TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

VOLUME ONE

(1914—1923)

LEXINGTON, KY.
1924

Transactions

OF THE

Kentucky Academy of Science

VOLUME ONE

(1914—1923)

DR. JOSEPH H. KASTLE

TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

VOLUME ONE
(1914—1923)

WILLARD ROUSE JILLSON, Sc. D.
PRESIDENT OF THE ACADEMY AND
EDITOR OF THIS VOLUME

LEXINGTON, KY.
1924

THE STATE JOURNAL COMPANY
Printer to the Commonwealth
Frankfort, Ky.

CONTENTS

PREFACE

During the last few years the growing need of a unit volume containing all of the transactions of the Kentucky Academy of Science has often been expressed. It has been repeatedly pointed out that such a volume would afford at once a ready source of reference to the scientific papers which have been presented at each of the annual meetings, and at the same time provide an accurate and available chronology of the activities and officers of the organization. A continued lack of funds in the treasury of the Academy, however, made the proposal, desirable as it was, quite impossible.

A year ago, at the tenth regular meeting, the writer of these paragraphs realizing that the transactions of the Academy would undoubtedly be withheld from publication for many more years unless individual initiative provided the ways and means to a considerable extent, offered to underwrite the cost and edit Volume One of the transactions for the Academy. This proposal was accepted by the Academy. As a result, this book now appears in a limited edition sufficient, however, for our entire membership, the regular exchanges of the Academy, and the principal scientific libraries of the country and abroad.

All papers herein presented, unless otherwise previously arranged, appear in abstract form as printed in "Science". In the preparation of this manuscript and the reading of the proof I have received most scholarly assistance and advice from Dr. A. M. Peter, the veteran secretary of the Academy. I have also been greatly aided by Dr. Peter's personal secretary, Miss Ethel V. T. Caswell. Without this generous cooperation these transactions would necessarily have lacked much in the way of completeness and real value.

Willard Rouse Jillson

Frankfort, Ky.,
March 1, 1924.

TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

Kentucky Academy of Science

OFFICERS

(1914-1923)

Organization meeting, May 8, 1914, Dr. P. P. Boyd, Chairman.
Charles J. Robinson, Secretary.

1914-1915.

President, Joseph H. Kastle, Experiment Station, Lexington.
Vice-President, N. F. Smith, Central University, Danville.
Secretary, Garnett Ryland, Georgetown College, Georgetown.
Treasurer, W. M. Anderson, University of Louisville, Louisville.

1915-1916.

President, N. F. Smith, Central University, Danville.
Vice-President, A. M. Miller, Univ. of Ky., Lexington.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, Garnett Ryland, Georgetown College, Georgetown.
Member Committee on Publications, R. T. Hinton, Georgetown College, Georgetown.

1916-1917.

President, A. M. Miller, Univ. of Ky., Lexington.
Vice-President, Garnett Ryland, Georgetown College, Georgetown.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, Paul P. Boyd, Univ. of Ky., Lexington.
Member Committee on Publications, Frank L. Rainey, Centre College, Danville.

1917-1918.

President, R. C. Ballard Thruston, Louisville.
Vice-President, J. E. Barton, State Forester, Frankfort.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, Paul P. Boyd, Univ. of Ky., Lexington.

1918-1919.

President, J. E. Barton, State Forester, Frankfort.
Vice-President, Paul P. Boyd, Univ. of Ky., Lexington.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, J. S. McHargue, Experiment Station, Lexington.
Member Committee on Publications, J. J. Tigert, Univ. of Ky., Lexington.

1919-1920

President, Paul P. Boyd, Univ. of Kentucky, Lexington.
Vice-President, Walter H. Coolidge, Centre College, Danville.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, J. S. McHargue, Experiment Station, Lexington.

1920-1921.

President, W. H. Coolidge, Centre College, Danville.
Vice-President, Geo. D. Smith, State Normal School, Richmond.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, J. S. McHargue, Experiment Station, Lexington.

Member Committee on Publications, Dr. Paul P. Boyd, Univ. of Ky., Lexington.

1921-1922.

President, Geo. D. Smith, State Normal School, Richmond.
Vice-President, Lucien Beckner, Winchester.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, Charles A. Shull, Univ. of Ky. Lexington.

1922-1923.

President, Lucien Beckner, Winchester.
Vice-President, John A. Gunton, Transylvania College, Lexington.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. M. Peter, Lexington.

1923-1924.

President, W. R. Jillson, State Geologist, Frankfort.
Vice-President, Austin R. Middleton, Univ. of Louisville, Louisville.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. M. Peter, Lexington.

CONSTITUTION OF THE KENTUCKY ACADEMY OF SCIENCE

(As adopted May 8, 1914, and subsequently amended.)

ARTICLE I—NAME. This organization shall be known as The Kentucky Academy of Science.

ARTICLE II—OBJECT. The object of this Academy shall be to encourage scientific research, to promote the diffusion of useful scientific knowledge and to unify the scientific interests of the State.

ARTICLE III—MEMBERSHIP. The membership of this Academy shall consist of Active Members, Corresponding Members, and Honorary Members.

Active members shall be residents of the State of Kentucky who are interested in scientific work. They shall be of two classes, to-wit: National members, who are members of the American Association for the Advancement of Science as well as of the Kentucky Academy of Science, and Local Members, who are members of the Kentucky Academy but not of the Association. Each active member shall pay to the Secretary of the Academy an initiation fee of one dollar, at the time of election. National members shall pay to the Secretary of the

Academy an annual assessment of five dollars,* payable October 1st, of each year, four dollars of which shall be transmitted by the Secretary of the Academy to the Permanent Secretary of the American Association for the Advancement of Science, and one dollar shall be turned over to the treasurer of the Academy. Local members shall pay an annual assessment of one dollar, payable October first of each year.

Corresponding members shall be persons who are actively engaged in scientific work not resident in the State of Kentucky. They shall have same privileges and duties as Active Members but shall be free from all dues and shall not hold office.

Honorary members shall be persons who have acquired special prominence in science not residents of the State of Kentucky and shall not exceed twenty in number at any time. They shall be free from dues.

For election to any class of membership the candidates must have been nominated in writing by two members, one of whom must know the applicant personally; receive a majority vote of the committee on membership and a three-fourths vote of the members of the Academy, present at any session or, in the interim between meetings of the Academy, the unanimous vote of the members of the council, present or voting by letter.

ARTICLE IV—OFFICERS. The officers of the Academy shall be chosen annually by ballot at the recommendation of a nominating committee of three, appointed by the President, and shall consist of a president, vice-president, secretary, treasurer, and councilor of the American Association for the Advancement of Science, who shall perform the duties usually pertaining to their respective offices. Only the secretary, treasurer, and councilor shall be eligible to re-election for consecutive terms.

It shall be one of the duties of the Retiring President to deliver an address before the Academy at the annual meeting.

The Secretary shall have charge of all books, collections, and records that may belong to the Academy.

ARTICLE V—COUNCIL. The Council shall consist of the President, Vice-president, Secretary, Treasurer, and President of the preceding year. The Council shall direct the affairs of the Academy during the intervals between the regular meetings and shall fill all vacancies occurring during such intervals.

ARTICLE VI—STANDING COMMITTEES. The Standing Committees shall be as follows:

---

*A recent action of the A. A. A. S. requires the payment to be made to the permanent Secretary in Washington, who returns one dollar of each five to the Kentucky Academy.

A Committee on Membership appointed annually by the President, consisting of three members.

A Committee on Publications consisting of the President, Secretary, and a third member chosen annually by the Academy.

A Committee on Legislation consisting of three members appointed annually by the President.

ARTICLE VII—MEETINGS. The regular meetings of the Academy shall be held at such time and place as the Council may select. The Council may call a special session, and a special session shall be called at the written request of twenty members.

ARTICLE VIII—PUBLICATIONS. The Academy shall publish its transactions and papers which the Committee on Publications deem suitable. All members shall receive the publications of the Academy gratis.

ARTICLE IX—AMENDMENTS. This Constitution may be amended at any regular annual meeting by a three-fourths vote of all active members present, provided a notice of said amendment has been sent to each member ten days in advance of the meeting.

BY LAWS.

I—The following shall be the order of business:

1. Call to Order.
2. Reports of Officers.
3. Report of Council.
4. Report of Standing Committees.
5. Election of Members.
6. Report of Special Committees.
7. Appointment of Special Committees.
8. Unfinished Business.
9. New Business.
10. Election of Officers.
11. Program.
12. Adjournment.

II—No meeting of this Academy shall be held without thirty days' notice having been given by the Secretary to all members.

III—Twelve members shall constitute a quorum of the Academy for the transaction of business. Three of the Council shall constitute a quorum of the Council.

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

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

VI—The President shall annually appoint an auditing committee of three who shall examine and report in writing upon the account of the Treasurer.

VII—The Secretary shall be free from all dues during his term of office.

VIII—All papers intended to be presented on the program or abstract of same must be submitted to the Secretary previous to the meeting.

IX—These by-laws may be amended or suspended by a two-thirds vote of the members present at any meeting.

IN MEMORIAM

They have crossed the river and are resting in the shade **of the trees:**

Arthur M. Breckler, ——, 1919.

Alfred Fairhurst, 1843-1921

Joseph Hoeing Kastle, 1864-1916.

James Oscar LaBach, 1871-1922.

Alexander T. Parker, 1832-1922.

John D. White, ——, 1920.

Miss Cora Williams, ——, 1922.

Charles O. Zahner, ——, 1918.

Percy Kendall Holmes, 1880-1924.

Charles T. Brookover, 1870-1922.

COMPLETE MEMBERSHIP LIST—1914-1923.

(Correct to March 1, 1924)

§—Corresponding member.
‡—Life member.
†—Deceased.
¶—Honorary member.
*—Dropped.
c-o.—Care of

The date denotes the year of election to membership.

Name and Address.	Branch of Science.
Allen, Harry, '20, Experiment Station, Lexington	Chemistry.
Allen, W. R., '23, University of Kentucky, Lexington	Zoology.
*Anderson, F. Paul, '14, Univ. of Ky., Lexington	Mechanical Eng.
Anderson, H. C., '23, W. Ky. State Nor. Sch., Bowling Green	Physics.
Anderson, W. M., '14, University of Louisville, Louisville	Physics.
Anderson, W. S., '15, Univ. of Ky., Lexington	Genetics.
*Andres, P. M., '19, 1370 Elmwood St., Toledo, Ohio	Engineering.
Averitt, S. D., '14, Experiment Station, Lexington	Chemistry.
Baer, Louis, '23, Univ. of Louisville, Louisville	Chemistry.
Bales, C. E., '23, Louisville Fire Brick Co., Louisville	Chemistry.
Bancroft, Geo. R., '19, Univ. of W. Va., Morgantown, W. Va.	Chemistry.
*Barnett, B., '20, Univ. of Kentucky, Lexington	Physics.
*Barr, T. J., '14, Univ. of Kentucky, Lexington	Mining Engineering.
*Barton, J. E., '15, c-o Gulf Refining Co., Huntsville, Ala.	Forestry.
Beckner, Lucien, '20, Winchester	Geology.
*Bedford, M. H., '15, University of Kentucky, Lexington	Chemistry.
Beebe, Morris W., '23, Univ. of Ky., Lexington	Mining & Metallurgy.
Belknap, William, University of Louisville	
Benjamin, Leonard P., '23, Huntington, W. Va.,	Bacteriology.
Best, Harry, '21, Univ. of Kentucky, Lexington	Sociology.
*Bitner, R. E., '16, Univ. of Kentucky, Lexington	Physics.
§Blumenthal, P. L., '16, Buffalo, N. Y.	Chemistry.
Boggs, Jos. S., '23, State Dept. Roads & Highways, Frankfort	Eng.
*Bories, Miss Marie, '19, 4601 Grand Blvd., Louisville	Chemistry.
Borries, W. J., '23, Louisville	Mining Engineering.
Boyd, P. P., '14, Univ. of Kentucky, Lexington	Mathematics.
†Breckler, A. M., '15, Louisville. D. 1919.	Chemistry.
†Brookover, Charles, '22, Univ. of Louisville, Louisville	Medicine.
Brown, L. A., '15, Experiment Station, Lexington	Chemistry.
*Brownell, Harry G., '15, Bethel College, Russellville	Physics.
Browning, Iley B., '22, Ashland	Geology.
*Bryant, T. R., '14, Experiment Station, Lexington	Agriculture.
§Bucher, Walter, '22, Univ. of Cincinnati, Cincinnati, Ohio	Geology.
Buckner, G. Davis, '15, Experiment Station, Lexington	Chemistry.
Bullock, H. E., '22, c-o Midland Mining Co., Lexington	Geology.
Burroughs, W. G., '22, Berea College, Berea	Geology.
¶Butts, Charles, '22, U. S. Geol. Survey, Washington, D. C.	Geology.

Caldwell, Morley A., '15, Univ. of Louisville, Louisville....Psychology.
*Carrel, W. J., '14, Univ. of Kentucky, Lexington....Civil Engineering.
Chalkley, Lyman, '22, Univ. of Kentucky, Lexington............Law.
§Clark, Friend E., '15, Univ. of W. Va., Morgantown, W. Va., Chemistry.
Conn, John F., '20, Bolivar, Mo..........................Chemistry.
Coolidge, W. H., '17, Centre College, Danville..............Chemistry.
Cooper, Thomas P., '18, Director Experiment Station, Lexington, Agri.
¶Coulter, Stanley, '14, Lafayette, Indiana....................Botany.
*Cowan, J. R., '15, Danville......................Biology & Chemistry.
§Cox, Benjamin B., '22, State Univ. of Iowa, Iowa City, Iowa..Geology.
Craig, W. J., '20, W. Ky. State Normal School, Bowling Green....
......................................Physics and Chemistry.
§Crandall, Albert R., '15, Milton, Wisconsin.................Geology.
Crider, A. F., '15, Shreveport, La. ....Geology.
Crooks, C. G., '15, Centre College, Danville..............Mathematics.
Crouse, C. S., '21, Univ. of Kentucky, Lexington...Mining Engineering.
Crump, M. H., '15, Bowling Green...........................Geology.
§Currier, L. W., '22, Syracuse, N. Y. ....Geology.
Curtis, H. E., '14, Experiment Station, Lexington..........Chemistry.
Dasher, Geo. F., '16, Bethel College, Russellville..............Science.
*Davies, Hywell, '14, Washington, D. C. ....Mining & Statistics.
Davis, J. Morton, '14, University of Kentucky, Lexington, Mathematics.
¶Day, Arthur L., '17, Director Geophysical Laboratory, Washington,
D. C. ....Geology.
¶Detlefsen, J. A., '18, The Wistar Inst. of Anatomy & Biology,
Philadelphia, Pa. ....Genetics.
Didlake, Miss Mary L., '14, Experiment Station, Lexington, Ent. & Bot.
Dilly, O. C., '19, Lou. College of Pharmacy, Louisville, Pharmacology.
Dimock, W. W., '20, Experiment Station, Lexington, Veterinary Science.
Downing, H. H., '14, Univ. of Kentucky, Lexington......Mathematics.
Duffield, Will Ward, '22, Harlan.......................Engineering.
*Easton, H. D., '14, Springfield, Ill. ....Mining Engineering.
Eichelberger, Marietta, '20, Univ. of Ky., Lexington..Home Economics.
Ervin, Walter E., '21, Centre College, Danville............Education.
Eyl, William C., '22, Lexington...........................Geology.
†Fairhurst, Alfred, '15, Lexington. D. 1921 ....Chemistry.
Fergus, E. N., '21, Experiment Station, Lexington..........Agronomy.
*Fleck, Louis C., '19....................................Chemistry.
*Fleming, W. R., '15, 519 Maple Ave., Newport, Ky. ....Chemistry.
Foerster, M. H., '16, Consolidation Coal Co., Jenkins........Forestry.
§Fohs, F. Julius, '15, Tulsa, Oklahoma. ....Geology.
Ford, N. C., '23, W. Ky. State Normal School, Bowling Green, Agricul.
Freeman, W. E., '14, Univ. of Kentucky, Lexington.....Electrical Eng.
Funkhouser, W. D., '19, Univ. of Kentucky, Lexington........Zoology.
Gabbert, W. R., '21, County Agent, Lexington............Agriculture.
§Gardner, J. H., '15, Tulsa, Okla. ....Geology.

