerland.

Berichte. Ac. 14+.

Schweizerische naturforschende Gesellschaft. Basel, Switzerland.

Verhandlungen. Ac. 75, 77, 79-81, 83, 84, 87-89, 91, 93, $94^{1,2}$.

Also called **Société** helvetique des sciences naturelles *q. v.*

Science. New York D. o. s. 1-22; n. s. 1+: E. o. s. 8, 9; n. s. 8, 9, 13+: Exp. 15+: F. 31+: Ft. W. 25+: I. U. o. s. 225; n. s. 1-34: N. D. 19+: N. H. n. s. 30*, 34*: P. o. s. 1-23; n. s. 1+: R. P. o. s. 1-23: n. s. 1+: S. N. 1-19; n. s. 1+: S. L. 13+: W. 5-24; n. s. 7-13, 19-22.

Science abstracts. London, England.

Physical and electrical engineering. P. 1-5*: R. P. 4-5*: I. U. 1-5*.

Section A, physics. N. D. '10+: P. 6+: R. P. 6+: I. U. 6+: W. 10+.

Section B, electrical engineering. P. 6+: R. P. 6+: I. U. 6+.

Science magazine. M. **31-34.**

Science news. Salem, Mass. P. **1.**

Science record (Beach). New York. R. P. **'74.**

Scientific American. New York. D. **1-25, 50+**: E. **6-8, 11-14, 16-21, 23-26, 30, 31, 36-74, 98-100, 105+**: F. **70-93, 96+**: Ft. W. **86, 90-98, 100+**: G. **82+**: I. U. **35, 44, 45, 49-67, 69, 72-75, 77, 86, 87, 89, 90+**: L. P. o. s. **11**; n. s. **1-8, 11, 15, 17-19, 23, 26-35, 77+**: M. **30+**: N. D. o. s. **14**; n. s. **4-9, 26, 28, 29, 39, 40*, 41-54, 55*-61, 62, 63*-70*, 80*, 81*, 83*, 88*, 90*, 91*, 94*-98*, 99, 100*, 101+**: N. H. n. s. **1-41, 50-51, 100+**: P. **34-43, 76+**: R. P. o. s. **1-14**; n. s. **1+**: S. L. **14-15, 18, 30-37, 57-66, 68-83, 86-106**: S. N. **86+**: T. H. **82+**: W. **1-31, 41-45, 48+.**

Scientific American. Building edition. New York. Ft. W. **37-39**‖: L. P. **27*, 28*, 29***: M. **17-39**‖: R. P. **25-39**‖.

Continued as **American** homes and gardens *q. v.*

Scientific American. Supplement. New York. D. **1+**: E. **65, 66, 68-70, 72+**: F. **59-62, 71+**: Ft. W. **57, 59-62, 64+**: G. **67+**: I. U. **1-32, 34, 54, 57+**: L. P. **1, 2, 44+**: M. **1, 2, 56+**: N. D. **1. 3**; H. **2*, 4*-7*, 9*, 12*-14*, 23*-25*, 28*, 29*, 34*, 42*, 45, 49*-52*, 53, 54*-58*, 59, 60*, 61, 62*-65*, 66+**: N. H. **8-10, 13-24**: P. **1-4, 9-24, 29+**: R. P. **13-20, 49+**: S. L. **16, 19-21, 23, 25, 35, 36, 41+**: S. N. **31+**: T. H. **1+**: W. **15-23, 35-54, 56, 58+.**

Scientific tracts. Boston, Mass. N. H. n. s. **1, 2, 4.**

Scotland agricultural college. Glasgow.

Annual report. Exp. **1, 2, 4-6.**

Scotland. Fishery board.

Annual report. S. L. **'07+.**

Scotland. Highland agricultural society. Edinburgh.

Transactions. Exp. IV. **8-11.**

Scottish geographical magazine. Edinburgh, Scotland. I. U. **25+**: S. N. **1+.**

Seismological society of Japan. Tokyo.

Transactions. R. P. **1-20.**

Selbourne magazine and nature notes. London, England. N. D. **23+.**

Semillas recolectados durante el ano. jardin botanico. Valencia, Spain. N. D. **'11+.**

Seminarium. Leipzig, Germany. N. D. **1+.**

Sibley journal of engineering. Ithaca, N. Y. P. **11, 19+.**

Siderial messenger. Northfield, Minn. D. **5-10**‖: W. **1-10**‖: I. U. **10**‖: S. L. **1, 2*.**

Continued as **Astronomy** and astro-physics.

Signal engineer. Chicago, Ill. P. 1+.

Silliman's journal. See **American** journal of science.

Skandinavisches Archiv für Physiologie. Leipzig, Germany. I. U. 1+.

Sketch book of nature and outdoor life. Manchester, N. H. N. D. 1, 2*||.

Smithsonian institution. Washington, D. C.

Annual report. D. **'53-'96, '98-'00, '02-'04, '07-'09**: E. **'71-'03, '07+**: Exp. **'82-'84, '87-'95, '97*, '99, '00**: F. **54, 56-60, 62-77, 79+**: G. **'96, '01, '08+**: I. U. **4-6, 8-54, 56+**: L. P. **'47, '53+**: N. D. **'84+**: P. **'53, '54' '56+**: R. P. **1+**: S. L. **'46+**: S. N. **'55, '59, '61, '63, '65, '77, '78, '81+**.

Contributions to knowledge. D. **1+**: I. U. **13-26, 28, 30+**: L. P. **23-26, 28, 30-32**: N. D. **2, 3, 5, 6-18, 20-24, 26, 30+**: P. **6, 10, 20-32, 34+**: R. P. **1+**: S. L. **1-35**: S. N. **2-13, 15-25, 28+**.

Miscellaneous collections. D. **1-30, 32-38, 40-42, 43, 46-57***: I. U. **1, 13+**: L. P. **1-6, 9-21, 23-28, 30-33, 35, 36, 37*, 38*, 39***: N. D. **1, 2*, 6-11, 14-33, 36+**: P. **1-2, 4, 5, 8, 9, 11-27, 29, 32-41, 44+**: R. P. **1+**: S. N. **32+**: T. H. **16, 18, 20, 22, 23, 25, 27, 40, 42-54, 56+**.

Smithsonian institution. United States national museum. Washington, D. C.

Annual report. B. **'04**: F. **'00-'04**: I. U. **'84+**: L. P. **'81+**: N. H. **'54+**: P. **84+**: R. P. **'85+**: S. L. **'85+**: S. N. **'84-'98, '07+**: T. H. **'86+**.

Bulletin. D. 29, 33-38, 39*, 40-46, 47*, 48-49, 50*, 51, 52, 53*, 54, 55, 56*, 57, 58, 60-69, 71-77, 79, 81: Exp. 3, 6, 11, 13, 21, 23, 26, 39*, 40-46, 47*, 50, 51, 53-60, 62-71, 73+: I. U. 1-38, 40-54, 56-58, 60, 70+: L. P. 39*+: N. H. 9, 10, 12, 40-43, 45, 48: P. 1-16, 20, 21, 24, 26, 33-38, 40-48, 50+: R. P. 1-16, 39-48: S. L. 1+: S. N. 1-48, 50+.

Proceedings. D. **10-22, 24-28, 32, 34-40**: Exp. **2, 3, 8, 9, 14-33, 36, 37, 39, 42+**: F. **14-16, 18-29**: I. U. **1+**: L. P. **14+**: N. D. **14+**: N. H. **14-19**: P. **1+**: R. P. **13+**: S. L. **1+**: S. N. **1+**: T. H. **2, 4, 6, 9, 13-33, 35+**.

Smithsonian institution. See also **United States.** Astrophysical observatory; **United States.** Ethnology, Bureau of American; **United States.** National herbarium.

Sociedad broteriana. Coimbra, Portugal.

Boletino. N. D. **25+**.

Sociedad cientifica "Antonio Alzate." Mexico City, Mexico.

Memorias y revista. Ac. $9^{9,10}$, 10^{5-12}, **11, 12,** 13^{1-10}, 14^{3-12}, **15, 16-18,** 19^{6-12}, 20^{5-12}, **21-28, 29,** 30^{1-6}+: N. D. **32+**.

Sociedad cientifica Argentina. Buenos Aires, Argentine Republic.

Anales. Ac. $45^{5,6}$, **46+**: N. D. **75+**.

Sociedad de geografia y estadistica de la República Mexicana. Mexico City.

Boletin. Ac. 1^{1-12}, 2^{1-5}: N. D. **6+**.

Sociedad Mexicana de historia natural. Mexico.
Naturaleza. Ac. **7**$^{16-18}$; II. **1**$^{1-a, 5, 6, 9, 10}$, **2**$^{10-11}$, **3**$^{1-10}$; III. **1**$^{1-4}$+: N. D. III. **1**+.

Sociedad quimica Argentina. Buenos Aires, Argentine Republic.
Anales. Ac. **1**^{1}.

Sociedad scientifica de São Paulo (Brazil).
Revista. Ac. **1**$^{1-4}$, **2**$^{1-8}$, **5**$^{1-8}$, **6**+.

Società africana d'Italia. Naples, Italy.
Bulletin. Ac. **13-31***.

Società botanica italiana. Florence, Italy.
Bollettino. N. D. **'09**+.

Società di naturalisti in Napoli (Italy).
Bollettino. N. D. **24**+.

Società entomologica italiana. Florence, Italy.
Bullettino. Ac. **34-43.**

Società italiana di scienze naturali e del museo civico di storia naturale. Milan. Italy.
Atti. Ac. **40-46**, **47**$^{3, 4}$, **48**$^{1, 2, 4}$, **49**$^{1-4}$, **50**$^{1-4}$, **51**$^{1-2}$+.

Societas royale de botanique de Belgique.
Bulletino. N. D. **'09**+.

Société belge de geologie de paléontologie et d'hydrologie. Brussels, Belgium.
Proces verbaux. Ac. **10-26***.

Société botanique de France. Paris.
Bulletin. Exp. **35-37.**

Société botanique de Geneva (Switzerland).
Bulletin. Ac. **8-9.**

Société chimique de France. Paris.
Bulletin. Exp. III. **1***, **2***, **3***, **4**, **5**, **6***, **7-36**; IV. **1**, **2***, **3**+: S. L. **'12**+.

Société des Americanistes de Paris (France).
Journal. N. H. **5.**

Société des sciences naturalles de l'Ouest de la France. Nantes.
Bulletin. Ac. **7-10**; II. **1-3**, **4**$^{3, 4}$, **5-9**, **10**$^{1-2}$; III. **1**, **2**$^{1-2}$+.

Société entomologique de Belgique. Brussels. Belgium.
Compte rendu. Ac. **54-67.**

Société entomologique de France. Paris.
Bulletin des séances. Ac. **'97**+*.

Société française de physique. Paris, France.
Bulletin des séances. N. D. **'79-'81**, **'86-'89***, **'92**, **'93**, **'95.**

Société géologique de Belgique. Liége, Belgium.

Anales. Ac. 25^{1-3}, 26^{2-4}, 27^{1-4}, 28^{1-3}, **29+**.

Memoires. Ac. **'04-'12.**

Société géologique de France. Paris.

Bulletin. I. U. III. **23-28**; IV. **1+**; S. L. II. **1.**

Société helvétique des sciences naturelles. Geneva, Switzerland.

Actes. Ac. **'93, '95, '99, '02, '07, '09.**

Compte rendu. Ac. **'99-'07.**

Also called **Schweizerische** naturforscheude Gesellschaft *q. v.*

Société hollandaise des sciences. La Hague, Holland.

Archives. Ac. $30^{4,5}$; II. $1^{1,4,5}$, **2-4, 6**, 7^{1-3}, $8^{1,2,5}$, **9-15**; III. A. **1-2**; III. B. **1+**.

Société impériale des naturalistes de Moscou (Russia).

Bulletin. Ac. **61-62**; n. s. **1-10**, $11^{1,2}$, $13^{2,3}$, **14, 15**, $16^{3,4}$, **17**, 18^{2-4}, **19+**.

Memoires. Ac. 15^{5}, $16^{3,4}$, $17^{1,2}$.

Beilage. Ac. **'87.**

Société internationale des électriciens. Paris, France.

Bulletin. P. **5+**.

Société mathématique de France. Paris.

Bulletin. D. **1-20**: I. U. **1+**.

Société rambertia.

Rapport annuel et presidentiel. N. D. **10-13.**

Société royale de botanique de Belgique. Brussels, Belgium

Bulletin. Ac. **36-45**, 45^{1-3}, $46^{1,2,4,5}$, 47^{1-4}: N. D. **46+**.

Société royale linnéenne de Bruxelles (Belgium).

Bulletin. Ac. **14-16*, 19-31*.**

Société royal malacologique de Belgique. Brussels, Belgium.

Annales. Ac. **41-46.**

Bulletin des seances. Ac. **'00-'01.**

Proces-verbaux des seances. Ac. **11-24*, 26-28*.**

Société scientifique de Bruxelles (Belgium).

Annales. N. D. **7-15, 22*, 24-26, 28*, 30+**.

Society for experimental biology and medicine. New York City. N. D. **1+**.

Society for horticultural science. Washington, D. C.

Proceedings. Exp. **'03-'10.**

Society for psychical research. London, England.

Proceedings. I. U. **1+**: S. N. **1+**: W. **1-6.**

Society for the promotion of agricultural science.

Proceedings. Exp. **4, 5, 9, 11, 14, 17-19**: P. **1-28**: S. L. **'96, '98, '99.**

Society for the promotion of engineering education. London, England.
Bulletin. P. 1+.
Proceedings. P. 1+: R. P. 1+.
Society of American foresters.
Proceedings. P. 1+*.
Society of chemical industry. London, England.
Journal. Exp. **27**+: I. U. **22**+: N. D. **24***, **25**: P. **1**+: R. P. **23**+: W. **13**.
Society of naval architects and marine engineers. New York.
Transactions. P. **1-11**: R. P. **1-15**.
Society of telegraph engineers. London, England.
Journal. P. **1-17**||: R. P. **1-14**.
Continued after Journal **17** as **Institution** of electrical engineers *q. v.*
Sound waves. P. **7-12**, **13***, **14-15**.
Merged with **American** telephone.
South Africa. Central locust bureau. Cape Town.
Report. Exp. **1-4**.
South Africa. Entomologist, Government. Cape Town.
Report. Exp. **'95**, **'98**, **'00**.
South Africa union. Agricultural journal. Pretoria, Transvaal. N. D. **'12**, **'13**+.
South African philosophical society. Cape Town.
Transactions. Ac. $\mathbf{9}^{2}$, $\mathbf{10}^{2, 3}$, $\mathbf{11}^{1-4}$, **12**, $\mathbf{15}^{1-4}$, $\mathbf{16}^{1-4}$.
South Australia. Agriculture, Department of. Adelaide.
Bulletin. Exp. **1-7**, **9-21**, **23-29**, **31-63**, **69**, **71*-74***.
Journal. Exp. **10***, **11***, **15***, **16**+.
Report. Exp. **'05-'07**, **'09-'11**.
South Carolina agricultural college. Clemson College.
Extension work. Exp. **1***.
South Carolina. Agricultural experiment station. Clemson College.
Annual report. Exp. **1**, **2**, **4**, **5**, **7**+: P. 2, 5, 7, **10**+.
Bulletin. Exp. 1-153, 155+: P. o. s. 1-8; n. s. 1-49, 52+.
South Carolina college. Columbia. Experimental farm.
Report. Exp. **'83-'86**.
South Carolina. Live stock association.
Annual report. Exp. **4-10**.
South Dakota. Agricultural experiment station. Brookings.
Annual report. Exp. **1-11**, **13**, **14**, **16**+: P. **1-5**, **7-9**, **15**+.
Bulletin. D. 87, **92**, **93**, **114**, **115**, **125**, **126**: Exp. 1+: P. 1+: R. P. **22-131**: S. L. **'04-'10**.

South Dakota. Agriculture, State board of.
Annual report. Exp. **'09, '10.**

South Dakota dairy association.
Annual report. Exp. **7.**

South Dakota. Engineer.
Report. P. **1+.**

South Dakota. Food and drug commissioner.
Annual report. P. **10-12.**

South Dakota. Geological survey.
Biennial report. S. N. **1, 2.**
Bulletin. P. **4.**

South Dakota. Improved live stock and poultry breeders' association.
Annual report. Exp. **'06-'08, '10.**

South Dakota (state) school of music. Geology, Department of.
Bulletin. P. **6, 9.**

Southern and southwestern railway club. Atlanta, Ga.
Proceedings. P. **5*, 6, 7*, 8.**

Southern California academy of science. Los Angeles.
Bulletin. Ac. **1**[1, 2].

Southern orchard and farm. Houston, Tex. Exp. **6*, 7*, 8+.**

Southern planter. Richmond, Va. Exp. **70+.**

Southern ruralist. Atlanta, Ga. Exp. **16*, 18*, 19*, 20+.**

Southern states association of commissioners of agriculture.
Proceedings. P. **11, 12.**

Southern woodlands. See **Georgia** forest association.

Southwest trail. Chicago, Ill. Exp. **29*, 30*, 31, 32*, 33*.**

Spokesman review. Spokane, Wash. Exp. **30*, 31+.**

Springfield (Mass). See **Museum** of natural history.

Stahl und Eisen. Dusseldorf, Germany. P. **25+.**

Standard guide. Chicago, Ill. Exp. **4.**

Statesman's yearbook. London, England. R. P. **'73, '76.**

Stockholm (Sweden). See **Kongliga** svenska vetenskaps-akademien.