Garman, H., '14, Experiment Station, Lexington..............Biology.
Gentry, H. V., '23, Lou. Gas & Elec. Co., Louisville........Chemistry.
*Gilbert, A. H., '14, Burlington, Vermont......................Botany.
*Gilcher, R. J., '15, Ithaca, N. Y. ....Physics and Eng.
¶Glenn, L. C., '22, Vanderbilt University, Nashville, Tenn.....Geology.
Good, E. S., '14, Experiment Station, Lexington....Animal Husbandry.
Gott, E. J., '18, Experiment Station, Lexington..........Bacteriology.
*Graham, Robert, '15, Univ. of Illinois, Urbana, Illinois........Biology.
Green, R. P., '20, Frankfort..............................Geology.
Grinstead, Wren James, '21, E. Ky. State Normal School, Richmond, ...Psychology.
Gunton, John A., '22, Univ. of Western Ontario, London, Canada, Chem.
Harms, Miss Amanda, '19, Experiment Station, Lexington....Biology.
¶Hart, E. B., '19, Univ. of Wisconsin, Madison, Wis. ....Nutrition.
§Havenhill, Mark, '19, Kansas State Ag'l College, Manhattan, Kans. ....Farm Mechanics.
Healy, Daniel J., '14, Experiment Station, Lexington......Bacteriology.
Hemmenway, Ansel F., '21, Univ. of Arizona, Tucson......Chemistry.
§Hendrick, H. D., '14, Takoma Park, Washington, D. C. ......Agronomy.
Henry, Miss Ruby A., '23, Louisville Girls' High School......Science.
Hinton, Robert T., '14, Georgetown College, Georgetown......Biology.
*Hoeing, J. B., '15, Lexington.............................Geology.
*Hoffman, Allen, '19, Frankfort.........................Chemistry.
*Hofman, Fred W., '14 ....Horticulture.
*Hollcroft, T. R., '14, Ithaca, N. Y. ....Mathematics.
†Holmes, P. K., '21, Univ. of Kentucky, D. 1924, Lexington ..Sanitation.
Homberger, A. W., '19, Univ. of Louisville, Louisville......Chemistry.
Hooper, J. J., '17, University of Kentucky, Lexington........Biology.
Hudnall, James S., '21, Geological Survey, Frankfort ....Geology.
Iler, W. D., '18, Experiment Station, Lexington............Chemistry.
Ingerson, N. J., '23, Centre College, Danville................Geology.
Jackson, Eugene L., '20, Emory Univ., Atlanta, Ga., ...Vegetable His.
*James, M. C., '19..............................Agr'l Education.
*Jamison, Knox, '14, ...History.
*Janes, W. E., '15, Louisville..........................Chemistry.
Jewett, H. H., '21, Experiment Station, Lexington........Entomology.
‡Jillson, W. R., '19, State Geologist, Frankfort..............Geology.
*Johnson, J. R., '15, University of Kentucky, Lexington ..Mathematics.
*Jones, Parry R., '15, Williamsburg, Ky. ....Chemistry & Math.
Jones, S. C., '14, Experiment Station, Lexington..........Agronomy.
Karraker, P. E., '15, Experiment Station, Lexington........Agronomy.
†Kastle, Jos. H., '14, Experiment Station, Lexington. D. 1916. Chemistry.
Koffman, Gladstone, '23, Principal High School, Frankfort....Physics.
§Kercher, Otis, '19, Pike Co. Farm Bureau, Pittsfield, Ill. ....Extension.
Killebrew, C. D., '15, Alabama Polytechnic Institute, Auburn, Ala. ....Physics.

Kinney, E. J., '15, Experiment Station, Lexington..........Agronomy.
§Kiplinger, C. C., '18, Mt. Union College, Alliance, Ohio......Chemistry.
§Knapp, R. E., '14, 1037 Philip Ave., Detroit, Mich. ......Bacteriology.
Kornhauser, S. I., '23, Univ. of Louisville, Louisville........Anatomy.
*Kurk, Fred, '15, c-o Wilson & Co., Chicago, Ill. ....Bacteriology.
†LaBach, J. O., '15, Experiment Station, Lexington. D. 1922, Chemistry.
Lee, F. S., '23, Middlesboro, Ky. ....Geology.
§Leigh, Townes R., '19, Univ. of Florida, Gainesville, Fla. ....Chemistry.
*Lewis, C. D., '15, Dept. of Education, Frankfort.......Natural Science.
*Lloyd, Henry, '14, Transylvania College, Lexington, Math. & Astronomy.
Lowe, Miss Gladys Marie, '21, Boston, Mass. ....Psychology.
McAllister, Cloyd N., '17, Berea College, Berea............Psychology.
*McCheyne, Gertrude, '20, Univ. of Ill., Urbana, Ill., Home Economics.
McCormack, A. T., '20, State Board of Health, Louisville...Sanitation.
McFarland, Frank T., '14, Univ. of Kentucky, Lexington.......Botany.
McHargue, J. S., '14, Experiment Station, Lexington........Chemistry.
§McKinnon, Miss Jean, '19, Univ. of Ill., Urbana, Ill. ..Home Economics.
McVey, Frank L., '18, President Univ. of Ky., Lexington..Economics.
Madison, J. T., '23, Frankfort....................Road Engineering.
Maney, Charles A., '23, Transylvania College, Lexington..............
Martin, Dean W., '17, Georgetown College, Georgetown........Physics.
Martin, J. H., '15, Experiment Station, Lexington..........Chemistry.
*Martin, J. Holmes, '19, Experiment Station, Lexington........Poultry.
Mathews, C. W., '16, University of Ky., Lexington........Horticulture.
Maxson, Ralph N., '23, Univ. of Kentucky, Lexington......Chemistry.
Mayfield, Samuel M., '23, Berea College, Berea, Ky. ...Natural Science.
Meader, A. L., '23, Experiment Station, Lexington ....Chemistry.
Meier, Henry, '15, Centre College, Danville........Math. & Astronomy.
*Melcher, C. R., '19, Univ. of Kentucky, Lexington..........Languages.
Middleton, Austin R., '22, Univ. of Louisville, Louisville......Biology.
Miller, A. M., '14, Univ. of Kentucky, Lexington............Geology.
¶Miller, Dayton C., '15, Cleveland, Ohio. ....Physics.
Miller, J. W., '23, Univ. of Louisville, Louisville...................
Miller, W. Byron, '22, Wallins Creek, Ky. ....Engineering.
¶Millikan, R. A., '20, California Inst. of Technology, Pasadena, California ....Physics.
Miner, J. B., '22, University of Kentucky, Lexington......Psychology.
Morgan, Geoffrey, '19, c-o Farmers' Union, Louisville......Agriculture.
§Morgan, Thomas H., '15, Columbia Univ., New York..........Biology.
¶Moulton, F. R., '16, Univ. of Chicago, Chicago, Ill. ....Astronomy.
*Mutchler, Fred, '15, Bowling Green, Ky. ....Agriculture.
*Nash, C. A., '15, Chicago, Ill. ....Chemistry.
*Nelson, J. B., '20, 53 Federal St., Newburyport, Mass....Bacteriology.
Newell, Miss Anna Grace, '21, Wellington, Cape Providence, S. Africa ....
Newton, H. P., '21, Chattanooga, Tenn. ....Chemistry.

Nicholls, W. D., '14, Univ. of Kentucky, Lexington....Farm Economics.
*Niswonger H. R., '14..............................Ent. & Botany.
§Nollau, E. H., '15, 14 Norton St., Newburg, N. Y. ....Chemistry.
Norwood, C. J., '14, Univ. of Ky., Lexington.....Mining & Metallurgy.
O'Bannon, Lester S., '23, Univ. of Kentucky, Lexington...Engineering.
Olney, Albert J., '20, Univ. of Kentucky, Lexington......Horticulture.
†Parker, A. T., '15, Lexington. D. 1922..................Microscopy.
Pence, M. L., '14, Univ. of Kentucky, Lexington.............Physics.
*Perry, Miss Homer, (Mrs. John R. Herman) '18, Berkley, Cal., ...
....Genetics & Botany.
Peter, Alfred M., '14, Experiment Station, Lexington......Chemistry.
Piper, W. C., '23, Danville, Ky. ....Physics.
Porter, R. E., '23, Ashland Leather Co., Ashland, Ky ......Chemistry.
Pryor, J. W., '14, Univ. of Kentucky, Lexington...........Physiology.
Rainey, F. L., '14, Centre College, Danville........Biology & Geology.
*Records, Ralph, '15, Bethany, W. Va. ....Chemistry.
Rees, E. L., '14, Univ. of Kentucky, Lexington..........Mathematics.
Rhoads, McHenry, '21, Supt. of Public Instruction, Frankfort,
.... Education
Rhoads, Wayland, '22, Experiment Station, Lexington....Animal Husb.
*Rhoton, A. L., '14, Georgetown College, Georgetown......Mathematics.
¶Richardson, Charles H., '22, Syracuse Univ., Syracuse, N. Y. ..Geology.
¶Ries, H., '22, Ithaca, N. Y. ....Geology.
Roberts, George, '14, Experiment Station, Lexington........Agronomy.
*Robins, Vernon, '15, Louisville.......................Bact. & Chem.
*Robinson, Chas. J., '14, Louisville......................Chemistry.
*Rodes, William, '15, Lexington, Ky. ....Chemistry.
§Roe, Miss Mabel, '19, 209 E. Bdway., Anaheim, Cal. ..Plant Pathology.
Rogers, John C., '22, Barrett Manual Training School,
Henderson ....Medicine.
Routt, Grover, C., '14, County Agent, Mayfield ....Biology.
*Rowe, Walter E., '14 ....Civil Engineering.
§Ryland, Garnett, '14, Richmond College, Richmond, Va. ....Chemistry.
Sandstrom, W. M., '23, Univ. of Louisville, Louisville......Chemistry.
Scherago, Morris, '23, Univ. of Kentucky, Lexington......Bacteriology.
Schneider, Ralph F., '23, Cleveland, O. ....Chemistry.
*Shedd, O. M., '14, Experiment Station, Lexington..........Chemistry.
*Shull, Charles A., '19, Univ. of Chicago, Chicago, Ill..........Botany.
Siff, Louis, '15, Univ. of Louisville, Louisville............Mathematics.
Slade, D. D., '19, Lexington...............................Poultry.
Smith, George D., '20, E. Ky. State Normal School, Richmond.
....Natural Science.
§Smith, N. F., '15, Citadel College, Charleston, S. C. ....Physics.
¶Smith, William Benjamin, '23, New Orleans, La. ....
Smithson, Frederick C. M., '19, Univ. of Louisville, Louisville....Chem.
Solomon, Leon L., '20, Louisville.......................Sanitation.

Sonnenday, Miss Dora, '20, Cincinnati, Ohio ....Home Economics.
South, Lillian H., '20, State Board of Health, Louisville..Bacteriology.
§Spahr, R. H., '14, New Haven, Conn. ....Physcis.
Sparks, Mrs. Sue D., '14, 224 E. High St., Lexington....Ent. & Zoology.
*Spears, Howell D., '14, Experiment Station, Lexington......Chemistry.
States, N. M., '17, Univ. of Kentucky, Lexington.............Physics.
§Stiles, Charles F., '14, A. & M. College, Stillwater, Okla. ..Entomology.
Suter, Arthur Lee, '20, Washington, D. C. ....Pharmacology.
Sweeny, Mary E., '20, Univ. of Ky., Lexington....Home Economics.
§Tashof, Ivan P., '14, 437 Second St., S. E., Washington, D. C.
.....................................Mining & Metallurgy.
*Terrell, Glanville, '17, Univ. of Kentucky, Lexington........Philology.
Thrun, W. E., '23, Univ. of Louisville, Louisville..........Chemistry.
Thruston, R. C. Ballard, '15, Louisville......................Geology.
Tigert, J. J., '14, Com'r of Education, Washington, D. C., Psychology.
Trelease, Samuel, Univ. of Louisville ....
Tuttle, F. E., '14, Univ. of Kentucky, Lexington............Chemistry.
*Valandingham, John T., '15, Williamsburg..............Mathematics.
Valleau, W. D., '20, Experiment Station, Lexington....Plant Pathology.
Van Beecelaere, Rev. E. L., '15, Cardome, Georgetown......Philosophy.
Vance, Sarah H., '20, State Board of Health, Louisville....Bacteriology.
*Vansell, George H., '16, Univ. of California, Berkley, Cal.
....Ent. & Zoology.
Vaughn, Erle C., '14, Experiment Station, Lexington ...Ent. & Botany.
Wallingford, J. K., '23, Bowling Green ....Geology.
*Walz, F. J., '15, Weather Bureau, Louisville............Meteorology.
¶Ward, Henry B., '21 Univ. of Illinois, Urbana, Ill............Zoology.
Waugh, Karl, '23, Berea College, Berea..................Psychology.
*Weaver, C. P., '14 ....English.
Webb, William S., '14, Univ. of Kentucky, Lexington ....Physics
¶Weller, Stuart, '22, Univ. of Chicago, Chicago..............Geology.
†White, John D., '15, Louisville, D. 1920...................Geology.
*Wilhoit, A. L., '14, Univ. of Kentucky, Lexington..Mech. Engineering.
Williams, A. S., '20, Georgetown College, Georgetown......Chemistry.
Williams, Charles, '23, Shively, Ky. ....Chemistry.
....Chemistry.
†Williams, Cora, '21, Bellevue. D. 1922...............................
*Wurtz, Geo. B., '14, Weather Bureau, Lexington..........Meteorology.
Yunker, J. A., '23, Louisville Gas & Electric Co., Louisville.
†Zahner, Chas. O., '16 Univ. of Louisville, Louisville, D. 1918..Biology.
*Zembrod, A. C., '14, Univ. of Ky., Lexington......Modern Languages.

CALL FOR ORGANIZATION OF KENTUCKY ACADEMY OF SCIENCE

The advantages and necessities of a State Academy of Science for the State of Kentucky, such as exist in at least seventeen other states, viz.: Wisconsin, Kansas, Iowa, Indiana, Minnesota, Nebraska, California, Ohio, Illinois, Michigan, Colorado, Utah, Oklahoma, Maryland, Tennessee, North Carolina and New York, are too numerous to mention in this brief space. Science is essentially mutualistic—successes in one branch are hailed with delight by those interested in other branches. A discovery made in one may be the stepping stone to future achievement along another branch of science. At present it is difficult for one person to keep abreast with the discoveries and achievements in one branch of science alone. Thus you obtain, from the diversified program, the grain from the chaff—that of which the author of the paper has made a special study requiring months or even years.

Then the value of submitting results for discussion, of discussing others' results, of broadening the scientific mind, of mutual stimulus and encouragement, of personal education by coming in contact with fellow workers. Then also the value to the community at large, giving them that which is best and most useful from the various branches. in the form of publications and otherwise, must not be overlooked.

In many cases they have served as scientific advisers, governmental or otherwise, to the states in which they exist. As expert non-partisan investigators they have linked science to the problems of everyday life, suggesting legislation, for the betterment of human welfare in industry, public health, sanitation, and social conditions. The results are, that the past quarter of a century has witnessed a more rapid progress than any equal period of the world's history.

Another reason for such an organization is the opportunity for acquaintance and the establishment of good fellowship among the laborers in this line of work. This in itself would be sufficient.

The State's interests are promoted in a number of ways by the co-operation of these people who are interested in the welfare of its citizens. This service may be political, literary, scientific or social but after all they have in common the encouragement of the individual to nobler efforts and benefit to the community.

The membership shall in the main consist of Active Members, Nonresident and Corresponding Members and Honorary Members. Everyone in the State of Kentucky interested in any of the following subjects is urged to join the proposed Association whether teacher or business man: Mathematics, Astronomy, Physics, Chemistry, Geology, Geography, Botany, Zoology, Physiology, Medicine, Engineering, Social and Economic Science, Agriculture and Anthopology.

The meeting for the Organization of the Kentucky Academy of Science will be held at the State University of Kentucky, Lexington, April 10th and 11th, 1914. More details and the announcement of a program will be made later.

The Committee on Organization appointed by the Kentucky Association of Colleges and Universities, urgently invites any criticism or suggestions from any one interested.

R. H. Spahr, State University, Chairman.
F. L. Rainey, Central University.
Garnett Ryland, Georgetown College.

We, the undersigned, are in sympathy with and favor the organization of a Kentucky Academy of Science, the organization meeting to be held at the State University of Kentucky, Lexington, May 8, 1914, and hereby pledge our moral as well as our active support by attending, if possible, said meeting as charter members.