Stone and Webster public service journal. Boston, Mass. P. **1-6.**

Strawberry. Three Rivers, Mich. Exp. **2*.**

Street railway journal. New York. Ft. W. **29-31**||: P. **7-31**||.
Continued as **Electric** railway journal *q. v.*

Street railway review. Chicago, Ill. P. **4-16**||.
Continued as **Electric** railway review *q. v.*

Student farmer. Madison, Wis. Exp. **3*, 4*.**

Successful farming. Des Moines, Ia. Exp. 8*.

Successful poultry journal. Chicago, Ill. Exp. **3***, **4**, **5***, **6**, **7***, **8**, **9***, **10***, **11-15**, **16***, **17***, **18+**.

Sugar beet. Philadelphia, Pa. Exp. **12***, **15**, **16**, **17***, **18-21**, **22***, **23***, **24***, **25***, **26***, **27**.

Quarterly. Exp. **27-32**.

Svenska vetenskaps-akademien. See **Kongliga** svenska, etc.

Sveriges geologiska Undersokning. Stockholm, Sweden.

Afhandlingar och uppsatser. Ac. ser. C. **92-111**, **113-134**, **195**, **196**, **201-203**; ser. Ca. **4**, **5**, **7**.

Arsbok. Ac. **'07-'09**.

Ofversiktskartor. Ac. ser. Ba. **6**, **7**.

Tacoma academy of sciences. Tacoma, Wash.

Proceedings. Ac. **'93**.

Technic. See under **Michigan** university.

Technical literature. New York. See **Engineering** digest.

Technical world magazine. New York. Ft. W. **11+**: G. **13+**: S. N. **1+**.

Technische Auskunst: Monatsheft des internationalen Institutes für Technobibliographie. Berlin, Germany. R. P. **'09+**.

Technograph. See under **Illinois** university.

Technology architectural record. Boston, Mass. Ft. W. **6+**.

Technology quarterly and proceedings of the Society of arts. Boston, Mass. P. **18-21**.

Technology review. Boston, Mass. I. U. **1+**: P. **1+**: R. P. **1+**.

Telegraph and telephone age. New York. S. L. **'11**.

Telephony, the American telephone journal. Chicago, Ill. P. **1-4**, **17**, **18**, **59+**.

Tennessee. Agricultural experiment station. Knoxville.

Annual report. Exp. **1+**: S. L. **'00**, **'01**, **'03**: P. **1+**.

Bulletin. Exp. 1+: S. L. '96-'08*: P. 1+.

Special bulletin. Exp. B-E.

Tennessee. Agricultural statistics and mines, Commissioner of.

Annual report. Exp. **'84**.

Tennessee. Entomology, State board of. Knoxville.

Annual report. Exp. **1**, **3-6**: N. D. **7+**.

Bulletin. Exp. 1, 3-5: N. D. 7+.

Tennessee. Geological survey.

Biennial report. N. H. **1**: P. **'69**.

Resources of Tennessee. P. 1+.

Tennessee. Health, State board of. Nashville. Exp. **3***, **4***, **5***, **6***, **7***, **9***.

Tennessee university. Knoxville.

Record. Exp. **7***: P. **4*-10***.

Tennessee university. Agriculture, School of.

Report on experimental work. Exp. **'79-'86***.

Continued by Tennessee. **Agricultural** experiment station, *q. v.*

Terrestial magnetism and atmospheric electricity. Chicago, Ill.; Cincinnati, O.: Baltimore, Md. I. U. **4, 5.**

Texas academy of science. Austin, Tex.

Transactions. Ac. **1**$^{1-5}$, **2**^{1,2}, **3. 4** pt. **2**$^{1-9}$, **7, 9-11**: N. D. **1**+.

Texas. Agricultural experiment station. College Station.

Annual report. Exp. **1-14**: P. **1**+.

Bulletin. D. 7: Exp. 1-77, 79-86, 88+: P. 1+: S. L. '05+*.

Texas. Agriculture, Department of. Austin.

Annual report. Exp. **1.**

Bulletin. Exp. 1, 3-7, 10-12, 14, 15, 19, 20-22, 24-28.

Texas farm cooperator. Ft. Worth. Exp. **34***, **35**+.

Texas farmer. Ft. Worth. Exp. **33***, **34**+.

Texas farmers' congress. Beaumont.

Annual report. Exp. **14**: P. **3-5, 9, 15.**

Texas geological and mineralogical survey.

Bulletin. P. 3-4, 7-9.

Texas university. Austin.

Bulletin. Medical series. Ac. **2, 3.**

Official series. Ac. **39.**

Reprint series. Ac. **2.**

Scientific series. Ac. **4, 6, 8, 10-17**: I. U. **12, 13**: N. D. **14, 20**+: P. **46, 51, 135, 165, 178, 189**: R. P. **23**+.

Record. P. **2-4***.

Mineral survey. Bulletin. P. **3, 4, 7, 9** : R. P. **7-9** .

Therapeutic gazette. Detroit, Mich. D. o. s. **4-11.**

Therapeutic notes. Detroit, Mich. I. U. **10**+.

Things chemical. N. D. **'06***, **'07***.

Tidsskrift for skovaesen. Copenhagen, Denmark. N. D. **'13**+.

Timehri. Journal of the royal agricultural and commercial society of British Guiana. Damerara. N. D. III. **1***, **2***, **3**+.

Tokyo (Japan) botanical society.

Botanical magazine and proceedings. N. D. **24**+.

Tokyo (Japan) university.
Journal. N. D. **1+.**

Toronto (Can.). City engineer.
Report. P. **'93, '95-'97, '99, '01, '02.**

Toronto (Can.) school of practical science.
Papers. P. **7-20.**

Toronto (Can.) university. Chemical laboratory.
Papers. Ac. **40-52, 54-72, 74-94.**

Toronto (Can.) university. Physical laboratory.
Papers. Ac. **18-40.**

Toronto (Can.) university. Engineering society.
Applied science. P. **1, 2**: R. P. **'92-'98, '00-'06.**
Called Papers before 1903.

Toronto (Can.) university.
Studies. Anatomical series. P. 1.
Biological series. Ac. 4-11: N. D. 3+: P. 1-3.
Chemical series. Ac. 40-52, 54-72, 74-93.
Geological series. Ac. 3-7: N. D. 1+: P. 1, 2.
Pathological series. Ac. 1.
Physical science series. Ac. 1-4.
Physics series. Ac. 18-36.
Physiological series. Ac. 4-7: P. 1-3.
Psychological series. Ac. 2^{2}, $3^{4, 1}$: P. 1, 2.

Torrey botanical club. New York.
Bulletin. Ac. **12-21, 25**: D. **19+**: F. **15, 17, 18**: I. U. **18-19, 21+**: N. D. **14, 15*, 16-24, 25*, 26, 27, 36*, 37+**: W. **19+.**
Memoirs. D. **1, 2, 4-11**: I. U. **1*, 6*, 9, 11*.**
Torreya. D. **1+**: N. D. **11+.**

Town planning review. Manchester, England. G. **3+.**

Trade; a journal of the canning industry. Baltimore, Md. Exp. **34*, 35+.**

Transit. See under **Iowa** (state) university.

Transvaal agricultural journal. Pretoria. Exp. **1*, 2*, 3*, 4-8, 9*.**

Transvaal. Agriculture, Department of. Pretoria.
Annual report. Exp. **'03-'08.**

Traveling engineers association.
Proceedings. P. **1-7, 9.**

Trenton (N. J.) natural history society.
Journal. Ac. 1^{1-5}, 2^{1}.

Trondhjem (Norway). See **Kongelige** norske videnskabers selskab.

Trucker and farmer. New Orleans, La. Exp. **4*, 5+.**

Tufts college. Tufts college, Mass.

Studies, Ac. **1**[2, 4, 5, 8], **2**[2, 3], **3**[1]: P. **1+*.**

United States. Agriculture, Department of. Washington, D. C.

Annual report. D. **'63, '65, '67, '68, '73, '75-'80, '85-'93:** Exp. **'47, '48, '50, '51, '53-'59, '61+:** P. **'48-'60, '62-'93, '98+:** R. P. **'62+:** S. L. **'43*+:** S. N. **'51-'05, '07+.**

Called **Report** of the commissioner of agriculture until 1888. After that called **Report** of the secretary of agriculture. Since 1894 the scientific and general informational matter has been published separately from the administrative report in the **Year** book *q. v.*

Department report series. Exp. **12, 14, 16, 18, 20, 22, 24, 26, 27, 30, 36, 39, 43, 47, 48-50, 52, 55-85, 88-90, 92+:** P. **59-63, 65-72, 74, 75, 77, 78, 80, 83, 84, 86+:** S. N. **5, 58, 60, 63, 65, 68-72, 74, 75, 77, 80, 86+.**

Farmers' bulletins. Exp. 1-375, 377+: N. D. 1+: P. 1+: R. P. 9-356: S. L. 1+: S. N. 1+.