Frank T. McFarland
R. E. Knapp
Arthur M. Miller
W. E. Freeman
Fred W. Hofmann
Geo. B. Wurtz
Chas. P. Weaver
Jno. J. Tigert
A. C. Zembrod
H. B. Hendrick
S. C. Jones
Knox Jamison
G. C. Routt
W. D. Nicholls

H. H. Downing
H. D. Easton
Paul P. Boyd
T. R. Hollcroft
S. D. McCann
F. Paul Anderson
J. W. Pryor
F. E. Tuttle
Joseph H. Kastle
H. R. Niswonger
Mary Didlake
H. Garman
J. Morton Davis
E. L. Rees
M. L. Pence
A. H. Gilbert
Geo. Roberts
C. J. Norwood
Hywel Davies
Alfred M. Peter
Erle C. Vaughn
O. M. Shedd
Howell D. Spears
H. E. Curtis
T. R. Bryant
T. J. Barr
Ivan P. Tashof
Walter E. Rowe
G. L. Wilhoite
C. F. Stiles
W. J. Carrel
R. H. Spahr

I.

MINUTES OF THE ORGANIZATION MEETING

At the invitation of a committee composed of R. H. Spahr, F. L. Rainey, and Garnett Ryland, about twenty-five scientists of the State of Kentucky met on May 8, 1914, at nine o'clock A. M., in the Physics Building at the State University, at Lexington, for the purpose of organizing an Academy of Science.

Dr. P. P. Boyd, of State University, at the request of the above mentioned committee, called the meeting to order. After a brief statement as to the purpose of the assemblage, by the chairman, a motion was offered that the assemblage proceed to the organization of a Kentucky Academy of Science, to be duly incorporated under the laws of the State, by first electing a presiding officer and secretary for the organization meeting. The motion was unanimously carried. It was moved that the temporary chairman, Dr. Boyd, be elected permanent chairman of the organization meeting. The motion was seconded and unanimously carried, and Dr. Boyd was declared elected. On motion unanimously carried, Dr. Robinson was declared elected secretary.

It was then moved and seconded that a committee of five be appointed by the chairman to confer on a constitution and by-laws for the proposed organization, and report to the assemblage before the close of the session. The motion was carried. The presiding officer named Messrs. Spahr, Ryland, Rainey, W. M. Anderson and Lloyd.

PAPERS PRESENTED

The following papers and addresses were then presented:

Dr. J. W. Pryor, of State University, "Some Interesting Features of the Ossification of Bones," with many illustrations by lantern slides.

Dr. N. F. Smith, Professor of Physics, Central University, Danville, "Theories of Thermal and Electrical Conductivity."

Dr. Joseph H. Kastle, Director of the Kentucky Agricultural Experiment Station. "The Significance of the Scientific Work of the Experiment Station to the Agricultural Prosperity of the State."

As defined in the Hatch act, the Federal law endowing agricultural experiment stations in the states, the scope of experiment station work is intended to be coextensive with the diversity of our agriculture; any problem which bears upon the agricultural welfare of the nation or of the states may be included. The work of the Kentucky Station has covered a great variety of subjects, many of which were mentioned. The products of Kentucky are many but her commercial resources, preeminently, are corn, tobacco, whiskey, coal, timber and live stock. The work of the Kentucky Station has been helpful, as shown by examples cited. The scientific method is much better than the cruder methods of empiricism. The object and purpose of the agricultural experiment station is to arrive at the truth by exact scientific methods, and it is only by the application of such methods to the problems in hand, that we can ever hope to make any noteworthy contributions to the agricultural prosperity of the State and Nation.

Van H. Manning, Assistant Director of the Bureau. Address "The Work of the Bureau of Mines."

Mr. Manning explained that the general aim and purpose of the Bureau is to conduct, in behalf of the public welfare, such fundamental inquiries and investigations as will lead to increasing safety, efficiency and economy in the mining industry of the United States.

The problems dealt with are general, fundamental or of nation-wide importance, the solution of such mining and metallurgical problems as are purely local being left to state or local organizations or to private enterprise.

Some of the investigations of immediate value to Kentucky, aside from those relating to the safety and health of miners and mining communities, are on the possible reduction of waste in coal mining, lengthening the life and increasing the total yield of oil and gas fields by improved methods of drilling and casing wells, the study of quarrying and mining methods, modification of the plasticity of clays and economical use of fuel. The author emphasized the importance of co-operation between engineers and scientists and hoped that the investigations of the Bureau will be of assistance to those members of the Kentucky Academy of Science who are studying problems bearing on the development of the mineral industries of the State. Several examples of co-operation were given and a general plan of co-operation between the Bureau and mine owners, managers and miners was outlined as follows:

(1) That the National Government conduct the necessary general inquiries and investigations, and that it promptly disseminate, in such manner as may prove most effective, the information obtained and the conclusions drawn.

(2) That each of the several states enact the needed legislation and make ample provision for the local police supervision or inspection of mining operations within its borders.

(3) That the mine owners make provision for the improvements with a view to increasing safety, bettering health conditions, and reducing waste as rapidly as the practicability of such improvements may be demonstrated by the inquiries and investigations of the Bureau of Mines.

(4) That the miners and mine managers co-operate in making and enforcing such rules and regulations as experience and investigations in this and other countries show will prove

to be helpful in carrying out the purpose mentioned, especially such as will best safeguard the lives of all men who work underground, where a single mistake may destroy many lives.

The author expressed the view that the Kentucky Academy can exert a great influence upon public opinion and thus do much to promote safety and efficiency in all industries.

Dr. Stanley Coulter, Purdue University, LaFayette, Indiana. Address: "Science and the State."

The relation involves a mutual duty, offers opportunities and opens splendid possibilities. The monastic idea has prevailed too largely among scientists, so that science has not done its full duty to the state. The duty to increase and conserve the material resources of the state may be the all-inclusive duty of science, since if thoroly done, all other desired conditions naturally follow. If science expects to justify herself to the state, and hopes for continued recognition by the state, she must, from time to time, at least descend from the heights of pure science and mingle in the affairs of common life. The duty of science to the state does not cease with the discovery of truth; it extends to its dissemination in fairly intelligible language, with sufficient suggestions as to its relations to make it practically useful. The truth, clearly put, is what will give credit and standing to science among the people. The Academy, as a body and thru its members, owes the duty to the state of disseminating scientific truth in a straightforward, clear-cut way, that the people may have put into their hands all the truths of science which have immediate practical bearing. The Academy should stand for the combined wisdom of all its members in all matters scientific which pertain to the common weal. Several ways were mentioned in which the Academy and its members may co-operate with state enterprises, such as collaboration with the Geological Survey, by bringing the knowledge of individual members to the Director of the Survey, when it could be co-ordinated and made useful instead of remaining idle in the possession of the individual; the collation of observations upon plant life as related to soils; of native plants possessing useful properties; of mineral resources and many others. It seems only just that when the scientists of the state are associated and organized for an increase of knowledge of the resources that state at least provide for the publication of this knowledge. The address was upon the same lines as the presidential address before the Indiana Academy of Science, Proceedings for 1896, pp. 33-46.

OTHER BUSINESS

At the conclusion of the program the committee on constitution reported a constitution and by-laws which was read and adopted unanimously, after slight modification.

The nominating committee reported the following nominations for officers:

For President, Joseph H. Kastle, Experiment Station.
For Vice-President, N. F. Smith, Central University.
For Secretary, Garnett Ryland, Georgetown College.
For Treasurer, W. M. Anderson, University of Louisville.

It was moved, seconded and unanimously carried, that these nominees be elected as officers of the Academy for the ensuing year.

Prof. Coulter was nominated and unanimously elected as an honorary member of the Academy.

The motion was offered and carried that a vote of thanks be extended by the Academy to the organization committee and especially to Mr. Spahr for their efforts in bringing about the organization.

It was also moved and carried that the Academy extend a vote of thanks to the speakers on the program, and especially to Prof. Coulter for his somewhat lengthy trip in order to address the meeting.

(Signed) CHAS. J. ROBINSON, Secretary.

II.

MINUTES OF THE SECOND ANNUAL MEETING

The second annual meeting of the Kentucky Academy of Science was called to order by President J. H. Kastle in the Chemistry lecture room of the State University on Saturday, May 15, 1915, at 9:30 A. M. After the President's introductory remarks the minutes of the last meeting were read and approved. The report of the treasurer, W. M. Anderson, was presented showing a balance on hand of two dollars. The Secretary showed that the roll of members contained the names of sixty persons who had signed the call for the organization or otherwise indicated a desire to be recognized as charter members of the Academy but that seven of these had since left the State.

The Council reported thru the Secretary, that it had held two meetings and had fixed the date for the payment of annual dues at January 1st of each year, payment to begin in the case of new members on January 1st following their election.

The Membership Committee nominated 65 persons for active membership, 11 for corresponding membership and Professor Dayton C. Miller for honorary membership, all of whom were duly elected.

The President appointed as Committee on Nominations, Professors Boyd, Pence and Davis, and as Auditing Committee Messrs. Bryant, Pryor and Hinton.

President Kastle delivered an address on "Recent Advances in Our Knowledge of Animal Nutrition in Relation to Growth."

PAPERS PRESENTED

"Relation between Matter and Radiant Energy." N. F. Smith, Centre College, Danville, Ky.

The paper discusses several theories, more particularly that of Planck as modified by Einstein. In conclusion the author writes "Let no one think that the problem is completely solved, for there remain many contradictions and inconsistencies. It seems certain that the theory of Maxwell must be modified or abandoned, but the great facts of interference and diffraction, for which it offered so complete an explanation, have not been accounted for on the basis of any other theory. In spite of the confusion and uncertainty of the present, we may feel confident that real progress is being made toward an ultimate solution of the great problems of present-day physics—the structure of matter and its relation to radiant energy."

"Faulting in North Central Kentucky." A. M. Miller, University of Kentucky.

The faults are of the normal type with wide drag zones on their down-throw sides. A prominent feature in connection with nearly all of them is the presence of a parallel secondary fault on the down-throw side of the main fault, heading in toward the latter to form a "fault block." The following are described in the paper:

1. The Kentucky River fault, traceable from near Levee, Montgomery County, to near Burdetts Knob, Garrard County, 48 miles, with a maximum displacement of about 350 feet. The Kentucky River follows the general course of this fault from Boonesboro to Camp Nelson, causing a striking deflection toward the southwest.

2. The West-Hickman fault, recognizable from near Union Mills, Jessamine County, to near Paris, Bourbon County, 28 miles, maximum displacement about 150 ft., notable for having brought the Eden shale, with its relatively poorer soil, down to the level of the Trenton limestone with its very rich soil, thus affording a striking contrast in native vegetation and agricultural characteristics.

3. The Kissinger and Switzer faults. Extend from near Great Crossings, Scott County, to near Camp Pleasant, Franklin County, about 11 miles. Displacement about 150 feet. This, also, gives rise to a strip of relatively poor land.

4. The Glencairn fault. From near Campton, Wolfe Co., to Irvine, Estill County, 25 miles. Maximum displacement about 150 feet. An interesting feature in connection with the eastern end of this and also of the Kentucky River fault, is the presence of an oil pool in the fault extension to where it ceases to be a distinct break, but becomes a monocline.

Other faults of smaller vertical throw and horizontal extent were pointed out on the map.

Note: Since this paper was read, the Glencairn fault has been proved not to die out near Campton but to extend continuously eastward as far as the Big Sandy River near Paintsville; therefore it is now called the Irvine-Paintsville Fault. It has also been proved to be the structure most responsible for oil in the Irvine sand as far eastward as Cannel City, in that it has limited the northwestward migration of the oil up the dip slope to this line.

"The Removal of Mineral Plant-Food by Drainage Waters." J. S. McHargue, Experiment Station, Lexington.

The paper describes a study of the kind and amount of mineral matter carried in solution by the water of springs and streams in different geological horizons and points out interesting and characteristic differences. The results are published in full in Bulletin 237, Kentucky Agricultural Experiment Station, Lexington, Ky., November, 1921.

"The Translocation of the Mineral Constituents of the Seeds of Certain Plants During Growth." G. D. Buckner, Experiment Station, Lexington. See Journal of Agricultural Research, Vol. 5, No. 11, Pages 449-58. December 15, 1915.

The Academy then adjourned to the Phoenix Hotel for lunch, and reassembled at 2:30 in the Physics lecture room.

Dr. Dayton C. Miller, Professor of Physics, Case School of Applied Science, Cleveland, Ohio, by special invitation of the Academy, delivered an illustrated address on "The Science of Musical Sounds."

The general nature of sound and sound waves is discussed and a detailed explanation of noise and tone and of pitch, loudness and tone quality is given. Sound originates in either simple or composite harmonic motions, and these can be represented by suitable curves. All musical tones are produced by periodic vibrations and all varieties of tone quality are due to particular combinations of a larger or a smaller number of simple tones. Every motion of the air which corresponds to a complex musical tone or to a composite mass of musical tones, is capable of being analyzed into a series of simple harmonic motions, to each of which corresponds a simple tone that the ear may hear. An adequate investigation of the tone quality of a sound, therefore, makes it necessary to have visible records of the sounds from various sources which can be quantitatively examined.

None of the methods previously in use seemed to be of sufficient delicacy for the present investigations, and the result of experimentation was the development of the Phonodeik which has been in use since 1908. The Phonodeik consists essentially of a diaphragm of thin glass mounted on the small end of a resonating horn. Close to the diaphragm is a minute steel spindle supported in jeweled bearings. A mirror about one millimeter square is attached to the upper portion of the spindle, while the lower portion is made in the form of a pulley. A few silk fibres attached to the center of the diaphragm are wrapped once around the pulley and are fastened to a delicate spring. Light from a pin-hole is focused by a lens and is reflected by the small mirror on a moving photographic film in a special camera. If the diaphragm vibrates in response to a sound wave, the spot of light will trace the record of the sound on the film. In the instrument used for photographing sound the motion of the diaphragm for sounds of moderate loudness is about one-thousandth of an inch. This is magnified 2,500 times by the mirror and light ray, producing a record two and one-half inches wide. For loud sounds the record may be five inches wide. The film moves with a speed of from one to fifty feet per second, according to the purposes for which the record is desired. Besides the record of the wave, there is placed on the film the zero line giving the axis of the curve and also time signals one-hundredth of a second apart, enabling the exact determination of pitch. The camera is arranged with several shutters for hand, foot and automatic-electric release and for any desired time of exposure.

Thousands of photographs have been made of sound waves from various sources, vocal and instrumental. While inspection and simple measurement will often give some information concerning these curves, they are generally too complicated for interpretation in their original forms.

The curves representing the sounds of music and of speech are properly analyzed for comparative investigation by the harmonic method based on the important mathematical principle known as Fourier's Theorem. This method is suitable for the investigation of all phenomena that may be represented by periodic curves. The numerical method of applying Fourier's Theorem to determine the components of a sound is very long and difficult. For this reason, various mechanical devices known as harmonic analyzers have been made to assist in this work. An analyzer on the principle devised by Professor Henrici of London has been used, and this has been developed in our own laboratories, so that it will determine the composition of a given curve up to the thirtieth harmonic component.

The converse of the analytic process just described, that is, a recombination of several simple curves to find their resultant, is often required. This operation is most conveniently accomplished by means of a machine. An harmonic synthesizer for thirty-two components has been especially designed and constructed in the laboratories of Case School of Applied Science.

The analytic investigation of sounds by the methods described has been in progress since 1908 and is to be continued indefinitely. Among the subjects under investigation are the characteristics of tones from different musical instruments, the effects of changes in material or construction of musical instruments, the nature of vowel tones and other sounds of speech, and the nature of noises and their prevention. The method is helpful in the teaching of vocal music and elocution, and it also provides a very convenient test for exact tuning. The ideal of musical tone of any voice or instrument having been selected by the artist, can be accurately defined and reproduced by the aid of analysis.

The analytic study of several thousand photographs of vowels from many different voices leads to the conclusion that each vowel is characterized by a particular fixed region of resonance. It is the particular pitch of the resonance of the overtones that identifies the vowel. The studies lead to specific quantitative definitions of each of the principal vowels.

The proof of this theory of the vowels consists in the reproduction of the several vowels by experimental synthesis made with organ pipes. The number of pipes required varies from three to sixteen for a single vowel.

For purposes of public demonstration, a Phonodeik of special construction has been made, by means of which the sound waves from the speaker's voice and from various musical instruments can be projected on the screen, the movements of the diaphragm being magnified 40,000 times, producing a wave which may be ten feet wide and forty feet long.

(The lecture was illustrated with slides and models and experimental demonstrations with the Phonodeik. Many of these illustrations, as well as detailed accounts of the methods and instruments here briefly mentioned and of the results obtained, have been given in a book by the author, "The Science of Musical Sounds.")

BUSINESS SESSION

Afterwards a business session was held at which the Committee on Nominations made the following report which was unanimously adopted:

For President, N. F. Smith.
For Vice-President, A. M. Miller.
For Secretary, A. M. Peter.
For Treasurer, Garnett Ryland.
For Member of Committee on Publication, R. T. Hinton.

These officers were then elected by unanimous vote.

Dr. Pryor, for the Auditing Committee, reported that they had audited and approved the report of the treasurer.

It was moved and carried that the Academy express its appreciation of Prof. D. C. Miller's very interesting address.

The Academy then adjourned.

(Signed) GARNETT RYLAND, Secretary.

MINUTES OF THE COUNCIL OF THE ACADEMY OF SCIENCE

The Council of the Academy of Science met December 4th, 1915, at the University Club.

Present: President N. F. Smith, Messrs. Miller and Peter.

It was agreed that the next annual meeting should be held the first Saturday of May; also that an effort be made to get this date recognized as the fixed date of the annual meeting, and in order to bring this about, an effort should be made to have it given in the college catalogs.

President Smith announced as committee on membership, Prof. W. E. Freeman, Chairman, Kentucky State University, C. A. Nash, Centre College, Danville, and F. J. Walz, Weather Bureau, Louisville; and as the Legislative Committee, J. B. Hoeing, of Lexington and Frankfort, Chairman, R. C. Ballard Thruston, Louisville, and N. F. Smith, Danville.

After some informal discussion about the program for the next meeting, it was agreed that the members of the committee should look out for a suitable person to make an address.

The meeting then adjourned.

(Signed) ALFRED M. PETER, Secretary.

The Council met in the Physics laboratory, University of Kentucky, April 6, 1916, at 10:15 A. M.

Present: Messrs. N. F. Smith, A. M. Miller and A. M. Peter.

The Treasurer's account was approved.

Account of ten dollars for clerical work approved and ordered paid.

A resolution favoring the use of the Centigrade Thermometer scale in government publications was approved and Prof. Miller was requested to present the same in the Academy meeting.

Adjourned.

III.

MINUTES OF THE THIRD ANNUAL MEETING

The third annual meeting of the Kentucky Academy of Science convened at Lexington, May 6, 1916, in the lecture room of the Department of Physics, University of Kentucky.

The Academy was called to order at 10:30 A. M., by President Smith.

The Minutes of the last meeting were read and approved.

The Secretary made an informal report, in which the membership was stated as 77 active members, 8 corresponding members and 2 honorary members.

The Acting-Treasurer presented the report of the Treasurer showing receipts $84.80, disbursements $26.50, balance on hand May 6, $58.30.

Statement of the Acting-Treasurer from January 1st, 1915, to date (May 6, 1916).

RECEIPTS

From Garnett Ryland, Treasurer	$ 8.80
Amounts collected as dues and initiation fees	76.00
Total	$84.80
Total disbursements	26.50
Balance on hand	$58.30

(Itemized statement and vouchers filed.)

Upon motion the report was received and referred to an auditing committee consisting of Messrs. Boyd, Chairman, Nash and McFarland, to report back at the afternoon session.

The President appointed as Committee on Nominations Messrs. Crooks, Chairman, Davis and Killebrew, to report nominations for officers at the afternoon session.

The Membership Committee nominated 9 persons for active membership, 1 for corresponding membership and Dr. F. R. Moulton, Professor of Astronomy, University of Chicago, for honorary membership, all of whom were duly elected.

Professor Gilbert moved that the time of the annual meeting be changed to the first week in April instead of the first week in May. After some discussion the sense of the members present was taken which resulted in 15 in favor of the present time for the meeting and 5 in favor of a change.

On motion of Professor Miller the matter of changing the time of the meeting was referred to the Council with the suggestion from the President that the informal vote taken would serve as an indication of the wishes of the members.

The following resolution moved by Prof. Miller was unanimously adopted:

RESOLVED, That the Kentucky Academy of Science heartily approves the move to substitute the Centigrade thermometer scale for the Fahrenheit scale in all government publications, and endorses the bill to that effect now pending in Congress, H. R. 528.

RESOLVED, That the Secretary transmit a copy of this resolution to the Thermometer Committee, A. A. A. S., Bureau of Standards, Washington.

The following program was then given:

PAPERS PRESENTED

President's Address—Problems and Progress of Twentieth-century Physics: N. F. Smith.

Twentieth-century physics had its birth in the year 1895, when Roentgen discovered the new form of radiation known as X-rays. There followed rapidly after this a succession of important discoveries chiefly connected with radio-activity. From the many new facts discovered there has gradually developed the electronic theory of matter and electricity. It has been definitely established that every electric charge is made up of an exact number of elementary electric charges or atoms of electricity. The magnitude of this elementary electric charge has been determined with great accuracy. From the value of this elementary charge other important physical constants can be accurately determined, among them the mass of an electron, and the masses of different atoms. It has been shown that every electric current is a convection current; the inertia of matter is probably entirely due to its electrical nature and is analogous to self-induction. It has been shown that X-rays are of the same character as light, but with a wavelength about one-ten-thousandth part as great. This has been established by the use of crystals as a diffraction grating. A reasonable theory of the structure of the atoms of the different elements has been established which is in close agreement with observed facts. The electro-magnetic theory, as worked out by Maxwell, is incomplete and requires important modification to account for the facts of radiation. On the whole, remarkable progress has been made in the development of physical theory.

Astronomy Applied in Archeological and Historical Research: Henry Meier.

The author had collected a large number of events and circumstances mentioned in works on ancient history and and given in ancient Greek or Roman classics, which events referred to a probable total eclipse of the sun or moon taking place about the time given and visible in the regions referred to. He then calculated the times of all possible eclipses for the time and place of each event and having thus established accurately the year, month and day of the event given by history he was enabled to determine with certainty other historic dates related to the event.

Likewise from the accurately measured orientations of certain ancient temples in Upper Egypt dedicated either to the sun or to a well-known star, he determined, based upon the facts that the obliquity of the sun's ecliptic is a variable quantity and that the declinations of fixed stars change from year to year, the probable time of construction of each temple, and thus he was able to fix chronologically the events related through inscriptions in each temple.

Some Historic Fish Remains: Arthur M. Miller.

When the writer took charge of the department of geology, State College, in 1892, he found stored in the basement of the old Chemistry Building, some interesting fossil fish remains. He later found that the labels pasted on them containing the initials "J. S. N." were placed there by J. S. Newberry and that these were the indentical specimens described in Vol. 1, Paleontology of the Ohio Geological Survey, under the names *Orodus* and *Ctenacanthus* from the "Waverly Shale" exposed at Vanceburg, Ky. It was the finding in this deposit of the teeth of the fish which had been named *Orodus* in such close juxtaposition with the spines of the fish which had been named *Ctenacanthus*, that led Professor Newberry to conclude that these two structures belonged to one and the same species.

Reference was made to a previous account of these remains given by Professor Andrews in a volume of the Ohio Survey published in 1870 on work done in 1869, in which these specimens were credited to a Captain James Patterson, who found them in the Upper Black Shale (Sunbury Shale) at Vanceburg, Ky.—presumably in the course of quarrying the shale for oil distillation, an industry started in this country in the fifties or sixties of the last century, but speedily abandoned, when the discovery by Silliman, of Yale, led to the obtaining of paraffiin more cheaply from petroleum.

Comment was made in this connection on how paleontology is indebted to commercial operations for some of its more interesting fossil remains.

A New Form of Frequency Meter: N. F. Smith.

A rotating disc marked off in sectors alternately black and white is illuminated by an A. C. arc light. Since the light comes principally from the positive carbon, the illumination of the disc is intermittent. Therefore a stroboscopic effect is produced, and with proper speed of rotation the disc appears to stand still. From the rate of rotation of the disc, the frequency of the current is at once determined.

The Dr. Robert Peter Herbarium of the University of Kentucky: Frank T. McFarland.

The paper shows the value of the Peter Herbarium as compared with the herbarium of the University of Kentucky.

In the University of Kentucky Herbarium are 4,106 specimens, of which 3,157 were collected by Dr. Robert Peter and Dr. Charles W. Short, of Lexington, from 1832 to about 1835. For the State, Dr. Peter has listed a total of 1,205 species, but only 470 mounted species are in the Herbarium. Only 592 species for the State are listed in the University of Kentucky Herbarium, with which the Peter Hermarium is consolidated, much fewer than the actual number in the State.

"Stem Rot" of Alfalfa and Clovers Caused by Sclerotinia Trifoliorum, Erik: Alfred Holley Gilbert, Kentucky Station Circular No. 8.

The paper contains reference to previous observations, as reported in Kentucky Experiment Station Circular No. 8, 1915; also a brief resume of the history of the disease in Europe and America, and a report of a recent attack upon crimson clover in Kentucky.

Since the causal organism is a soil fungus and sclerotia may remain in the soil, retaining their vitality, possibly, for several years, a rotation of crops in which no one of the several legumes which serve as hosts for the fungus is grown for at least three years, is recommended as a control measure. The host plants so far as known are all the cultivated clovers and alfalfa. A common weed, *Abutilon*, was also observed to act as a host plant.

On the Distribution of Phosphorus in a Section of Blue-grass Soil: Alfred M. Peter, "Soil Science" Vol. II, No. 4, Oct. 1916.

Analyses of soil samples from each 6 inches, from the surface to the rock, showed strikingly different percentages of phosphorus, ranging from 0.258 in the second to 6.692 in the twentieth 6 inches, with other maxima in the fifteenth and twenty-fifth 6 inches.

These differences are similar in degree to those existing between different layers of the phosphatic Lexington limestone, and are accounted for by supposing that the calcium carbonate of the limestone has been dissolved away, leaving most of the phosphate in layers of greater or less richness, according as the limestone layers were more or less phosphatic.

Precipitation of Cobalt and Nickel Salts in Gels: C. A. Nash and John Ardery.

The following paper was read by title:

"Note on a Specimen of Radioactive Mineral," by J. W. Pryor.

At the afternoon session Dr. F. R. Moulton, of the University of Chicago, delivered an illustrated lecture on "Some Recent Discoveries in the Sidereal Universe," in which the present methods of determining the distances and motions of the fixed stars were explained in a popular way.

Dr. Moulton was given a rising vote of thanks for his very able lecture.

BUSINESS SESSION

The auditing committee reported that they had audited the Treasurer's report and found it correct. The report was unanimously adopted.

The nominating committee reported the following nominations for officers:

For President ....Prof. A. M. Miller
For Vice-President ....Dr. Garnett Ryland
For Secretary ....Dr. A. M. Peter
For Treasurer ....Dr. Paul P. Boyd
For member of the Committee on Publications ....
..............................Prof. Frank L. Rainey

The report was adopted and the nominees were unanimously elected.

The Society then adjourned without date.

After adjournment several members visited the observatory of the University, upon invitation of Prof. Miller. Dr. Moulton pointed out the planet Venus, visible in broad daylight to the unaided eye, which fact was verified by a number of members present.

The following members were noted as attending one or both sessions: S. D. Averitt, J. E. Barton, M. H. Bedford, R. E. Bitner, P. P. Boyd, L. A. Brown, G. D. Buckner, C. G. Crooks, J. M. Davis, M. L. Didlake, W. E. Freeman, H. Garman, P. L. Blumenthal, A. H. Gilbert, D. J. Healy, P. E. Karraker, C. D. Killebrew, F. T. McFarland, J. S. McHargue, H. Meier, A. M. Miller, C. A. Nash, A. T. Parker, M. L. Pence, A. M. Peter, J. W. Pryor, O. M. Shedd, N. F. Smith, C. F. Stiles, I. P. Tashof, J. J. Tigert, F. E. Tuttle, E. C. Van Becelaere, G. H. Vansell, W. S. Webb, G. E. Wurtz.

The following members met in the Phoenix Hotel grill at an informal luncheon, with Dr. Moulton as guest of honor: Professors N. F. Smith, C. A. Nash, Frank W. Rainey, Prof. and Mrs. Henry Meier and Prof. C. G. Crooks of Centre College. Prof. A. M. Miller, Dr. Paul P. Boyd, Prof. F. T. McFarland and Prof. W. S. Webb, of the University of Kentucky, and Dr. Alfred M. Peter, Dr. P. L. Blumenthal, S. D. Averitt and J. S. McHargue of the Kentucky Agricultural Experiment Station.

(Signed) ALFRED M. PETER, Secretary.

The Council met in Professor Miller's office May 5, 1917, at 9 o'clock A. M., pursuant to the call of the President. Present: Prof. A. M. Miller, Dr. Garnett Ryland, Dr. P. P. Boyd and Dr. A. M. Peter.

President Miller reported that he had appointed a Membership Committee composed of Dr. G. D. Buckner, Chairman, Dr. P. L. Blumenthal and Mr. J. S. McHargue.

Several accounts were presented and approved for payment.

It was ordered that the Treasurer give Dr. Arthur L. Day a check for fifty dollars ($50.00) to cover his expenses and a small bonus for his address before the Academy.

It was ordered that the Treasurer give Dr. Peter a check for three dollars to pay for Pullman reservation for Dr. Day's return trip to Washington.

It was suggested by Dr. Ryland and concurred in by the other members present that it would be well to nominate a Louisville man for President.

Adjourned.

(Signed) ALFRED M. PETER, Secretary.

Lexington, Ky., June 20, '16.

REPORT OF ACTING TREASURER, FROM MAY 6, TO JUNE 20, 1916.

Balance on hand on date of annual meeting, May 6, '16		$58.30
Amounts received as dues and initiation fees between May 6 and June 20, '16		11.00
		$69.30
Disbursements between May 6 and June 20, '16:		
F. R. Moulton, expenses for trip from Chicago, Ill.	$25.00	
University Press for 100 folders	5.00	
University Press for envelopes	1.75	
Stamps	2.00	
Filing box	.25	
Clerical work	10.00	$44.00
Balance in the treasury		$25.30

(Signed) ALFRED M. PETER, Acting Treasurer.

IV.

MINUTES OF THE FOURTH ANNUAL MEETING OF THE KENTUCKY ACADEMY OF SCIENCE

The fourth annual meeting of the Kentucky Academy of Science convened in the Physics Lecture Room of the University of Kentucky at 10 o'clock A. M., on Saturday, May 5th, 1917, President Miller presiding. Present, about fifty members and visitors.

The Minutes of the last meeting were read and approved.

The reports of the Secretary and of the Treasurer were read and approved.

REPORT OF THE SECRETARY, MAY 5, 1917

The Secretary transmitted promptly to the Thermometer Committee of the A. A. A. S., at Washington, an official copy of the resolution passed by the Academy at its last meeting advocating the adoption of the Centigrade thermometer scale in government publications. No action ordering this change seems to have been taken by Congress.

Abstracts of all the papers read at our last meeting were forwarded to "Science" for publication and they appeared in the issue of July 14, 1916. This being our only means of publication, it is desired that members supply the Secretary with short abstracts of their papers, for this purpose.

Letter ballot of the Council was taken upon the matter of changing date of the annual meeing proposed in Prof. Gilbert's resolution. The result was unanimously in favor of retaining the present date, the first Saturday in May.

Of the 9 persons elected to active membership at the last meeting, 6 paid the initation fee and their names have been added to the list. Prof. Moulton acknowledged his election to honorary membership in a very cordial letter to the Secretary.

As Membership Committee the President appointed Dr. G. D. Buckner, Chairman, Dr. P. L. Blumenthal and Mr. J. S. McHargue.

The Academy has lost by death one of its most distinguished members and past president, Dr. Joseph H. Kastle.

We have lost by resignation two regular members, Prof. H. G. Brownell of Russellville and Prof. A. L. Rhoton, of Georgetown.

The total membership is now 91, classified as follows:

Regular members in good standing	39
Regular members in arrears for dues	39
Corresponding members	10
Honorary members	3
Total	91

The Secretary has sent at least two notices to each member in arrears.

Classified by subjects, our membership list is as follows:

Agriculture and agronomy	5
Animal husbandry	2
Astronomy	2
Bacteriology	4
Biology	6
Botany, entomology and zoology	8
Chemistry	24
Electrical engineering	1
Forestry	2
Geology	10
Horticulture	1
Mathematics	6
Meteorology	2
Microscopy	1
Mining engineering	3
Psychology	2
Physics	9
Physiology	1
Philosophy	1
Unclassified	1
	91

The Secretary desires to call attention to the predominance of chemists among our membership, as shown in the list of members arranged by subjects, and to make an appeal to the workers in other branches of science to come to the support of the Academy. There must be more workers in Kentucky in the mathematical sciences and biological sciences than there are in chemistry. Are these satisfied to allow the chemists to outdo them in activity? Should not all the scientists of the

State vie with each other in supporting an organization like ours?