Library bulletin. Exp. 1+: P. 1+: S. N. 40+.

Library monthly bulletin. Exp. 1, 2+: P. 1+.

Miscellaneous reports. Exp. 1-10||: S. L. 1-10||.

Special reports. D. 18-37: S. L. o. s. 1-65||.

Yearbook. D. **'94-'97, '07, '08, '10+:** Exp. **'94+:** N. D. **1+:** P. **'94+:** R. P. **'94+:** S. L. **'94+:** S. N. **'94+.**

Continues the scientific and informational matter of the **Annual** report *q. v.*

United States. Agrostology, Division of.

Bulletin. D. 11-20: Exp. 1, 2, 4-7, 9-25||: P. 1-7, 9-25||: R. P. 2-25||: S. N. 1, 2, 4, 6, 8, 9, 12-16, 18, 19, 21-25||.

Continued as **United** States Plant industry, Bureau of, *q. v.*

United States. Animal industry, Bureau of.

Annual report of the bureau. D. **24+:** Exp. **1+:** P. **1-16, 21+:** R. P. **1-24:** S. N. **'84, '87-'92, '97-'03, '07+.**

Annual report of the chief. Exp. **'89-'91, '95-'03, '05, '06, '08-'10, '12+.**

Bulletin. D. 2-4, 6, 7, 10-15, 17, 20-22, 24, 25, 31, 32, 34, 38, 39, 42, 44-53, 56-58, 60, 63, 66-101, 103-139, 141-159, 161-164, 166+: Exp. 1-78, 80-106, 108-124, 125, 126-159, 161-164, 166+: P. 3-5, 7-9, 11, 13+: R. P. 10-11, S. N. 9, 15-18, 28, 30-34, 36, 39.

United States astrophysical observatory.

Annals. D. **2+:** N. D. **1+:** R. P. **1+.**

United States. Biological survey, Division of.

Annual report. Exp. **'87-'89, '98, '01-'09, '11+**: N. D. 1+.

Bulletin. D. 1, 6, 8, 10, 15-17, 20, 22+: Exp. 1, 3+: N. D. 1+: N. H. 1: P. 1-37, 39+: S. L. 9+: S. N. 7-9, 12, 15+.

Circular. Exp. 14-17, 20, 23-35, 38-40, 42-44, 46-47, 51+: N. D. 1+: P. 1-61, 63-85, 87-90, 92+: S. L. 17+: S. N. 28+.

North American fauna. D. 1-5, 7, 11, 12, 17, 20, 23: Exp. 1-5, 7, 8, 10+: P. 1-4, 7, 8, 10+: S. L. 1+: S. N. 2-5, 8-10, 11-13, 15, 17, 18, 20-26, 27+.

Formerly **United States** Ornithology and Mammalogy, Division of, *q. v.*

United States. Botany, Division of.

Annual report. Exp. **'85, '86, '88-'91, '93, '94, '96-'98**: P. **'86, '88-'95.**

Bulletin. D. 1, 3, 6, 8, 15-25, 27: Exp. 1-29||: P. 1-3, 5-8, 12-29||: R. P. 16-29||.

Circulars. Exp. 1-30||: P. 2-30||: S. L. 9, 12, 15, 18, 23-30||.

Continued as **United** States Plant industry, Bureau of, *q. v.*

United States brewers' association.

Proceedings. P. **'08-'11.**

Yearbook. P. **'09+.**

United States census bureau, forest products. P. **'07+.**

United States. Chemistry, Bureau of.

Annual report. Exp. **'90, '93, '97, '98, '00-'03, '05, '07+**: N. D. 1+: P. **'90, '98-'01, '03-'05, '08.**

Bulletin. Exp. 3, 8, 9, 11-96, 99-113, 115-160, 163+: N. D. 1+: P. 1-6, 8-10, 13-15, 17, 18, 20+: R. P. 13-124: S. L. 1+: S. N. 13, 15, 20, 21, 34, 39, 40, 42, 46-58, 62+.

Circulars. Exp. 1, 2, 3-6, 7-18, 20+: N. D. 1+: P. 1-77, 79-85, 87+: S. L. 1+: S. N. 5, 16, 41+.

United States. Coast and geodetic survey.

Annual report. D. **'52, '54, '55, '60, '62-'68, '71-'73, '77-'89, '91+**: N. D. 1+: P. **'51+**: R. P. **'51-'57, '59-'62, '64-'65, '67+**: S. N. **'51-'57, '60, '61, '78-'95, '97+.**

Bulletin. N. D. 1+: R. P. 1-17, 19-21, 25, 26, 28, 29, 32, 33, 35-38, 40+.

Charts. N. D. 1+.

Special publications. P. 1, 5+: R. P. 1, 7, 10+: S. L. 3-5, 7-12.

Surveys. N. D. 1+.

Tide tables. D. **'03-'05, '07, '13**: N. D. 1+: P. **'08+**: S. N. **'02+.**

U. S. coast pilot. Atlantic coast. D. **1-8**: S. N. **1-6, 8.**

Pacific coast. D. **1**: S. N. **1.**

U. S. magnetic tables and magnetic charts. D. **'05**: S. N. **'05.**

United States. Engineer department.

Professional papers. N. D. 1+. R. P. 22, 23, 25, 26, 28.

Report of chief. R. P. '68+: S. L. '67+: S. N. '83, '07+.

Report of examination and surveys. N. D. 1+.

United States. Engineer school. Washington, D. C.

Occasional papers. N. D. 1+.

United States. Entomological commission.

Annual reports. Exp. 3-5 : P. 1-4.

Bulletins. D. 1-7 : Exp. 1-3, 5-7 .

United States. Entomology, Bureau of.

Annual report. Exp. '08, '10+: N. D. 1+.

Bulletin. D. o. s. 6, 7, 10, 13-17, 19, 21, 23, 25, 27-30, 32, 33; n. s. 4, 6, 7, 11-20, 23, 26-30, 32, 37-39, 41-44, 46-50, 52-54 56-80, 82, 84, 86-93, 95, 97-98, 100-110, 112+: Exp. o. s. 4-25, 27-33; n. s. 1-82, 84-93, 95*, 96*, 97, 98, 100-113, 115*, 116*, 117-121, 127+: N. D. 1+: P. o. s. 6, 10, 11, 13, 14, 17, 19, 20, 22-25, 27-29, 31, 32; n. s. 1+: S. L. o. s. 1-33; n. s. 1+: S. N. o. s. 4, 6, 9-19, 22, 29, 31, 45-50; n. s. 1 3, 4, 6-9, 25, 27-30, 52+.

Bulletin. Technical series. D. 2, 3, 10+: Exp. 1-3, 5-13, 15, 16*, 17*, 19*, 20*, 21-23*, 24, 25*, 26+: N. D. 1+: P. 1+.

Insect life. D. 1-7 : Exp. 1-7 : L. P. 2, 3*, 4, 5*, 7* : P. 1-4, 5*, 7 : W. 1-7 .

Special report. Exp. 1-3, 5-8.

United States. Ethnology, Bureau of American.

Annual report. E. 1-26: Exp. 26: F. 2-23: L. P. 1-22: N. D. 1+: N. H. 1-28: P. 1-3, 5-19, 21+: R. P. 1+: S. L. 1-26: T. H. '79-'89, '93, '94, '96+.

Bulletin. F. 25-27: I. U. 25, 30-36, 39, 42-45, 47+: P. 33+: R. P. 1-48: S. L. 1-52: S. N. 6-23, 25-45, 47+: T. H. 25-29, 32-35, 37+: W. 1+.

Ethnological survey publications. P. 1, 2*, 4*: S. N. 1.

United States. Experiment stations, Office of.

Annual report. D. '08+: Exp. '01-'09, '11+: N. D. 1+: P. '01+: R. P. '01, '04-'07: S. N. '07-'10.

Annual report of director. Exp. '89+: P. '89, '91+.

Bulletin. Exp. 1-253, 255+: N. D. 1+: P. 1+: R. P. 1-210: S. N. 1, 3-7, 10-20, 22-25, 65-68, 80, 83-85, 88-106, 108-118, 120-130, 132+: S. L. 1+.

Experiment station record. D. 1*, 2*, 3-5, 6*, 7, 9*, 10*, 11*, 13*, 14*, 15*, 16*, 17-20, 21*, 22*, 23+: Exp. 1+: N. D. 1+: P. 1+: R. P. 3-20: S. L. 1+: S. N. 8+.

Experiment station work. Exp. 1+: P. 1+: S. N. 2.

Farmers' institute lecture. Exp. 1-14: P. 1+: S. L. 1+: S. N. 1+.

Miscellaneous bulletins. Exp. 1, 3||: P. 1-3||.

United States. Fiber investigations, Office of.