(Signed) ALFRED M. PETER, Secretary.

REPORT OF TREASURER FROM JUNE 20, 1916, TO MAY 5, 1917

RECEIPTS

July, 1916, From A. M. Peter, Acting Treasurer	$25.30	
1916-17 Initiation fees and dues	59.00	
	$84.30	$84.30

DISBURSEMENTS

Dec. 8, 1916, Welsh & Murray, printing receipt cards ..	$2.50	
May 3, 1917, Jas. M. Byrnes, account book	.40	
" " " Postage	.50	
" " " Printing envelopes	3.00	
" " " Printing programs	5.00	
" " " Postage	4.09	
" " " Clerical work	10.00	
" 5, " Expenses Dr. Day's lecture	53.00	
	$78.49	$78.49
Balance on hand		5.81

The foregoing account has been examined and found correct, the expenditures being supported by proper vouchers and receipts.

(Signed) C. D. Killebrew
L. A. Brown
J. T. McFarland, } Auditing Committee

May 5, 1917.

President Miller reported informally for the Council.

The Membership Committee nominated 4 persons for active membership, and Dr. Arthur L. Day, Director of the Geophysical Laboratory of the Carnegie Institute, Washington, D. C., for honorary membership, all of whom were duly elected.

PAPERS PRESENTED

The following program was then given:

"History And Present Status Of Opinions In Regard To The Origin And Antiquity Of Man: Address of the President, A. M. Miller.

The long persistence of crude and irrational conceptions bearing on the origin and antiquity of man was ascribed to the very great authority of the church coupled with the late development of the Science of Geology furnishing a basis for belief in the very great age of the earth.

The history of opinion from the time of Lucretius was sketched in which especially Lyell's and Darwin's views were set forth with their reciprocal reactions upon each other.

The scant geological evidence for the evolutionary origin of man forthcoming at the time of the publication of Darwin's Descent of Man was cited in explanation for the total ignoring of such evidence by Darwin.

Reasons for the imperfect geological evidence even today bearing on man's descent were found in his probable early arboreal and later terrestrial habits coupled with his superior intelligence.

The greater relative frequency of man's implemental as compared with his skeletal remains and among the latter the predominance of lower jaw bones was explained. The relative frequency of lower jaws was illustrated by citation of all known instances of skeletal remains of Paleolithic Man.

The history of discovery of man's ancient skeletal and implemental remains was divided into two periods, an earlier in which ecclesiasticism suppressed discovery and a later in which there has been comparative freedom from such interference.

All the known instances of alleged discovery of early traces of man in Europe, North America, South America and Africa, were enumerated in chronological order and the creditability of each commented upon.

The opinion arrived at was that the existence of Paleolithic Man outside of Europe and possibly Africa was not proved.

In conclusion the upward trend of man was sketched in panoramic view from a near human arboreal creature, originating "somewhere in Asia" through stages represented by

Pithecanthropus erectus, Heidelberg Man, Neanderthal Man and Cro-Magnon Man with the various successive cultures attained by the last two races. The times with reference to the epochs of the glacial period assigned to each race and culture were given according to Osborn.

"Some Possible Deductions Obtainable from Observations of Places of Comet B-1916", Dr. Henry Meier.

"Taxation Of Forest Land:" J. E. Barton, State Forester.

The best thought in the United States in regard to forest taxation embraces the dictum that forest land must be taxed on an equitable basis with other property. The essential features of the best laws on forest taxation at the present time are: (1) the classification of land as forest land or otherwise; (2) an agreement with the State to maintain forest land in forest growth for a definite period of years, and penalties for failure to carry out the agreement; (3) assessment of the land at a certain amount or rate per acre, which shall be a fixed annual tax on the land during the entire period for which the contract with the State calls; (4) assessment on the timber in the form of certain percentage of the value of the forest crop when it is harvested, this percentage to be distributed among the proper county, State or school funds; (5) fixed charges to meet other taxes which may be considered necessary. If a code of taxation laws with relation to forest property embodying these features were put into effect there is no reason why the continuity of timber growth and consequently of a forest crop should not be assured.

"A Study Of The Proteins Of Certain Insects With Reference To Their Value As Food For Poultry:" J. S. McHargue

The writer called attention to the greater efficiency of animal proteins over vegetable proteins as shown by the work of previous investigators. It as also pointed out that wild animals, including birds, show an instinct in their natural selection of food for their young which is compatible with the most recent scientific investigations concerning the relation of the proteins to nutrition and growth. It was shown that the desiccated bodies of grasshoppers contain more protein than does commercial meat-meal, as well as notable amounts of fat, phosphorus and potassium.

The author expressed the view that, with the proper machinery for catching, drying and grinding these insects, a valuable source of protein could be thus made available for such purposes as feeding poultry, etc. See Journal, Agr. Research, Vol. 10, No. 12, Sept. 17, 1917, pp. 633-637.

"The Geologic Structure Which Explains The Accumulation Of Oil In The Irvine Feld:" A. M. Miller.

The oil sand in the Irvine field is the Columbus magnesian limestone of middle Devonian age overlaid immediately by Ohio Black Shale of upper Devonian age. It seems probable that the oil was forced out of the shale into the porous limestone by differential capillary attraction of the oil and salt water, and working up the dip on the northwestern slope of the great Eastern Kentucky Syncline, became trapped on top of the saltwater against the plane of a fault which extends with some interruptions on the surface from near Irvine to near Campton. The mechanics of the process was illustrated by reference to a diagram drawn upon the blackboard, and maps were exhibited showing the positions of the producing wells in their relation to this Irvine-Campton, or Glencairn Fault.

"A Method Of Ashing Organic Materials For The Determination Of Potassium:" P. L. Blumenthal, A. M. Peter, D. J. Healy and E. J. Gott.

The authors have shown that potassium is lost mechanically and by volatilization of its salts during the ashing of organic material. While such losses cannot be entirely eliminated they may be materially reduced by conducting all such operations in a muffle furnace and by preliminary treatment of the sample with nitric and sulfuric acids before ashing.

The sample should be evaporated on a water-bath with about 5 cc of molar nitric acid and 5 or 6 cc of 1:1 sulfuric acid for each 0.7 gm. of organic material taken, and then ashed. The quantities of potassium determined ranged from 3 to 21 mgms and the maximum loss was 0.46 mgm upon the largest sample. See Jour. Ind. and Eng. Chem. Vol. 9, No. 8, p 753, August, 1917.

"Killing Frost, and Length of the Growing Season in Various Sections of Kentucky:" By F. J. Walz, B. S., U. S. Weather Bureau, Louisville.

In his operations the farmer every season is confronted with risks due to weather and climate. Among the risks that he faces each season are those of damage by late frost in spring, early frost in autumn, and a possible shortening of the growing season below that needed for the proper development and ripening of his crops. This paper summarizes and presents in the form of tables and charts the results of a study of the dates in Kentucky of the last killing frost in spring and first killing frost in fall, and the length of the growing season considered as the number of days between these dates. The records of the regular stations of the U. S. Weather Bureau, and those of the co-operative stations with 20 years or more of record, were carefully examined and analyzed, employing mathematical methods used in the investigation of statistics and probabilities. The average dates of last killing frost in spring and first killing frost in fall, the average number of days in the growing season, and the "standard deviations" from these averages were computed for each station, and consequent risks or probabilities determined. See Ky. Experiment Station Circular 19.

"Some Factors Influencing Kentucky As An Oil State:" James H. Gardner.

At the present writing (June, 1917) Kentucky stands in the limelight as a prospective oil state. Due to the fact that the Irvine District of Estill County has been extended over a large area together with the greatly renewed activity in the older Kentucky fields, operators are now turning their attention to the State as a whole. This is particularly true of oil men from the Mid-Continent Field. So it appears that the latter part of this year and the early months of 1918 will forever settle the question as to the State's potential rank in the production of petroleum and natural gas. Test wells are to be drilled in nearly every county in the State and the most modern applications of petroleum geology are being freely used. Up to the present time most of the "wild cat'' work has progressed only to the mapping or leasing state but the high standing of the companies interested is a good indicator of the developments that are surely to follow.

There are four important geological factors that are always met in the search for new oil fields. When all of them are found to work in harmony great fields, like those of Oklahoma, Kansas and Texas or those of Pennsylvania, Ohio and West Virginia, are the result. Geological ''structure'', such as anticlines, domes etc., constitute only one of these factors. A large number of structures do not produce oil or gas. They may or may not produce salt water. Furthermore they may lie in what would be considered favorable regions. In such cases the detail which may have been expended in mapping them is of no avail. Such conditions result from failure of one or more of the three other factors, namely either (1) there is no open ''sand'' or other porous medium under the structure to serve as a retainer for oil and gas; or (2) there has never been present any salt water or other water in the sand to serve as a concentrating factor; that is, no gathering of oil and gas from a disseminated state to a commercial body; or (3) there is an absence of petroliferous shale or other fossil-bearing rocks that produce oil in a disseminated form.

Now the future of Kentucky as an oil state depends on the four factors above mentioned: (1) structure; (2) sand; (3) water; (4) original oil. There can be no question about the State having three of the above points in its favor, namely (1) structure; (2) water; (3) original oil. There are numerous favorable structural conditions in various counties of the State. The rocks contain plenty of water and there are some good beds of oil bearing shale. The Devonian Black Shale is particularly a splendid carrier of original oil. The fourth factor is, however, as yet to be proven of sufficient importance to place Kentucky in high rank as an oil state; namely, ''sand''. In great oil fields there are large bodies of sand or retaining reservoirs in close proximity to beds of oil bearing shale. There are frequently several such ''sands'' in the geological column in close relationships to oil shale beds.

In Kentucky the ''sands'' or ''porous beds'' near the Devonian Oil Shale are carrying most of the oil so far discovered.

In Wayne County these sands lie in the Waverly series above the Black Shale, but in other districts the oil is held below the shale in porous beds of limestone. This is true of the oil fields at Irvine, Cannel City, Campton, Menifee County, and other districts of Eastern Kentucky. In the coal basins of Eastern Kentucky and Western Kentucky there are a large number of beds of porous quartz sandstone: they lie in the Chester and Pennsylvania series but in connection with these sandstone beds, oil shales must be proven to exist in order that any particular structure may be found productive. If for instance a bed of oil shale like the Devonian Black Shale could be found just above or below the Big Clifty Sandstone at the base of the Chester, then an anticline containing these beds at sufficient depth would most certainly make a big oil and gas field like those of Oklahoma; but it so happens that in a great many cases in Kentucky the oil shales do not lie near dependable porous reservoir rocks or else the porous sandstones in the higher portion of the geological column, such as those above enumerated, do not have near them any great amount of typical oil shale.

In conclusion the writer desires to state it as his opinion that Kentucky is not to rank high as an oil state in comparison with many other areas in the United States where the four factors work in harmony and there are numerous porous sands near beds of oil shale; however, the writer wishes to emphasize the probability that a number of structures in Kentucky will find the four factors working together and will furnish new oil pools that will be highly valuable to those who are fortunate enough to discover them.

Careful studies by geologists working in the State will serve to gather a great deal of important information in addition to merely mapping suitable structural conditions in any particular locality.

"The Species of Nicotiana and Some Classifications of the Varieties of Nicotiana Tabacum:" G. C. Routt.

The *Index Kewensis* lists 124 species of Nicotiana from many countries; 75 are native to South America and 24 to North America. Nicotiana tabacum and Nicotiana rustica are the only ones grown commercially for the production of the various forms of tobacco and snuff. Plants of this genus were among the first used by the geneticists for experimental work in plant breeding, the first hybrids having been produced by Koelreuter in 1760 by applying pollen of N. paniculata to the stigmas of N. rustica. Much breeding and selection work has been done on N. tabacum. Prof. Comes of Naples gives 6 varieties of N. tabacum, viz: fruticosa, lancifolia, virginica, brasiliensis, havenensis and macrophylla. N. lancifolia, to which the Kentucky Burley belongs, is a native of South America. N. havanensis, to which Havana cigar tobacco belongs, is a native of Mexico, having been carried to Cuba by the Spaniards. Dr. G. E. Anastasia, of Scafati, Italy, enumerates only 4 varieties of N. tabacum, viz: havanensis, brasiliensis, virginica and purpurea.

The Academy then adjourned for lunch in the Phoenix Hotel grill room where about thirty members gathered at an informal luncheon in honor of Dr. Day.

Upon the reconvening of the Academy at 2:30, Dr. Arthur L. Day delivered a very able and interesting illustrated lecture entitled: "The Volcano Kilauea in Action."

From a physical-chemical viewpoint the study of volcanic activity centers first on the nature of the participating ingredients, then on the condition of equilibrium or the progress of the reactions taking place between them. At the time of our visit all the three states of matter—gases, liquid, and solid—were found represented. Gases were emitted constantly in great volume and displayed nearly all the great variety of cloud forms which have been so frequently described in volcano literature, except the violently explosive type, which has been rarely or never seen at Kilauea since the advent of the white man (1820). There was a liquid lava basin of oval shape some 600x300 ft. (Figure 1) inclosed by a lava dyke or rampart built up from the surrounding floor of the basin by the tumultuous, spattering, splashing of the lava lake. Both floor and rampart are frequently overflowed when the lake is high and rising, and again great masses of it fall into the lake and are redissolved when it is low. The floor of the pit at the time of our first descent had been completely overflowed but three

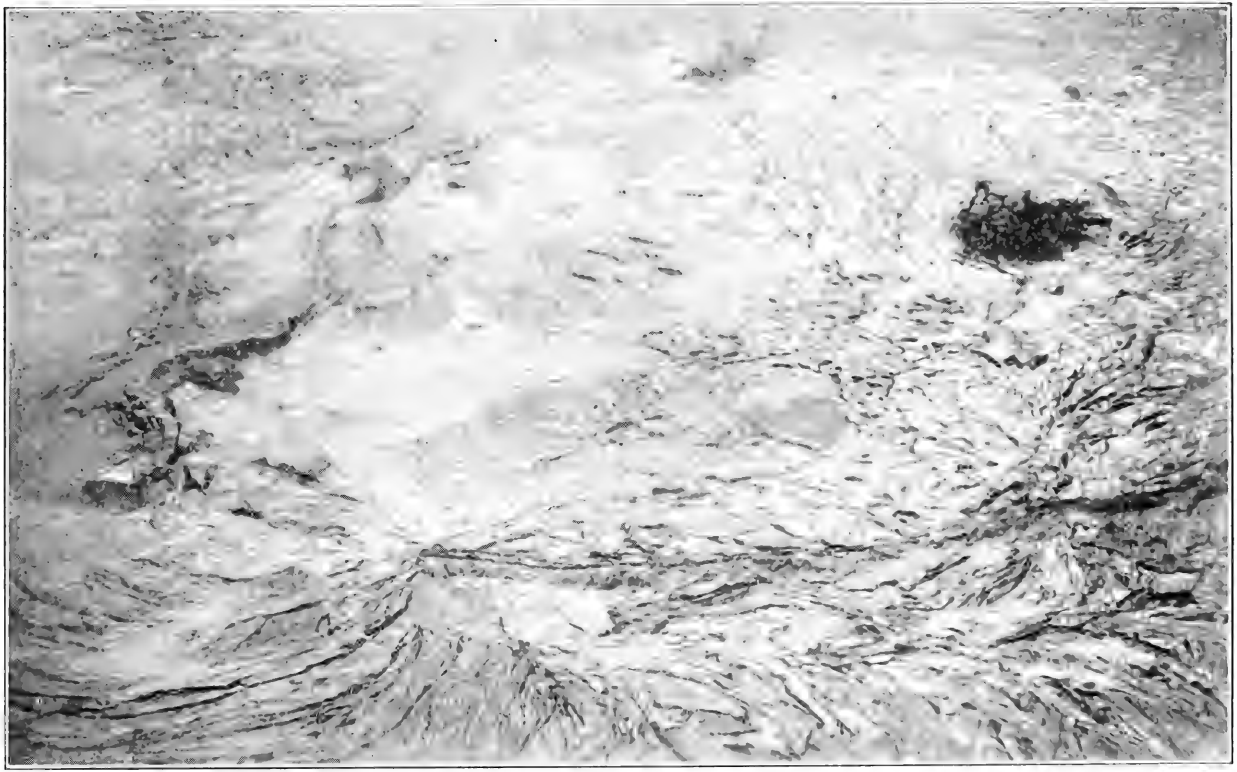


FIG. 1. LAVA BASIN, CRATER OF KILAUEA

FIG. 2. COLLECTING VOLCANIC CASES, CRATER OF KILAUEA

days before and was reasonably level. The fresh lava had solidified to a dept of some 10 inches and was abundantly solid to walk upon but was still uncomfortably hot and the cracks were still glowing.