Report. D. 2-9: Exp. 1-11||: P. 1, 3-11||: R. P. 8-11.

Continued in **United States**. Botany, Division of. *q. v.*

United States. Fisheries, Bureau of.

Bulletin. D. 1-8, 11-17, 27+: L. P. 1+: N. D. 1+: N. H. 8, 12, 15: P. 1+: R. P. 10: S. N. 1+: T. H. 1+.

Documents. P. 603*+: S. N. 602-604, 609, 610, 612, 613, 618+.

Economic circular. N. D. 1+: S. L. '12+.

Report. D. '71-'72, '78, '82, '87-'99: Exp. '91-'92: I. U. '71, '72, '73-'04: L. P. '71-'74, '77-'81, '83+: N. D. 1+: N. H. '71, '87, '04: P. '71-'77, '79-'88, '94-'06: R. P. '71-'87: S. L. '71+: T. H. '73-'04: W.

Before 1903 known as **Commission** of Fish and Fisheries.

United States. Food and drug inspection, Board of.

Food inspection decisions. P. 1+*.

United States. Forestry service.

Annual reports. Exp. '93, '97, '08, '09, '11+: P. '91-'93, '99-'06, '09.

Bulletin. D. 6, 10-12, 33, 35, 37-41, 43, 45-48, 50-52, 54-61, 63-76, 78-81, 83-97, 99-112, 115, 119, 121-123, 125+: Exp. 2, 4-22, 24-119, 121-123, 125+: F. 7, 15, 16, 20, 21, 24-26, 31-34, 41-43, 45-52, 54, 55: L. P. 15-17, 19, 20, 25-32, 34, 35, 37-58, 60, 63-66, 68-73, 75-81, 83-90, 94, 97-102, 104+: N. D. 1+: P. 2, 4-10, 12-21, 24+*: R. P. 9-74, 77, 104+: S. L. 1+: S. N. 7, 9, 30-35, 37+: T. H. 15+.

Silvical leaflets. L. P. 12, 15-24, 26-33, 35-37, 39, 41, 42: N. D. 1+: P 1+: S. L. 3+*.

Report on forestry. S. N. 2-4.

United States. Geographical and geological survey of the Rocky mountain region.

Contributions to North American ethnology. D. 1, 3-5: P. 4-7, 9||: S. N. 6, 7, 9||.

Vol. 8 never published.

United States. Geographical and geological survey west of the 100th meridian.

Report. D. 2-7: N. D. 1-7: P. 1, 3, 7.

United States. Geological and geographical survey of the territories.

Bulletin. D. 3*, 1-6: P. 4-6*.

Report. D. 1-3, 6-11, 13||: N. D. '52: P. 1-3, 5, 6, 8-10, 12, 13||: S. N. 3, 8, 9, 11, 12.

United States. Geological exploration of the 40th parallel.

Report. D. **1-7**: N. D. **1-7**: P. **4, 5, 6.**

United States. Geological survey.

Annual report. D. **3-5, 8, 11**: E. **1-13*, 14-22*, 23+**: F. **3-25**: I. U. **1+**: L. P. **1+**: N. D. **1+**: N. H. **2+**: P. **2+**: R. P. **'80-'91**: S. L. **'67-'78**: T. H. **1, 4-9, 14+**.

Bulletin. E. 80-87, 90-97, 173, 177, 215, 217-222, 243: G. 400+: I. U. 1+: L. P. 1*+: N. D. 1+: N. H. 1+: P. 1+: R. P. 1+: S. L. 1+: S. N. 1-273, 322-470, 472+.

Geologic folios. N. D. **1+**: R. P. **1+**.

Mineral resources of the United States. D. **'67, '68, '83-'88, '91, '92**: F. **'82-'99, '08**: I. U. **'82**: L. P. **'66*+**: N. H. **'67, '68, '83-'93**, P. **'67, '68, '70, '73, '74, '76, '82-'93, '96, '97, '00+**: R. P. **'67, '68, '83-'93**: S. N. **'83-'93, '98+**: T. H. **'83-'88, '91-'93, '00+**.

Monographs. E. **1-52+**: F. **25-48**: I. U. **1-8, 10-49, 52+**: L. P. **1*+**: N. D. **1+**: N. H. **1-50, 52**: P. **1+**: R. P. **1+**: S. N. **1-48, 51, 52+**: T. H. **2, 3, 6, 8, 15-18, 20, 21, 23-31, 33-46, 49+**.

Professional papers. F. **1-39**: I. U. **1-68, 70, 72, 73, 75+**: N. D. **1+**: P. **1+**: R. P. **1-43, 48**: S. N. **1+**.

Topographic atlas. R. P. **1-3.**

Water supply and irrigation papers. I. U. **1+**: L. P. **1*+**: N. D. **1+**: P. **1+**: R. P. **1+**: S. L. **1+**: S. N. **40-256, 261-280, 284+**: T. H. **42+**.

United States. Health, National board of.

Report. F. **'80, '82, '83**: P. **'79, '80, '83.**

United States. Hydrographic office.

Bulletin. N. D. **1+**.

Charts. N. D. **1+**.

Notices to mariners. N. D. **1+**.

United States. Hygienic laboratory. See under **United States.** Public health and marine hospital service, Bureau of.

United States. Isthmian canal commission.

Annual report. S. N. **'07+**: P. **'05+**.

United States. Life-saving service.

Annual report. R. P. **'84, '07+**: S. N. **'01+**.

United States. Lighthouse board.

Annual report. R. P. **'76, '77, '79, '81, '84+**.

United States. Microscopy, Division of.

Annual reports. Exp. **'92**: P. **'91-'93.**

Food products. Exp. **1, 2**: P. **1-3**‖.

Special reports. Exp. **'84, '85.**

United States. Mines, Bureau of.

Bulletin. P. 1-30, 34-37, 39-41, 43-53, 55, 56, 59, 61-66, 69, 71: R. P. 1+: S. L. 1+*.

Miners' circular. P. 2-6, 8-12, 15: R. P. 3+: S. L. 2-6, 9-11.

Report. P. **'11+**: S. L. **'11, '12.**

Technical papers. P. 1-33, 36-44, 46-49, 51-55, 60: R. P. 1+: S. L. 1+*.

United States national herbarium. Washington, D. C.

Contributions. D. 1*, 2, 3*, 4, 5*, 10*, 11+: Exp. 1*, 2-9, 10*, 11+: L. P. 5*, 6*, 7*, 8*, 9*, 10*, 11*, 12*, 13, 14*, 15*, 16+: N. D. 1*, 2-4, 9, 10*, 11+: P. 1+: R. P. 1+: S. N. 2+: T. H. 5+.

United States national museum. See **Smithsonian** institution.

United States naval medical bulletin. I. U. **1+**: N. D. **1+**: P. **1***, **2+**:

United States. Nautical almanac office.

American ephemeric and nautical almanac. N. D. **1+**: P. **'83-'91, '93+**: R. P. **'82, '86-'90, '94-'96, '98+**: S. L. **'86+**: S. N. **'55, '65, '69, '70' '76, '77, '79, '80-'84, '96, '00+.**

United States naval observatory.

Annual report. R. P. **'89, '90, '92, '98, '99, '01, '03.**

Magnetic observations. R. P. **'88-'94.**

Meteorological observations. R. P. **'83-'90.**

Observations. S. N. **'83.**

Publications. P. II. **1-3, 5**: R. P. II. **1+**: S. L. II. **1-7**: S. N. II. **6, 7.**

Washington observations. D. **'81-'92**: P. **'62, '81-'92**: R. P. **'86-'92.**

United States. Navigation, Bureau of.

Annual report. R. P. **'00-'01.**

United States. Ordnance bureau.

Test of metals. R. P. **'79+**: S. L. **'83+**: S. N. **'84-'00+.**

United States. Ornithology and mammalogy, Division of.

Bulletin. S. L. **3-8.**

Continued as **United States** Biological survey *q. v.*

United States. Patent office.

Annual report. N. D. **1+**: S. N' **'47, '55, '61, '64, '99+.**

Decisions of the commissioners. S. N. **'99+.**

Official gazette. G. 157+: L. P. 47+: N. D. 1+: N. H. '07+: P. 1+: R. P. 1+: S. L. 1+: T. H. '53-'63, '88+.

Specifications and drawings of patents. R. P. '71+: S. L. '71+.

United States. Plant industry, Bureau of.

Bulletin. D. 1, 20-23, 25, 26, 28-37, 39-43, 45-51, 53-63, 66, 68, 69, 71, 73-75, 77-135, 137-162, 165, 168, 171-173, 175-197, 199-235, 237-258, 260-272, 274, 277+: Exp. 1-91, 93-96, 98-108, 110+: F. 14, 44, 46, 90*: N. D. 1+: P. 1-45 47+: R. P. 1-118: S. L. '01+: S. N. 1-63, 65+.

Report. N. D. 1+: P. 1-4.

United States. Pomology, Division of.

Annual report. Exp. '92-'97: P. '91, '93-'95.

Bulletin. D. 1, 2, 6, 10‖: Exp. 1-10‖: P. 1-10‖: S. N. 2, 4, 5, 7, 9, 10‖.

Miscellaneous reports. Exp. '83, '96.

Continued in **United States** Plant industry, Bureau of.

United States. Public health and marine hospital service, Bureau of.

Annual report. N. D. 1+: P. '94: S. L. '03+: S. N. '03+: T. H. '94-'97, '99+.

Hygienic laboratory. Bulletin. I. U. 70-71, 76-78: N. D. 1+: P. 1+: S. L. 8+*: S. N. 8, 10, 11, 13, 14, 16-32, 36-62, 64-78, 84+.

Public health bulletin. D. 7, 19, 22, 23, 26-28, 30, 32-35, 38-47, 49-55, 59+: S. L. 4+*.

Public health reports. N. D. 1+: P. 14+: S. L. 19+: S. N. 15-17, 20+: T. H. 11+.

Transactions of annual conference with health officers. N. D. 1+: P. 1+: S. N. '03+.

Yellow fever institute. Bulletin. N. D. 1+: P. 1+: S. N. 1, 3.

United States. Public road inquiries, Office of.

Annual report. Exp. '02, '08+: P. '03, '11+.

Bulletin. Exp. 1, 3+: N. D. 1+: P. 1-26, 28+: R. P. 16, 19-34, 38, 40+: S. N. 4+.

Circulars. Exp. 14-30, 32+: N. D. 1+: P. 14-64, 66-67, 83-85, 87, 89+: R. P. 19+.

United States. Reclamation service.

Annual report. S. N. 6+: P. 2, 4+.

Maps. N. D. 1+.

Publications. N. D. 1+.

United States. Seed and plant introduction, Section of.

Inventories. Exp. 1-8.

United States. Signal service.

Annual report of chief signal officer of the army. R. P. **'79, '84, '86: S. N. '88.**

Professional papers. S. N. 4, 15.

United States. Soils. Bureau of.

Annual report. Exp. **'96-'01, '04, '06+**: N. D. 1+: P. **'97-'00, '03.**

Bulletin. Exp. 1-19, 21-77, 80-93, 95+: N. D. 1+: P. 1-39, 41+: R. P. 5-56: S. L. 1+: S. N. 1-4, 17-19, 21+.

Circular. Exp. 2-6, 8-76, 79+: P. 3+: S. L. 5+*.

Field operations. N. D. 1+: P. '89+: R. P. '99-'06: S. N. '99+.

Publications. N. D. 1+.

Surveys. N. D. 1+.

United States. Standards, Bureau of.

Bulletin. D. 1+: G. 6+: N. D. 1+: P. 1+: R. P. 1+: S. L. 2-7: S. N. 2+.

Circulars. N. D. 1+: P. 1+: R. P. 2, 4+: S. L. 3+.

Conferences. D. 1+: N. D. 1+: P. 1+.

Reprints. N. D. **1+**.

Technologic papers. D. **1-5,** 7+: R. P. 1+: W.

United States. Statistics, Bureau of.

Bulletin. P. 22, 24, 25, 27, 77, 81-85, 88, 90, 94, 93-96, 99+: S. N. 24, 25 27+.

Circulars. Exp. 1-13, 15+: P. 1+: S. N. 1-13, 16+.

Crop reporter. Exp. 1*, 2*, 3-7, 8*, 9-11, 15+: P. 2+.

Continues Monthly reports *q. v.*

Miscellaneous bulletin. Exp. 1-79, 81-85, 88-91, 93-96, 99+: S. N. '90-'03.

Monthly reports. Exp. o. s. 3, 5-10, 11*, 12, 13: n. s. 1, 2*, 3*, 4-6, 7*, 8:14: S. N. n. s. 112+.

Continued by **Crop** reporter, q. v.

Special report. Exp. o. s. 1, 2, 4, 6, 10-42, 14-63, 65.

United States. Steam engineering bureau.

Annual report. N. D. **1+**.

Publications. N. D. 1+.

Specifications. N. D. **1+**.

United States. Surgeon-general's office.

Index catalogue of the library. P. I. **1-3, 5-16; II. 1-10, 12+**: T. II. II. 1+.

Report. N. D. 1+.

United States. Vegetable pathology, Division of.

Bulletin. D. 1-7.

Continues in **United States.** Vegetable physiology and pathology, Division of. *q. v.*

United States. Vegetable pathology, Section of.

Bulletin. D. **5, 7, 9, 10.**

Continues in **United States.** Vegetable pathology, Division of. *q. v.*

United States. Vegetable physiology and pathology, Division of.

Annual report of the chief. Exp' '87, '89' '92, '96+.

Bulletin. D. 8-10, 21 23, 25: Exp. 1-10, 12-29 : P. o. s. 7, 11: n. s. 1-3 5-29a : R. P. 8-29 : S. L. 1-14, 16-19, 21-29 : S. N. 5, 8, 10, 11, 15, 16, 17, 19-21, 23, 28, 29 .

See also **Journal** of mycology.

Continued in **United States.** Plant industry, Bureau of. *q. v.*

United States veterinary association. See **American** veterinary association.

United States. War department. Report of explorations and surveys to ascertain the most practicable and economic route for a railroad from the Mississippi river to the Pacific ocean. S. N. **2, 8, 9, 12*.**

Botanical report. N. D. **'57.**

United States. Weather bureau.

Bulletin. D. 36: Exp. 1-10, 11*, 12-16, 19, 21, 22, 24-32, 35-37: Exp. C-H, J-Q: S. N. C, E, F, G, H, I, L, M, N, P, Q, R, S, T, K.

Monthly weather review. D. **37*, 38+**: Exp. **12*, 17*, 23*, 31*, 32*, 33-36, 37*-40***: N. D. **1+**: S. N. **20-23, 30+.**

Proceedings of the convention of weather bureau officials. S. N. **1-3.**

Report of the chief. D. **'91, '06+**: Exp. **'00+**: N. D. **1+**: R. P. **'91+**: S. N. **'99+.**

Weather bulletins. S. N. 1, 5-10, 14, 16-22 24, 26, 28, 30-33, 35, 36+.

Weather maps. N. D. **1+.**

United States. Yellow fever institute. See under **United States.** Public health and marine hospital service, Bureau of.

Unterrichtsblaetter für Mathematik und Naturwissenschaften. I. U. **1+.**

Upper Iowa university.

Bulletin. Biological series. N. D. **11.**

Upper Iowa university. Biology laboratory.

Contributions. P. **1-3.**

Upsala (Sweden) university.

Bulletin. Ac. **1-11*.**

Upsatser praktisk entomologi. Upsala, Sweden. Exp. **20-22.**

Up-to-date farming. Indianapolis, Ind. Exp. **13***.

Utah. Agricultural experiment station. Logan.

Annual report. Exp. **1**+: P. **1**+: S. L. **'98-'03***.

Bulletin. D. 69: Exp. 1+: P. 1+: S. L. '98+.

Utah. Farmers' institutes. Salt Lake City.

Annual report. Exp. **4, 10-13**: P. **1-6, 8-13.**

Utah. Horticultural commission. Logan.

Biennial report. Exp. **'09-'12.**

Bulletin. Exp. 1.

Utah (state) horticultural society. Salt Lake City.

Proceedings. Exp. **'12.**

Utah. Horticulture, State board of. Salt Lake City.

Biennial report. Exp. **'03-'04.**

Vanderbilt university. Nashville, Tenn.

Quarterly. I. U. **2-3, 5**+: P. **1***, **2, 3***, **5***, **5-8.**

Van Nostrand's chemical annual. New York. P. **1**+.

Van Nostrand's engineering magazine. New York. P. **1-35** : R. P. **1-35** .

Continued in **American** engineer and railroad journal. *q. v.*

Vegetable growers. Chicago, Ill. Exp. n. s. **1***, **2***, **3**+.

Vegetable growers' association of Ontario. Toronto.

Report. Exp. **1**+.

Verein deutscher Ingenieure. Berlin, Germany.

Zeitschrift. Ft. W. **57**+: R. P. **43**+.

Verein für Erdkunde. Leipzig, Germany.

Mittheilungen. Ae. **'84, '85, '94-'11.**

Wissenschaftliche Veröffentlichungen. Ae. **3-7.**

Verein für Naturwissenschaft zu Braunschweig (Germany).

Jahresbericht. Ae. **'87-'09.**

Verein zum Schutze der Alpenpflanzen. Bamberg, Bavaria.

Berichte. N. D. **12.**

Vermont. Agricultural experiment station. Burlington.

Annual report. D. **13**: Exp. **1**+: P. **1, 3-8, 10**+: S. L. **'87**, '88, **'90, '91.**

Bulletin. D. 83, 168: Exp. 1-159, 161+: P. 8+: S. L. 142 143.