Surrounding this floor are the walls of the pit, some 200 ft. high at the time of our first descent, and made up of the exposed edges of successive earlier overflows which individually rarely exceeded two or three feet in thickness. The pit as a whole was about 1500 ft. in diameter, roughly circular in plan and with nearly perpendicular walls except for the talus pile which extended about half way up the wall. All these diameters vary somewhat from day to day and considerably from year to year with the state of activity in the basin.

It will be of interest to record some of the observations made in the course of the extended study of this volcano, the purpose of which is to obtain definite information about the character of the chemical reactions which take place in an active volcano and in particular to determine the role played by the gaseous ingredients which are very important factors in both its chemical and physical activities. In many studies of volcanoes the gases have been allowed to escape entirely while in others they were not captured until the nature of the components was so much altered by oxidation or otherwise that their identification, to say nothing of the determination of their relative processes and the character of the equilibrium existing between them, has remained uncertain. On these broader questions, which are laboratory problems, much work still remains to be done. It is, however, possible to offer evidence of the participation of water and of some of the other volatile ingredients in the activity of Kilauea in advance of this detailed study which may require some years before all the questions which have been raised are satisfactorily elucidated.

The problem of collecting volcanic gases which are satisfactory from the chemical viewpoint is a most difficult matter. Hot gases of more or less complicated composition discharged from an active volcanic vent into the air undergo immediate and violent chemical and temperature changes, the consequence of which with our present limited knowledge of gas relations at these temperatures can be only partly inferred.

It is therefore a matter of the first importance to collect the gases directly from the liquid lava or the explosive vents before contact with the air has given opportunity for alterations to occur. We accordingly made the somewhat difficult descent into the crater without mishap and two crates, each containing ten glass tubes of one-half liter capacity each, were then lowered down to us. To one end of these series of tubes a glass pipe line was attached which led directly into one of the cracks in a lava dome (Figure 2) through which the gas was escaping. The gases discharged through this dome were free to escape only through narrow slits where they could be seen at night burning with a pale blue sheet of flame, thereby demonstrating (1) an excess pressure within and in consequence (2) that the gases released from the liquid lava came first in contact with the air on emerging from these cracks. The other end of the tube system was connected to a piston pump about four inches in diameter with a displacement of about 2 ½ liters per stroke. The gases entered the pipe line at a temperature of about 1000 degrees. The pumping was kept up for fifteen minutes in order to make sure that the air originally contained in the pipe line and connecting tubes was displaced by the gases from the volcano. In this pipe line water began condensing with the first stroke of the pump and at the end of fifteen minutes about 300 cubic cm. had accumulated in the collecting tubes.

Insofar as this reconnaissance yields final results it shows that the gases evolved from the hot lava at the Halemaumau are nitrogen, water, carbon dioxide, carbon monoxide, sulphur dioxide, free hydrogen, free sulphur, together with chlorine, fluorine and ammonia in comparatively insignificant quantity.

The first plain conclusion which follows from the discovery of this particular group of gases associated together at a temperature of 1000 degrees or more is that they cannot possibly be in equilibrium there and that chemical action between them is still going on. Whatever may have been the previous opportunities for chemical readjustment among the gases as they arose in the magma and were gradually set free with the diminishing pressure, they are still in process of active reaction when discharged into the air. Free sulphur for example could not have remained in permanently stable association with carbon dioxide; neither could free hydrogen be found in stable association with CO^2 and SO^2 at 1000 degrees.

The consequence of the gradual release of these gases is the interreaction between the gases thus set free in constantly increasing quantity as the surface is approached. The reactions are accompanied by evolution of heat which obviously operates to raise the temperature of the surrounding lava so long as the reacting gases remain in contact with it.

In full accord with the positive conclusion that these particular gases cannot exist together in stable equilibrium at the temperature at which they are found, but are in process of active reaction, the record of the analyses shows their composition to vary from one tube to another. It is therefore probable that the proportions of the individual gases change with every bubble which bursts from the liquid basin.

Further confirmation of the same conclusion is found in the observation that when the gases given off by the lava increase in quantity, the quantity of lava remaining the same, its temperature increases, and conversely when less gas is discharged this temperature diminishes again. The measured change in the temperature of the surface lava during the period of our observations amounted in maximum to 115 degrees.

The heat generated by these gas reactions in the region near the surface when the amount of gas is large may well be more than sufficient to counteract the cooling effect of the expansion within the rising lava calumn which *may thus become hotter and not cooler as it approaches the surface.* It appears further from the order of magnitude of the quantities of heat thus released by chemical reaction within the volcano conduit that we have here happened upon an enormous store of volcanic energy which approaches its maximum temperature at the surface itself. It is not certain at the moment that this discovery throws new light on conditions far below the surface, except perhaps to relieve us of the necessity of postulating extreme temperatures for the lava chambers below which on other grounds must be considered highly improbable.

The Academy gave Dr. Day a rising vote of thanks.

BUSINESS SESSION

The Membership Committee made a supplementary report presenting 3 more names for regular membership. The report was approved and these gentlemen were unanimously elected to membership.

The Auditing Committee reported that they had examined the Treasurer's report and found it correct. The report was approved and the committee discharged.

The Nominating Committee reported the following nominations for officers:

For President ....R. C. Ballard Thruston
For Vice-President ....J. E. Barton
For Secretary ....A. M. Peter
For Treasurer ....Paul P. Boyd

The report was approved and these gentlemen were unanimously elected.

There being no other business, the Academy adjourned without date.

(Signed) ALFRED M. PETER, Secretary.

V.

MINUTES OF THE FIFTH ANNUAL MEETING

Lexington, Ky., May 4th, 1918.

The Academy was called to order in the Physics lecture room, University of Kentucky, by Vice-President Barton.

The report of the Secretary was read and approved.

REPORT OF THE SECRETARY OF THE KENTUCKY ACADEMY OF SCIENCE FOR THE YEAR ENDING MAY 4, 1918

As Membership Committee the President re-appointed Dr. G. D. Buckner (Chairman), Dr. P. L. Blumenthal and Mr. J. S. McHargue.

Of the seven persons elected to active membership at the last meeting, six paid their initiation fee and their names have been added to the list.

The status of our membership, as shown by the Secretary's books May 3rd, is shown in the following table:

		Am't due
Active members in good standing	32	
Members in arrears for current year	33	$33.00
Members in arrears for two years	11	22.00
Members more than 2 years in arrears	6	21.00
Corresponding members	11	
Honorary members	4	
Total membership	97	$76.00

Several members have left the State since our last meeting, some of them to take up different kinds of war work.

We have lost by resignation two regular members, Dr. J. R. Cowan, Danville, and Prof. George F. Dasher, Bethel College, Russellville.

In connection with the latter it should be mentioned that Professor Dasher, in his letter of resignation, suggests that it might be a good thing to hold the annual meeting of the Academy in connection with that of the Kentucky Educational Association and in that way a larger number of out-of-town members will be enabled to be present—especially those interested in education.

If our membership be classified by subjects, chemistry heads the list with 25 members, followed by physics with 11 and geology with 10. The other sciences less than 10 each.

Listed by localities, Lexington leads, with 41 members, out of the State 25, Louisville, 12, Danville 4, Georgetown and Frankfort, 3 each, Berea and Williamsburg, 2 each, and Richmond, Jenkins, Fort Thomas, Bowling Green, Russellville and Winchester, 1 each.

The Secretary received the following letter from Mr. Roscoe Nunn, Secretary of the Tennessee Academy of Science:

> "The Tennessee Academy of Science is seeking the acquaintance of similar societies in other states. Recently we have come in touch with a number of academies in various states. We desire to exchange publications where agreeable. Through Prof. Walz, of the Weather Bureau Office, Louisville, I procured your address; hence this letter.

> The Tennessee Academy of Science was organized in 1912. We have held a regular annual meeting each year, in the fall, and occasionally a spring meeting. We have issued two volumes of Transactions, the second one in November, 1917. We would be glad to be placed on your exchange list, and will forward our publications to you, if such an arrangement would be satisfactory to you."

We have since received the two volumes of Transactions mentioned above, which have been placed in the archives of our Academy.

Also the following from the Kansas Academy of Science:

> "The Kansas Academy of Science will celebrate its semi-centennial anniversary in connection with the Annual Meeting which will be held at the University of Kansas in Lawrence on March 15 and 16, 1918.
>
> The Academy will be pleased to have the Kentucky Academy of Science send a delegate to this meeting."

The Secretary acknowledged the invitation regretting that we were not able to send a delegate.

Dr. Arthur L. Day, who was elected an honorary member of the Academy acknowledged his election in the following cordial letter:

> "I received in this morning's mail your formal notification of my election to honorary membership in the Kentucky Academy of Science.
>
> "May I take this opportunity to assure you of my keen appreciation of the honor which you have done me by this election, and of the many courtesies extended to me by yourself and your colleagues of the Academy during my visit there. Such cordial hospitality sufficed in a very short time to make me feel as much at home as the "oldest living member". It was therefore in no sense an obligation but a pleasure and a privilege to meet with you and to be given this opportunity to present certain phases of my own work.
>
> "With kind regards to President Miller and very cordial thanks to the entire membership of your Academy for the courtesies shown me, I have the honor to remain,
>
> "Very sincerely yours,
>
> "(Signed) ARTHUR L. DAY."

Abstracts of papers read at the last meeting were not published in "Science" because the Secretary was unable to get all of them from the authors. The by-laws require that "All papers intended to be presented on the program, or abstracts of the same, must be submitted to the Secretary previous to the meeting." This provision has not been complied with by all. The Secretary earnestly requests that all who present papers this year will not fail to provide him with a copy of each for our archives and a hundred-word abstract for publication.

The report of the Treasurer was read by Prof. Downing, in the absence of Treasurer Boyd, and approved. The report showed:

Balance on hand, May 5, 1917		$5.81
Received for fees and dues		56.00
		$61.81
Paid for programs	$4.25	
Paid for stamps	6.05	
Paid for clerical work	10.00	
Paid Dr. J. A. Detlefsen for expenses	30.00	50.30
Balance on hand, May 4, 1918		$11.51

The report of the Membership Committee was read by Dr. Buckner, the Chairman, nominating 8 persons for active membership and Dr. J. A. Detlefsen for honorary membership. All persons nominated by the Committee were unanimously elected.

On motion of Dr. Buckner, it was unanimously resolved that the Academy go on record as offering its services to the Government in any capacity, during the time of the war.

After some discussion as to whether it is advisable to hold meetings of the Academy in Louisville at the same time as the Kentucky Educational Association, this matter was referred to the Council.

The Chairman appointed the following Committees: Membership Committee: Dr. Buckner, Mr. McHargue and Dr. N. F. Smith. Auditing Committee: Dr. Pryor, Dr. Brown and Prof. McFarland. Nominating Committee: Dr. Pryor, Dr. Buckner and W. S. Anderson.

The following program was then rendered:

President's address, by J. E. Barton, acting president, "The Regenerative Forests of Eastern Kentucky and their Relation to the Coal-mining Industry."

The extensive coal-measures of Eastern Kentucky support a valuable forest growth, which is of great usefulness in the mining of coal. At the present time it takes about three acres of timber to mine one acre of coal. The ratio should be nearly one acre of timber to one acre of coal. This condition can be brought about by careful management, which is justified by the fact that the coal supply will last about one hundred years. at present rate of production. Timber can be raised in a thirty-year rotation, of sufficient size and character for mining purposes, by a proper selection of species, an area fully stocked and adequate protection against fire and live stock.

Differences in the Ossification of the Male and Female Skeleton: Dr. J. W. Pryor.

Scientific Education: J. J. Tigert.

The rapid development of scientific agriculture. Education followed agriculture in scientific progress. Scientific procedure dependent upon quantitative measurement. Statistical methods and measurements in education. Standard tests. The measurement of intelligence. Charts and tables showing results of measurements in the Cynthiana schools in 1916-17 and the Lexington schools in 1917-18. Age-grade table, Cynthiana, shows 22 per cent of pupils retarded. Comparison of promotions in Cynthiana and other American cities shows a larger percentage of promotion in Cynthiana than elsewhere. Ayres Spelling Test in Lexington and Cynthiana shows Lexington three points above the average of 84 American cities, and Cynthiana equal to the average of 84 American cities. Handwriting tests in Lexington and Cynthiana show both these cities below the average city in speed and quality of handwriting. Arithmetic tests in Cynthiana show Cynthiana below standard measured by the Woody Scale. A comparison of boys and girls in spelling and handwriting shows the girls to be superior to the boys.

The Effect of Manganese on the Growth of Wheat: J. S. McHargue. Jour. Ind. and Eng. Chemistry Vol. 11, No. 4, p. 332, April, 1919.

After reviewing briefly some noteworthy results obtained by previous investigators on the relation of manganese to agriculture, the author presented results obtained by growing wheat in manganese-free sand and in cultural solutions, with and without the addition of manganese.

Wheat plants grown to within a few weeks of maturity in cultural solutions containing manganese and others of the same age in which the manganese had been omitted, were on exhibition. Where manganese had been added to the cultural solutions the plants were apparently normal in every respect, whereas the plants grown in solutions containing no manganese showed a retarded growth in the blades, stalks and roots, as compared with the plants of the same age receiving manganese. There was evidence of lack of the proper development of chlorophyl in the plants receiving no manganese and the blades of these plants exhibited a drooping appearance in that they were not able to hold themselves erect, which was quite characteristic and not to be observed in any of the plants receiving manganese.

The author concludes from his experiments that manganese plays a more important role in the growth of wheat than has hitherto been suspected.

Formation of Petroleum: C. J. Norwood (By title.)

Cryoscopic Work with an Ordinary Thermometer: C. C. Kiplinger.

It has been found possible to read small temperature intervals on a common thermometer, within an accuracy of 1/100 degree, by measurements of the parallax on an auxiliary scale equipped with a sliding peep-sight.

Several heretofore troublesome sources of error in the boiling point method of determining molecular weights have been eliminated by using but one point as reference on a thermometer scale, having established this point by the use of a known substance with a high degree of purity. This procedure eliminates the need of a calibrated thermometer.

The use of the parallax method is suggested in the estimation of fractional parts of a scale division on other instruments than the thermometer.

Generalization on the Mean-value Theorem: H. H. Downing.

The speaker, applying the mean-value theorem which states for certain functions that

$$f(x+h) - f(x) = h'f'(x+\phi h),\ 0<\phi<1,$$

to certain elementary functions, obtained interesting relations between ϕ and h. For the function $f(x) = ax^3 + bx^2 + cx + d$ the relation was an equation which was simplified by setting $\phi = \phi h$. This equation in terms of ϕ and h as variables represents a hyperbola with one focus, one vertex, the center, the other vertex, and the other focus, lying on the lines whose equations are, respectively,

$$\phi = 0,\ \phi = 1/3\ h,\ \phi = 2/3\ h,\ \phi = h,\ \ \phi = 4/3\ h.$$

Magnolia fraseri: Does it Occur in Kentucky?: Frank T. McFarland.

List of Fungi from Kentucky: Frank T. McFarland.

An Equation Balance: E. L. Rees.

A Method of Constructing the Graph of an Equation in which the Variables may be Separated: E. L. Rees.

Protein Metabolism in the Growing Chick: G. D. Buckner and others. (By title.) See Bulletin 220, Ky. Experiment Station.

Review and Observations on the Mosaic Disease of Tobacco: G. C. Routt.

The author reviews the work of other investigators and reports observations of his own upon the disease in experimental plots of different varieties of tobacco. He favors the view that the best way to combat the disease will be to develop a resistant strain of tobacco.

Dr. J. A. Detlefsen, of the department of genetics of the University of Illinois, addressed the academy on "Laws governing the transmission of characters from parent to offspring."

The speaker gave a brief review of the search by investigators for the cause or causes of evolution. He then explained the law for the transmission of mono-hybrids, di-hybrids, and tri-hybrids. He presented these laws and illustrated them so well that there was left no doubt in the minds of workers in other fields that great progress has been made in genetics in recent years.

He threw upon the screen the tables giving the result of his own breeding experiments to show how nearly actual counts agree with the mathematical expectation, in the laws of transmission. It is remarkable how nearly actual counts of animals bred agree with the expectation of what, by Mendel's law, they should be.

A vote of thanks was given Dr. Detlefsen for his valuable address.