Vermont. Agriculture, State board of. North Pomfret.

Annual report. Exp. **7, 9-12**: P. **5, 11-28.**

Vermont. Agriculture, Department of. Plainfield.

Annual report. Exp. **1**: P. **1**+.

Bulletin. Exp. 2, 3, 5, 8-15.

Vermont botanical club. Burlington.
Annual bulletin. N. D. 1+.
Vermont dairymen's association.
Annual report. Exp. **19**: P. **40-41.**
Vermont (state) geological survey. Montpelier.
Report. N. D. n. s. 3+.
Vermont (state) highway commission. Montpelier.
Biennial report. N. D. 7+.
Vermont (state) horticultural society. Burlington.
Annual report. Exp. **2, 4, 5, 8.**
Vermont. Library commission. St. Johnsbury, Vt.
Biennial report. Exp. **8.**
Veterinarian. London, England. Exp. **1-62, 66-75.**
After 1902 continued in **Journal** of comparative pathology and therapeutics, *q. v.*
Veterinary journal. London, England. Exp. n. s. 1+.
Veterinary journal and annals of comparative pathology. London, England. Exp **1-49.**
Veterinary magazine. Philadelphia, Pa. Exp. **1, 2.**
Veterinary medical association. London, England.
Proceedings. Exp. **1-5.**
Transactions. Exp. **1-3.**
Veterinary record. London England.
Transactions. Exp. **1-6.**
Vick's illustrated monthly magazine. Rochester, N. Y. N. H. **1-13.**
Victoria (Australia). Agriculture, Department of Melbourne
Annual report. Exp. **'05-'10.**
Bulletin. Exp. 1-16. 22-24.
Guides to growers. Exp. **49, 50.**
Journal. Exp. **1*, 2*, 3*, 4-6, 9**+.
Leaflets. Exp. 1.
Yearbook. Exp. **'05.**
Victorian institute of engineers. Victoria, Australia.
Proceedings. P. **10, 11.**
Victoria institute of Trinidad (British West Indies).
Proceedings. Ac. **1, 2, 4.**
Videnskabs-selskabet. Christiania, Norway.
Forhandlinger. N. D. **'12**+.
Vienna. See **Wiener.**

Virginia. Agricultural experiment station. Blacksburg.
Annual report. Exp. **'89-'93' '95-'06, '08+**: P. **'91-'94, '97-'06, '08+**.
Bulletins. Exp. 1+: P. 2+: S. L. '05+*.

Virginia. Agriculture, State board of. Richmond.
Annual report. Exp. **'78, '88, '92-'94, '96, '01, '03.**
Bulletin. Exp. 7, 9, 11, 13, 18, 19, 33.

Virginia. State crop pest commission. Richmond.
Circular. Exp o. s. **45; n. s. 4, 5.**

Virginia. State entomologist and plant pathologist. Richmond.
Annual report. Exp. **5, 8.**

Virginia truck experiment station. Norfolk.
Bulletin. Exp. 1+.

Virginia university. Charlottesville.
Biennial report. Exp. **'93, '94.**

Virginia university. Philosophical society. Charlottesville.
Bulletin. Science series. Ac. 1^{1-12}: P. **1.**

Virginia. State veterinarian. Blacksburg.
Annual report. Exp. **1-3,** 5.

Wagner free institute of science of Philadelphia (Pa).
Transactions. Exp. **7.**

Wallace's American trotting register. S. L. **1-13.**

Wallace's farmer. Des Moines, Ia. Exp. **28*, 29, 30*, 31*, 32*, 33*, 34*, 35*, 36+**: P. **30+**.

Wallace's monthly. New York. S. L. **1-14.**

Warren (Pa.) academy of science.
Reports and papers. Ac. **'07-'08.**
Transactions. Ac. $1^{1,2}$ N. D. 1+.

Washburn college. Topeka, Kan. Laboratory of natural history.
Bulletin. Ac. 1^{1-4}, 2^{5-11}.

Washburn observatory. See **Wisconsin** university.

Washington (D. C.). See **Biological** society.

Washington (D. C.) academy of science.
Journal. P. 1+.
Proceedings. Ac. 1+: I. U. 1+: N. D. **1+**: P. **1+**: R. P. **1-13**: S. N. **1+.**

Washington (state). Agricultural experiment station. Pullman.
Annual report. Exp. **1-8, 10+**: P. **1, 6, 8, 16+**.
Bulletin. Exp. 1-106, 109+: P. 1-8, 13, 20-26, 28-47, 49-61, 63+.
Popular bulletins. Exp. 1, 4, 6-7, 9-12, 14-15, 18-24, 26, 28-32, 34+.
Special bulletin. Exp. 1-6, 8+.

Washington (state) fruit grower. North Yakima. Exp. **3***.
Washington (state). Highway commission.
Biennial report. Exp. **3**: P. **3**.
Washington (state) horticultural society. Walla Walla.
Annual report. Exp. **7**.
Washington university. St. Louis, Mo.
Record. P. **'09+**.
Theses. P. **7, 14**.
Washington university association.
Bulletin. P. **1+**.
Wellcome research laboratories. Khartoum, Africa.
Annual report. Exp. **2-4**.
West American scientist. San Diego, Cal. Ac. **1, 3-8, 10-15***: Exp. **12*, 13*, 14*, 15***.
West Virginia. Agricultural experiment station. Morgantown.
Annual reports. D. **3**: Exp. **1-15**: P. **1+**.
Bulletin. D. 3-6, 12, 14-17, 19, 22, 25-27, 30, 44, 53, 54, 64, 65, 67, 68, 69, 96, 112-116, 134: Exp. 1+: P. 1+: S. L. '10+.
Inspection bulletin of department of chemistry. P. 1+.
Report of the work of the experiment station for the destruction of the San Jose scale. Exp. **'01+**.
Special bulletin. Exp. 1+.
West Virginia. Agriculture, State board of. Charleston.
Biennial report. Exp. **3, 5-7**.
Quarterly report. Exp. **1+**.
West Virginia. Conservation commission.
Report. P. **1+**.
West Virginia dairy association.
Annual report. Exp. 8.
West Virginia (state) horticultural society. Morgantown.
Annual report. Exp. **1, 13, 15, 17, 18**.
Western architect. Minneapolis, Minn. G. 18+: N. D. **4*. 9, 10*, 11, 13*, 14*, 15, 16*, 17, 18+**.
Western camera notes. N. D. **6***.
Western Canada irrigation association.
Annual report. Exp. **'10**.
Western druggist. Chicago, Ill. P. 8+.
Western electrician. Chicago, Ill. I. U. **34+**: M. **31-43**||: R. P. **4-43**||.
Combined in 1908 with **Electrical** review, *q. v.*

Western farmer and gardner and horticultural magazine. Cincinnati. N. H. 5: S. L. 1-5.

Western horticultural review. Cincinnati, Ohio. P. 2, 3 .

Continued as **Horticultural** review and botanical magazine.

Western lancet and hospital reporter. Cincinnati, O. D. 12-14.

Western New York apple. Barker. Exp. 1*.

Western New York horticultural society. Rochester.

Report. Exp. 41-44, 46-56.

Western Pennsylvania society of engineers.

Proceedings. P. 22+.

Western poultry journal. Cedar Rapids, Ia. Exp. 23+.

Western railway club. Chicago, Ill.

Proceedings. P. 5, 6*, 7*, 8-16, 17*, 18*, 19+.

Western society of engineers. Chicago, Ill.

Journal. Ft. W. 18+: P. 1+: R. P. 1+.

Western stock journal. Oregon City, Ore. Exp. 1*, 2+.

Westinghouse electric company.

Bulletin. N. D. '03+.

Wiener universität. Institut für Anatomie und Physiologie des Centralnervesystems.

Arbeiten. I. U. 1+.

Wilson bulletin. Oberlin, O. N. D. 22, 23, 24+: P. 14+.

Winnipeg (Manitoba). City engineer of.

Report. N. D. '98, '02+.

Wisconsin academy of sciences, arts and letters. Madison.

Transactions. Ac. 10-16: E. 3+: P. 3+: S. L. 1-9.

Wisconsin agricultural experiment association. Madison.

Annual report. Exp. 3, 4, 6, 7.

Wisconsin. Agricultural experiment station. Madison.

Annual report. Exp. 1+: P. 1-5, 7+: R. P. '03-'07, '10+: S. L. '89-'93.

Bulletin. Exp. 1+: P. 1+: R. P. 8+.

Research bulletin. Exp. 1+: R. P. 1-14.

Wisconsin (state) agricultural society. Madison.

Report. S. L. '59-'68, '71-'91.

Transactions. Exp. 2, 5, 8-12, 18, 20-25: P. 1-3, 5-8, 10-34.

Wisconsin. Agriculture, State board of. Madison.