The Committee on Nominations reported the following nominations for officers for next year:

For President ....J. E. Barton
For Vice-President ....Paul P. Boyd
For Secretary ....A. M. Peter
For Treasurer ....J. S. McHargue
For member of Publications Committee ......J. J. Tigert

Each of these was then duly elected.

The Auditing Committee reported that the Treasurer's accounts had been examined and found correct.

There being no further business, the Academy adjourned *sine die*.

The following members and visitors were reported at the morning session: J. E. Barton, J. A. Detlefsen, A. M. Peter, F. K. Sutton, J. S. McHargue, G. Davis Buckner, Frank T. McFarland, S. D. Averitt, W. D. Iler, W. S. Anderson, N. F. Smith, Linwood A. Brown, G. F. Reddish, Foster F. Elliott,

M. L. Pence, Jno. J. Tigert, E. L. Rees, H. H. Downing, N. M. States, C. C. Kiplinger, C. D. Killebrew, J. W. Pryor, Vernon G. Grove, W. E. Butt, S. A. Boles, R. F. Hemmenway, and the following from Berea: Maxwell Morgan, Dewey Trosper, C. B. Anderson, Cloyd N. McAllister, Alma B. Ackley.

(Signed) ALFRED M. PETER, Secretary.

VI.

MINUTES OF THE SIXTH ANNUAL MEETING

The sixth annual meeting of the Kentucky Academy of Science convened in the Physics Lecture Room of the University of Kentucky at 10 o'clock A. M. on Saturday, May 3rd, 1919, President Barton presiding. Present, about 40 members and visitors.

The Minutes of the last meeting were read and approved as well as the reports of the Secretary and Treasurer.

Abstracts of papers presented at the last meeting were forwarded to "Science" for publication and appeared in that Journal under date of July 19, 1918, copies of which were duly sent to the members.

Copy of motion by G. D. Buckner offering the aid of the Academy to the country during the war, was sent to Hon. R. C. Stoll, June 6, 1918, to be forwarded to the Government at Washington.

In a circular letter sent out to the members November 12, 1918, an opinion was asked regarding the feasibility of changing the date of meeting of the Academy to coincide with that of the Kentucky Educational Association. Your Secretary has received only two opinions to date—one in favor of the change and the other opposing it, namely, Mr. Ivan P. Tashof, of Washington, D. C. says:

> "I think it is an excellent idea to hold the annual meeting of the Kentucky Academy of Science at the same time as the annual meeting of the Kentucky Educational Association. I think the Academy and various scientific men scattered over the State will be mutually benefited thereby. Undoubtedly the men interested in science and teaching in the High Schools will be glad to join the Academy and no doubt they will be benefited by the splendid annual address which is delivered before

> the members of the Academy each year. The idea is too good to drop and I hope to hear that the next meeting will be held in Louisville when the Kentucky Educational Association meets."

Prof. C. W. Mathews of the College of Agriculture, says:

> "Regarding location of headquarters of the Kentucky Academy of Science, I feel that with a growing State University at Lexington there will probably continue to be a larger number of persons interested in membership located in and near Lexington than at Louisville or any other point, therefore, as I see it, would be opposed to changing to Louisville as headquarters".

As no interest in the question was apparent and the members of the Council saw no need for the change, no further action was taken in the matter.

In the same circular letter the members were informed that State Academies of Science are now counted as affiliated societies of the A. A. A. S. and that they have the privilege of joining this Association without the payment of an initiation fee but only the annual dues of $3.00 which entitles them also to receive one of the publications of the Association. So far only two of our members have taken advantage of this offer, namely, Mr. Ivan P. Tashof, of Washington, D. C., and Mr. N. M. States of the University of Kentucky, both of whom were recommended by your Secretary for membership. Your Secretary desires again to call the attention of our members to the advantage of belonging to this Association and to urge that all who do not belong to the Association take advantage of this opportunity to join.

Our membership is now 93. Of the 8 persons elected to membership last year all have paid their initiation fees and their names have been added to the list.

Since our last meeting we have lost one member by death, namely, Dr. Charles O. Zahner, Prof. of Physiology in the University of Louisville, who died of influenza, November 6, 1918. We have lost 3 members by resignation, namely, Prof. Geo. F. Dasher of Bethel College, Russellville: Prof. C. A. Nash, formerly of Centre College, Danville; and Dr. Charles J. Robinson, of the University of Louisville. One who has left the

State, Prof. C. C. Kiplinger, desires to be transferred from an active to a corresponding member.

The total membership is classified as follows:

Regular members in good standing	30
Regular members in arrears for dues	45
Corresponding members	12
Honorary members	6
	93

The Secretary has sent two notices to each member in arrears and he desires to again call their attention to the importance of attending to the matter at this meeting, inasmuch as the by-laws provide that any who are in arrears for two years shall be dropped from the list of members.

The report of the Treasurer showed:

Balance on hand May 4, 1918		$11.51
Received for fees and dues		41.00
Total		52.51
Paid for programs, stationery, etc.	$27.17	
Paid for clerical work	10.00	37.17
Balance on hand		$15.34

The report of the Membership Committee was read by Dr. Buckner, the Chairman, nominating 27 persons for active membership, 2 to be transferred from active to corresponding membership. All were unanimously elected.

An open discussion was held as to the advisability of holding our annual meeting jointly with the Kentucky Educational Association. The change was opposed by Dr. Terrell, who moved that the meetings be continued as heretofore. Motion seconded and passed by unanimous vote.

Auditing Committee appointed by President Barton: A. M. Miller, Chairman; C. D. Killebrew and N. F. Smith.

Nominating Committee appointed by President Barton: Dr. Henry Meier, Chairman; Dr. Terrell and Dr. Buckner.

The following program was then rendered:

President's address, by J. E. Barton, "The Relation of Private Forestry to the Economic Interests of Kentucky."

It was brought out that there are no public forests in Kentucky, the large bodies of forest lands being privately owned, mainly by coal companies. The preservation of timber in Kentucky is therefore a problem in private forestry. It was considered desirable that the legislature should pass some law regulating private forests and stimulating timber development by suitable modification of the methods of taxing timber land.

New Fossil Invertebrates from a New Fossil Horizon in the Coalmeasures of Eastern Kentucky: W. R. Jillson, State Geologist.

A new fossiliferous limestone horizon in the Coal Measures of Eastern Kentucky has been discovered by the author who has done sufficient field work on it to demonstrate that it possesses features of fundamental stratigraphic importance to the unmapped geology of this section. A comprehensive collection of invertebrates taken by the author from an outcrop of this horizon on the Dr. G. T. Kendrick farm on the headwaters of Cow Creek, Floyd County, and identified by Professor Charles Schuchert, shows an incomplete list of about forty species of which ten are new and about sixteen very rare. It is a very unusual Pottsville fauna with the characteristic index forms absent. Three other widespread fossiliferous limestones in this same area are noted, all of which possess virgin stratigraphic potentialities. The author tentatively correlates them into the Norton (Middle) and Wise (Upper) Pottsville.

A Phase of Evolution: W. S. Anderson.

In every breed of animals it is found that a few are exceptionally potent in passing on their good qualities. The author illustrated this from certain families of horses and advanced some speculations as to the possible cause.

Electrolytic Solution Glow: Dean W. Martin.

In December, 1917, the author observed a glow on the aluminum terminal of an electrolytic rectifier with lead and aluminum electrodes in a 10 per cent solution of sodium phosphate. It was found possible to produce the glow with solutions of many different salts, of different concentrations, at temperatures from 0 to 100 degrees and with electrodes of aluminum, zinc or magnesium and with voltages ranging from 80 to 1,500. A simple apparatus was exhibited and production of the glow was demonstrated. The observation is published for the purpose of learning whether others have noted or investigated the phenomenon.

The Bacteriological Descriptive Group Number: D. J. Healy.

The author has found it necessary to develop the group number of the Society of American Bacteriologists in such a manner that it will indicate the action of soil bacteria on nitrogenous compounds, organic acids and sulfur. The group number, enlarged in this manner, has proved valuable in the study of soil bacteria.

A Brief Discussion of Lexington Sewage Purification: H. D. Spears.

A modern sewage-disposal plant operated by gravity takes care of 3,000,000 gallons containing 2 1-2 tons of suspended solids. The sewage passes through bar screens and grit chambers into Imhoff tanks, where bacterial action takes place and sludge is deposited. The effluent passes into "dosing tanks" which empty automatically every 15 minutes into filter beds, 2 acres area, of coarsely broken limestone covered with broken granite, together 6 feet deep. Thence the effluent passes through secondary sedimentation tanks and into a near-by stream. It is clear, odorless and has a "relative stability" of about 95 per cent. The sludge from the Imhoff tank is drawn off periodically into drying beds whence it is returned to the soil, when spadable.

A Specimen of Lodestone from Kentucky: A. M. Peter.

A specimen of titaniferous magnetite possessing polarity was exhibited, which had been sent in from Edmonson County.

The Composition of the Ash of Crab Grass *Digitaria sanguinalis* as Affected by the Soil in which it is Grown: G. Davis Buckner.

See Jour. Amer. Chem. Soc. Vol. 41, No. 9, p. 1384, Sept.,

1919. Crab grass *Digitaria sanguinalis,* when grown in garden soil, contains an ash which is 16.1 per cent larger than the ash of the same species when grown in a 4-inch limestone roadway. The comparative composition of the ashes shows that the sample grown in limestone contains 22.7 per cent more P_2O_5; 44.0 per cent more CaO; 27.6 per cent more MgO, and 18.8 per cent less K_2O than the one grown in garden soil. The external appearance of these two samples was identical.

Some Experiments in Adsorption Phenomena: P. L. Blumenthal, D. J. Healy and A. M. Peter. (Presented by P. L. Blumenthal.)

The adsorption of crystal violet by powdered phlogopite was demonstrated and it was shown that the mineral which had been acted upon by bacterial cultures withdrew from dilute solution more of the dye than did the untreated mineral, weight for weight.

An Improved Astatic Galvanometer: C. C. Kiplinger.

A new coil for an astatic galvanometer has been designed, the simplicity and efficiency of which is described. A current equivalent to 1° C. temperature difference between the terminals of a 5 couple iron-germansilver thermopile shows a swing of 8 inches on a scale 50 inches from the instrument.

A Modified Ebullioscopic Apparatus for Accurate Molecular Weight Determinations: C. C. Kiplinger.

A method is suggested whereby an ebullioscopic apparatus may be independent of variations in atmospheric pressure. It has been shown that molecular weights may be determined by this method of comparison without any knowledge of the constant for the given solvent, thus rendering the experiment independent of previous experimental errors involved in the determination of *C*.

Notes on the Viability of Tobacco Seed: G. C. Routt.

Experience in Canada shows that home-grown seed germinates better than seed from more southern localities and a higher percentage of viable seed are set during bright, warm weather than when cool, cloudy weather prevails. A higher percentage of germination is obtained from seeds gathered when the pods are half brown than when they are left until the pods are wholly brown. Tobacco seed retains its viability for many years; a sample eight years old having shown 95 per cent. germination, and one twelve years old, 70 per cent.

The Projection of Water Waves: N. F. Smith.

A simple method was described by which surface waves in water could be produced and projected by means of the lantern so as to illustrate important characteristics of wave motion.

The McCreary County Aerolite: A. M. Miller.

Portions of the aerolite which recently fell in McCreary County, Ky., were exhibited and an account of the occurrence was given. The body is stony and nearly white, containing very little metallic iron. Dr. Peter reported a qualitative chemical analysis showing that the mineral is essentially a magnesium silicate, probably enstatite. Metallic particles amounting to less than 0.2 per cent. were shown to be nickeliferous iron. Chromium, phosphorus and sulfur were detected.

A Mica Deposit in Eastern Kentucky: W. R. Jillson, State Geologist: Kentucky Geological Survey.

The discovery of a single stratigraphic unit deposit of nearly pure flake mica in the Pottsville of Pike County—the first in Kentucky—was described. The type locality is one mile above Elkhorn City in the valley of the Russell Fork of Big Sandy River, 50 feet east of the C. C. and O. R. R. tracks. This flake mica is about 1 foot thick and of small areal extent.

At the afternoon session Dr. E. B. Hart, of the University of Wisconsin, Madison, Wis., addressed the academy on "The Widening Viewpoint in Animal Nutrition."

An illustrated discussion was given of the most important results of investigations concerning nutrition which had been conducted in his laboratory at the University of Wisconsin and elsewhere. A brief account was given of the accumulative toxic properties of wheat embryos and the corrective properties of corn stover which, however, did not equal the legume hays in this respect. The vitamine factor was briefly discussed as were the subjects of roughage, protein efficiency, and the necessity of inorganic salts. Finally it was stated that a balanced diet must contain sufficient fuel value, efficient proteins, food accessories, roughages and inorganic salts and be sensibly free from toxic material.

President Barton suggested that Dr. Hart be made an honorary member of the Academy. Dr. Terrell made a motion to that effect which was seconded and passed by unanimous vote.

The Nominating Committee then made its report, and the officers for the ensuing year were elected by unanimous vote:

For President .... Dr. Paul P. Boyd
For Vice-President .... Dr. Walter H. Coolidge
For Secretary .... Dr. Alfred M. Peter
For Treasurer .... Mr. J. S. McHargue

Prof. A. M. Miller, Chairman of the Auditing Committee, then reported that the accounts of the Treasurer had been properly audited and found to be in good shape. His report was accepted.

The meeting then adjourned.

(Signed) ALFRED M. PETER, Secretary.

VII

MINUTES OF THE SEVENTH ANNUAL MEETING

The seventh annual meeting of the Kentucky Academy of Science convened in the Physics Lecture Room of the University of Kentucky, at nine o'clock A. M., Saturday, May 8th, 1920, President P. P. Boyd presiding. Present, about 60 persons in the morning and about 150 in the afternoon.

The reports of the Secretary and Treasurer were read and approved.

SECRETARY'S REPORT

Abstracts of papers presented at the last meeting were forwarded as usual to "Science" for publication and appeared in that Journal under date of July 25, 1919, copies of which were duly mailed to the members.

Membership in the Academy is now 110. Of the 27 persons nominated for membership at the last meeting, 23 paid the initiation fee and were added to the list of members.

Since our last meeting we have lost one member by death, Mr. A. M. Breckler, of Louisville, who was killed on January 28th, at Cincinnati, Ohio, when his automobile was struck by a passenger train on the Big Four Railroad.

Nine members have left the State, most of whom will be continued on our roster as Corresponding Members. Several have been dropped since the last meeting because they were more than two years in arrears.

The total membership is classified as follows:

Regular members in good standing	51
Regular members in arrears for dues	41
Corresponding members	12
Honorary members	66
	110

The Secretary has sent two notices to each member in arrears.

Of the 35 different lines of activity represented in our membership, chemistry leads with 26 members; geology is second, with 10 members; physics third, with 9 members; entomology and botany, and mathematics fourth, with 7 members each; biology and agriculture fifth, with 6 members each, and the others with from 1 to 3 each.

Classified geographically and as to Educational Institutions, our membership is as follows:

47 from the University of Kentucky, Lexington.
5 from the University of Louisville, Louisville.
4 from Centre College, Danville.
3 from Georgetown College, Georgetown.
2 from Berea College, Berea.
1 from Transylvania College, Lexington.
1 from Cardome, Georgetown.
1 from the College of Pharmacy, Louisville.
1 from Williamsburg Institute, Williamsburg.

Not connected with educational institutions in the State are:
5 from Lexington.
5 from Louisville.
5 from Frankfort.
1 from Bowling Green.

1 from Newport.
1 from Jenkins.
1 from Winchester.

Besides these are 26 from outside the State, including honorary and corresponding members.

After the first year our membership has increased very slowly. In 1914 there were 46 (charter members); in 1915, 88; in 1916, 87; in 1917, 91; in 1918, 97; in 1919, 93 and in 1920, 110. The increasing interest in the Academy meetings may be inferred from the number of speakers on our annual programs. In 1914, the organization meeting, there were five; in 1915, 6; in 1916, 10; in 1917, 9; in 1918, 12; in 1919, 14 and 1920, 24.

The distinguished scientists from other states, who have addressed the annual meetings of the Academy are Van H. Manning, Stanley Coulter, Dayton C. Miller, F. R. Moulton, Arthur L. Day, J. A. Detlefson and E. B. Hart, to which list we will add today the name of Dr. R. A. Millikan.

In November last we had some correspondence with the National Research Council which is getting in touch with all the academies in the country. Their request for information in regard to our work and for a list of members was promptly complied with.

During the year we have received programs and publications of several other state academies, which have been placed in the archives.