Annual report. Exp. '12: P. '00+.

Biennial report. P. '97-'00.

Bulletin. Exp. 1.

Wisconsin agriculturist. Racine. Exp. **33*, 34*, 35*, 36*, 37+**
Wisconsin archeologist. Milwaukee. I. U. 2+.
Wisconsin butter-makers' association. Madison.
Annual report. Exp. **6-9.**
Wisconsin cane growers' association.
Annual report. Exp. **3.**
Wisconsin. (State) conservation commission.
Report. P. **'10.**
Wisconsin country magazine. Madison. Exp. 5 .
Wisconsin (state) cranberry association.
Annual report. Exp. **'99-'11.**
Wisconsin. Dairy and food commission. Madison.
Annual report. Exp. **'91-'94:** P. **'94.**
Biennial report. Exp. **'97, '98, '01, '02:** P. **'95-'10:** S. N. **'92, '94, '96.**
Wisconsin dairymen's association.
Annual report. Exp. **17-20, 25, 26, 28, 35-38:** P. **6-9, 17+.**
Wisconsin. Dunn county school of agriculture. Menomonie. Exp. 3*, 4*, 5*, 6*.
Wisconsin farmers' institute. Madison.
Bulletin. Exp. 2, 6-8, 10: P. 1-10, 12, 14, 16-23.
Wisconsin. (State) forester.
Annual report. Exp. **'06:** P. **'06+.**
Wisconsin. Forestry commission.
Report. P. **'06-'08.**
Wisconsin. Geological and natural history survey.
Biennial reports. P. **1-5.**
Bulletin. I. U. 1-7*, 8-22 25+: P. 2-17, 20+: T. H. 1-4.
Wisconsin. Health, State board of.
Annual report. P. **'77-'82, '84, '85, '87-'06.**
Wisconsin (state) horticultural society. Madison.
Bulletin. D. 12: Exp. 1-5, 9-10, 12-13.
Transactions. D. **13, 19:** Exp. **'76, '78-'86, '91, '94-'96, '98-'01, '03, '04, '06-'08, '10+:** N. D. **10:** P. **'74-'80, '85, '89+:** S. L. **'87, '88, '90-'94.**
Wisconsin horticulture. Madison. Exp. **1*, 2+.**
Wisconsin. Marathon county school of agriculture and domestic economy. Wausau.
Bulletin. Exp. **2*, 3*, 4*, 5*, 6*, 9*.**

Wisconsin natural history society. Milwaukee, Wis.
Bulletin. Ac. 1[1, 2], 2+: Exp. 7*, 8-10: N. D. 3+.
Wisconsin public museum. Milwaukee.
Bulletin. Exp. 1, 2.
Wisconsin university. Madison.
Bulletin. Exp. 141, 459, 480, 507, 508, 537, 547+.
Engineering series. E. 2: I. U. 1-4, 6+: P. 1+: R. P. 1-5, 6*.
Science series. E. 2: I. U. 1+: P. 1+.
Wisconsin university. Pharmacy, Department of.
Contributions. P. 1.
Wisconsin university. Washburn observatory.
Publications. I. U. 2-11.
Wisconsin; Winnebago county school of agriculture. Winneconne.
Quarterly bulletin. Exp. 3, 8, 15.
Wissenschaftliche Beilage zum Program des Falk real Gymnasiums. Berlin, Germany. N. D. '90.
Woodcraft. Cleveland, O. Ft. W. 19+: P. 8, 9, 10*, 11+.
Wood's crop special. Richmond, Va. Exp. 3*, 4*, 5*, 6*.
Woodworker. Indianapolis, Ind. Ft. W. 28+.
Wyoming. Agricultural experiment station. Laramie.
Annual report. Exp. '91+: P. 1+: S. L. '11, '12.
Bulletin. D. 19, 42-45: Exp. 1+: P. 1+: S. L. 83-96*.
Wyoming. Dairy, food and oil commissioner. Cheyenne.
Annual report. Exp. 3-5.
Bulletin. Exp. 3-10.
Wyoming. (State) engineer.
Report. P. 1-4.
Wyoming historical and geological society. Wilkes-Barre, Pa.
Proceedings and collections. Ac. 2[1, 2], 3.
Wyoming. Horticulture, State board of. Laramie.
Biennial report. Exp. 1-3.
Special report. P. 1*.
Yale university. New Haven, Conn. Astronomical observatory.
Transaction. S. L. 1*, 2*.
Yale university. Psychological laboratory.
Studies. I. U. 1-10; n. s. 1+: S. N. 1-10.
Yearbook of agriculture. Philadelphia. N. H. '56.
Yearbook of facts (Vincent). London, England. R. P. '75.

Yearbook of facts in science and art (Timbs). London, England. N. H. '53: R. P. '56-'68.

Yearbook of nature and popular science. New York. N. H. '73.

Zeitschrift der deutschen geologischen Gesellschaft. See **Deutsche** geologische Gesellschaft.

Zeitschrift der naturwissenschaftlichen Ableitung. Posen, Germany. N. D. 19+.

Zeitschrift für ärztliche Fortbildung. Jena, Germany. I. U. 1-6.

Zeitschrift für allgemeine Physiologie. Jena, Germany. I. U. 1+.

Zeitschrift für analytische Chemie. Wiesbaden, Germany. D. 32: Exp. 1+: I. U. 1+: N. D. 40: R. P. 34+: W. 32-40.

Zeitschrift für angewandte Chemie. Berlin, Germany. I. U. 1+.

Zeitschrift für angewandte Psychologie. Leipzig, Germany. I. U. 1-3, 5+. Beihefte. I. U. 1+.

Zeitschrift für anorganische Chemie. Hamburg, Germany. P. 1+: W. 1-68.

Zeitschrift für Biologie. Munich; Leipzig, Germany. D. 18.

Zeitschrift für Botanik. Jena, Germany. Exp. 1-3: I. U. 1+.

Zeitschrift für experimentelle Pathologie und Therapie. Berlin, Germany. I. U. 3+.

Zeitschrift für induktive Abstammung und Vererbungslehre. Berlin, Germany. Exp. 5+.

Zeitschrift für Instrumentenkunde. Berlin, Germany. P. 28+: R. P. 5.

Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht. Leipzig; Berlin, Germany. I. U. 41+.

Zeitschrift für Mathematik und Physik. Leipzig, Germany. I. U. 40-51, 58+.

Zeitschrift für Morphologie und Anthropologie. Stuttgart, Germany. I. U. 1+.

Zeitschrift für pädagogische Psychologie, Pathologie, und Hygiene. Berlin, Germany. I. U. 1-12.

Zeitschrift für Pflanzenkrankheiten. Stuttgart, Germany. Exp. 1-4, 6+.

Zeitschrift für physikalische Chemie, Stochiometrie und Verwandtschaftslehre. Leipzig, Germany. I. U. 1+: P. 1: R. P. 47-56: W. 1+.

Zeitschrift für physikalische und chemische Unterricht. R. P. 3-5.

Zeitschrift für physiologische Chemie. Strassburg, Germany. I. U. 1+.

Zeitschrift für Psychologie und Physiologie der Sinnesorgane. Hamburg, Germany. I. U. 1+.

Zeitschrift für Schulgesundheitspflege. Hamburg, Germany. I. U. 1+.

Zeitschrift für Socialwissenschaft. Berlin, Germany. I. U. 7-12.

Zeitschrift für Untersuchung der Nahrungs- und Genussmittel. Berlin, Germany. Exp. **19+**.

Zeitschrift für wissenschaftliche Insektenbiologie. Berlin, Germany. Ac. 7^{2-11}.

Zeitschrift für wissenschaftliche Mikroskopie und für mikroskopische Technik. Leipzig; Brunswick, Germany. D. **1-10**: Exp. **1-5**: I. U. **21+**.

Zeitschrift für wissenschaftliche Zoologie. Leipzig Germany. I. U. **46-69, 76-95, 97+**: W. **63-68**.

Zentralblatt. See **Centralblatt.**

Zoological bulletin. Boston, Mass. I. U. **1, 2**||.

Continued as **Biological** bulletin, *q. v.*

Zoological record. London, England. D. **1-24**: I. U. **1-46, 48+**.

Zoological society of London, England.

Transactions. I. U. **15*, 16***.

Zoologisch-zootomisches Institut. Würzburg, Germany.

Arbeiten. I. U. **9*, 10***.

Zoologische Station zu Neapel, Italy.

Mittheilungen. I. U. **1+**.

Zoologischer Anzeiger. Leipzig, Germany. D. **13-17**: I. U. **1+**.

Zoologisches Centralblatt. Leipzig, Germany. I. U. **4-7, 9+**.

Zurich (Switzerland) universität. Botanischer Garten und botanisches Museum.

Mittheilungen. N. D. **'13+**.

INDEX

A.

B.

C.

D.

E.

F.

G.

H.

3 2044 106 261 977

Date Due