Your Secretary has called attention heretofore to the arrangement by which our members may join the American Association for the Advancement of Science without payment of the initiation fee, but only three of our members have taken advantage of this opportunity.

The Association has increased its annual dues from three to five dollars and has modified the terms somewhat, so that members of affiliated academies may have membership in the Association, including journal, if the Academy remits to the Association four dollars each for such members. It is necessary, however, for the Academy to formally accept the Association's proposition, by resolution. This is a matter which deserves consideration at this meeting. If we should accept the terms of affiliation, the further question will arise, whether all of our members should become members of the Association or should we have two classes; one belonging only to the Academy, or Local Members, and the other belonging to both bodies, or National Members.

In this connection it is announced that members of the Association who are in arrears of dues for 1917, 1918 and 1919, may be reinstated upon payment of dues for 1920.

Respectfully submitted,
(Signed) ALFRED M. PETER, Secretary.

The matter of the affiliation with the A. A. A. S. was referred to the Resolutions Committee.

The report of the Treasurer showed:

Balance on hand May 8, 1920		$ 15.34
Received for fees and dues		104.00
Total		$119.34
Paid, Dr. Hart's expenses for 1919 meeting	$47.00	
Paid, for programs, letterheads, stamps, etc.	25.50	
Paid for clerical work	25.00	97.50
Balance on hand		$21.84

The report of the Membership Committee was read by W. D. Iler (Dr. Buckner, the Chairman, being absent). Twenty-five persons were nominated for active membership; and 8 persons transferred from active to corresponding membership.

The President then appointed the following committees:

Auditing Committee: A. M. Miller (Chairman), George D. Smith and E. S. Good.

Resolutions Committee: Glanville Terrell (Chairman), A. J. Olney and Henry Meier.

Nominations Committee: Frank T. McFarland (Chairman), W. S. Webb and Lucien Beckner.

Prof. Shull suggested that the Academy co-operate with the Ecological Society for the preservation of natural conditions. Referred to Resolutions Committee.

Prof. Miller suggested that some steps be taken to have the papers of the Academy published. Referred to Resolutions Committee.

The following program was then rendered:

President's address. The future of the Kentucky Academy: Dean Paul P. Boyd, University of Kentucky. Science, Vol. 51, p. 575, June 11, 1920.

The speaker presented first the summaries of state academies given by Mr. D. D. Whitney in Science of December 5, 1919 and then told the results of a questionnaire which he had lately sent to secretaries of state academies, the object being to ascertain the future and the field of such organizations. He concluded that there is a definite need for them and urged that the Kentucky Academy begin a forward movement in order to fill more properly its field in the nation-wide organization of science. Some of his suggestions were that the Academy co-operate more effectively with the national bodies; that membership be extended more widely to educational and industrial plants; that science clubs be organized throughout the State; that better science teaching in the high schools be promoted; that funds be solicited from the legislature and private sources for publication and research funds; that committees be formed for the study of important State problems and for State surveys; and that recommendations be formulated for presentation to the next legislature.

Blood Lines of Genetic Value: W. S. Anderson, Kentucky Experiment Station.

In the domestic breeds of live stock great sires seldom produce more than one or two sons that are greater progenitors than themselves. This means, in blooded stock, that the greatness of any given blood line is handed on by one or two in any one generation, the others of the generation merely add members. In support of the statement, the great sires of nine breeds of domestic animals were cited and the few sons of each were named who have been instrumental in handing on the breeds.

Failure of Lettuce to Head: A. J. Olney, and W. D. Valleau, Kentucky Experiment Station.

The various physiological troubles associated with the failure of greenhouse head lettuce, including those known as rosette, tip-burn, black heart and elongation of the central stalk with the production of laterals (Rio Grande disease), have been found to be associated with a root rot apparently due to *Fusarium*, sp. Soil sterilization by steam and formaldehyde have only partially controlled the trouble, due probably to incomplete sterilization of the lower soil layers.

Variation in *Abutilon Theophrasti Medici*: Charles A. Shull, University of Kentucky.

This paper is a report of progress in an investigation of variability in the number of carpels in the ovaries of *A. Theophrasti*. The range of variability is from ten to seventeen, with the mode usually on fourteen or fifteen. The material shows a skewed frequency distribution, and tendency toward half Galton-curves. A number of plants have been found with half curves and the mode on 15. But whenever a number of plants are counted together, there are usually a small number falling on sixteen. Only three specimens in about eight thousand had seventeen carpels to the ovary. The mode falls on a lower number in material collected in Kansas than in similar material from Kentucky. The drier climate of Kansas is probably responsible for this difference. If plants from an unfavorable habitat are counted the mode is found to be depressed. The modifications of the variability curves noted are probably related rather directly to nutritional conditions. Heredity and suboptimal nutrition are believed to be responsible for the half-curve variability.

Some Factors to be Considered in Attempting to Communicate with Supposed Inhabitants of Mars: Henry Meier, Centre College.

In the first place, the probable low temperature, rarified atmosphere and absence of water are against the existence on the planet of beings endowed similarly to us. Ability to signal by light is negatived by the fact that the earth's atmosphere would absorb about 40 per cent. of the light sent out, and by the great distance. The author estimates that an area of light 10 miles square, on the earth, if seen from Mars through a telescope magnifying 500 times, would appear like an area 1 inch square, viewed at a distance of 500 feet. The possibility of signaling by radio is negatived by the distance, it being computed that it would require a current of a million amperes at the sending station in order to obtain one of one ampere at a receiving station on Mars, when the planet is nearest the earth. Besides, the powerful currents radiated from the sun would probably overwhelm the weak waves from the earth.

The Future of Nutrition and Medicine: Dr. A. W. Homberger, University of Louisville.

The paper brought out the close relation between diets in health and disease. It laid emphasis upon the benefits derived from urine and blood analyses. Urine analysis is not new and yet, with the modern methods of blood analysis, it becomes a new and valuable aid in treating diseases. The direct relations were illustrated by the conditions found in the body under diabetic conditions. Tables showing analyses, representing the work of some 80 men on blood and urine were presented—also a classified schedule of dietaries the object of each group being to throw together foods particularly adapted to the diseases involved. The author predicts that in the future there will be a closer scientific relation between the nutrition of the sick and medicine than there has been in the past.

Asphalt Coal: Willard Rouse Jillson, State Geologist of Kentucky.

Unique in a list of about twenty-five high-grade Kentucky coals, including steam, domestic, gas, and coking bituminous, and cannel grades, all of which are of growing industrial importance, there occurs an asphaltic coal—the Nolin seam (Pottsville) of Edmonson and Grayson Counties. The Nolin coal has been correlated with Dr. David Dale Owen's 1-B*. While this coal as a commercially important body covers a unit area of about 250 square miles (drainage cut outs not excepted) only a relatively small area, possibly not more than 20 square miles, is known to be impregnated with asphalt. The asphalt is found not in the coal itself but as a

*Miller, A. M., Geology of Kentucky, Kentucky Geological Survey, Series V, Vol. II, p. 283.

filler within the crevices of the coal which, it should be pointed out, is completely fractured in the bed. These fractures, no doubt, have had their origin in the structural strains and stresses to which this regional sedimentary block has been at various times subjected.

The asphalt enriched portion of the Nolin coal centers about Kyrock postoffice on the Nolin River in northern central Edmonson County, and has been noted in the literature.† It has never, however, been adequately described, nor has an hypothesis been advanced for its occurrence. The following notes are based upon original field investigations of the writer, which included sampling the coal, during October, 1919 and January, 1920.

The Nolin coal (Pottsville) occurs about 350 feet above the top of the Mississippian series in the type asphaltic locality which is found on the headwaters of Pigeon, Dismal, Second, Bylew, and some adjacent creeks, all tributaries of the Nolin River, which in turn is a south-flowing tributary of the Green River. On the head of Pigeon Creek near the road leading from Kyrock to Sweden postoffice this asphaltic coal occurs at an elevation of about 780 feet. Dipping to the North from this point, and occupying a well-defined syncline, it outcrops at lower elevations on Dismal Creek beneath a strong bed of bituminous sandstone—"rock asphalt". On Dismal Creek the Nolin coal has been opened at a number of points for domestic use. Here this coal has a thickness of about 36 inches with a blue shale roof and fire-clay bottom. Altho the Nolin coal shows high in ash, ranging generally from 6 to 12%, and fairly high in sulfur—2 to 3% its asphaltic content varying from 4 to 5% is also considerable. This latter quality renders it easily ignitable, and therefore keeps it much in demand throughout the countryside. Removed about 15 miles from the nearest railroad, and therefore not accessible from an industrial standpoint, this asphaltic coal enjoys a good local reputation and finds a considerable use for domestic heating, cooking and smithing.

Within general limitations the particular region in which

†Bryant, J. Owen: The Economic Geology of a Portion of Edmonson and Grayson Counties, Ky., Ky. Geol. Survey, Series IV, Vol. II, Part I, pp. 177-178, 1914.

the Nolin coal is enriched with asphalt, coincides with one of the several regions of unusual enrichment of "rock asphalt" —the bituminous sandstone of this portion of Edmonson and Grayson Counties. On Pigeon Creek the rock asphalt occurs in the Pottsville conglomerate at a point about 230 feet above the top of the Mississippian series. The asphalt impregnation at this point averages about 25 or 30 feet in thickness, and 6 to 7% in bituminous matter. A second, but thinner and leaner bituminous sandstone occurs irregularly at some little distance above this main stratum of rock asphalt. In between these bituminous strata occur sandstones and shales barren of any bituminous matter on the outcrop. Superimposed upon this second or upper ledge of rock asphalt, occurs another sequence of barren sands and shales, and at an altitude of 780 feet, or 120 feet above the main body of rock asphalt, occurs the asphalt impregnated Nolin coal.

The distinctly disconnected bed positions of these three asphaltic impregnated bodies, their synclinal position and regional coincidence suggests the development of vertical or semi-vertical joint plane or fissure connections from the lowest and richest bituminous sand body up through the second and leaner sand body into the Nolin coal long after the completion of the coal forming process. The marked degree of asphaltic impregnation of the crevices of the Nolin coal in this region is interpreted as indicating that the liquid bitumens were forced into the coal under hydraulic pressures at a comparatively recent date geologically and chronologically, tho from a historical standpoint in the remote past.

Such a thoro impregnation, even with as light a petroleum as are most of those of Pennsylvanian age in Kentucky, could only have occurred during a time of considerable regional depression, possibly in the late Mesozoic or early Cenozoic times. It is assumed that the liquid bitumens were gradually moved upward thru the geological section by gravity pressures of the saline waters of deposition until the considerable regional uplift which followed the period of depression arrested the movement, and locked the crude oil in place in the Nolin coal.

Subsequently the Nolin River entrenched itself in the broad plateau formed by the uplifted Coal Measures of this part of Edmonson County, and exposed beneath the Bee Springs sandstone the basal Pennsylvanian. This process brought to outcrop, (1) the Nolin coal, (2) the thin upper rock asphalt beds, (3) the main lower body of rock asphalt (conglomeratic), and (4) the upper limestones and shales of the Mississippian series. In the course of the entrenchment of this drainage system practically all the volatile constituents of the petroleum in the Nolin coal and the underlying conglomeratic sandstones made their escape by way of the outcrop, leaving only a tarry or asphaltic residue. The most recent event in the geologic history of the region is a well substantiated subsidence of the entire lower Green River basin, which has resulted in a ponding of these waters, valley filling of all lowlands, and a certain reduction in elevation of all regional stratigraphic units, including the Nolin asphaltic coal.

The Occurrence of Cretaceous Sediments Between the Cumberland and Tennessee Rivers in Western Kentucky: Willard Rouse Jillson, State Geologist of Kentucky.

One of the most important and unexpected results of economic studies of the sediments of the west Tennessee River Valley, made two or three years ago by Wade*, was the final assignment of Upper Cretaceous age to certain gravels extending more or less continuously northward from the Waynesboro Quadrangle through central Stewart County, Tennessee, into Trigg County, Kentucky. Prior to this time the age of these gravels, which rest on a much eroded platform of Mississippian limestones, had been greatly in dispute. They were regarded by some geologists as of Tertiary age, having been indicated as younger than the Cretaceous by Safford†. At least one prominent text-book‡ on geology, however, had referred them to the Cretaceous and had so indicated them on a small outline map. But Miller, holding to the older view, in his recent work§ on the geology of Kentucky, denotes these deposits

*Wade, Bruce, Gravels of West Tennessee Valley, Tenn., Geol. Survey, The Resources of Tennessee, Vol. VII, No. 2, p. 61, April, 1917.

†Safford, James M., Geology, of Tennessee, Tenn. Geol. Survey, pp. 434-438, 1869.

‡Chamberlin, T. C. and Salisbury, R. D., Geology, Vol. III (Earth History, pp. 140-141. Henry Holt & Co., New York City, 1907.

§Miller, Arthur M., Geology of Kentucky, Dept. of Geol. and Forestry of Kentucky, Series V, Vol. II, pp. 168, 169, Frankfort, 1919.

as belonging to the Lafayette and hence Pliocene in age. Stephenson, in his discussion¶ of the Cretaceous—Eocene contact of this region, ignored them entirely, following the course of Willis who, in his monumental work on the stratigraphy of North America** marks the lower Upper Cretaceous as absent in Kentucky.

In 1919 Berry produced his monograph† which extended the Eutaw and Tuscaloosa formations undifferentiated through Trigg County to a point slightly across the Lyon County, Kentucky, line. The basis of this determination was almost entirely paleobotanical whereas that of former investigations had been to a considerable degree lithological, the take-off having been in the latter case from deposits of known Cretaceous age within the limits of the Waynesboro Quadrangle‡. Within the present year further studies*** of the sands and gravels resting on the Mississippian platform of this portion of the west Tennessee River Valley indicate the probable differentiation of the Eutaw sands and laminated clays from the subjacent Tuscaloosa gravels in Trigg County, Kentucky, and further, the occurrence of laminated sands and clays of Eutaw age in the vicinity of Riverview, a point some five miles above Paducah on the Tennessee River in McCracken County, Kentucky.

During the fall of 1919 and early spring of 1920, the writer, in the course of a general reconnoissance of a part of Western Kentucky, found occasion to traverse that section lying between the Cumberland and Tennessee Rivers from Grand Rivers southeastward across southwestern Lyon and Trigg Counties into Stewart County, Tennessee. Particular attention was given to the position and character of the deposits of sands and gravels. Some localities referenced in the literature were visited

---

¶Stephenson, Lloyd William, The Cretaceous-Eocene Contact in the Atlantic and Gulf Coastal Plain, U. S. G. S., pp.90-J; and geologic map, p. 157, 1915.

**Willis, Bailey Index to the Stratigraphy of North America, U. S. Geol. Survey, p. 71, and geological map, pp. 654-660. Chart of Correlations, opp. p. 654, Washington, 1912.

†Berry, Edward Wilber, Upper Cretaceous Floras of the Eastern Gulf Region in Tennessee, Mississippi, Alabama and Georgia. U. S. Geol. Survey. Prof. Paper 112, pp. 13 and 31; and attached geologic map, 1919.

‡Miser, Hugh D., Mineral Resources of the Waynesboro Quadrangle, Tennessee. Tenn. Geol. Survey, Bull. 26, 1921.

***Wade, Bruce, Recent Studies of the Upper Cretaceous of Tennessee. Tenn. Geol. Survey, Bull. 23, p. 58, 1920.

and lithological and altitudinal comparisons were made. It was found that certain persistent gravels of this region, sometimes conglomeratic, exhibiting generally well rounded quartz pebbles, and not infrequently subangular cherty pebbles, checked closely with those which were regarded as belonging to the Tuscaloosa formation in Stewart County, Tennessee. Above these gravels certain deposits of sands and their laminated clays occur at isolated points. These seem to be similar to the sands of Stewart and adjoining counties which have been referred to the Eutaw formation.

If these comparisons be accurate the Upper Cretaceous is represented in Lyon and Trigg Counties, Kentucky, by remnants of these two basal members of the Upper Cretaceous, the Eutaw and Tuscaloosa formations. Taken together these sediments cover a considerable area "in between the rivers" extending as outliers in a northwest direction, possibly as far as the Ohio River. While the lack of good topographic and county base maps for the entire area involved has rendered a comparative determination of the age of these unconsolidated deposits difficult, and to a degree uncertain, it has not operated to obscure the importance of the Northeast extension of these Cretaceous sediments into Western Kentucky. Assuming that these sands and gravels are a unit erosional outlier their thickness and relatively high topographic position plainly indicate a former broad and continuous extension of the Upper Cretaceous lagomal sea to the northeastward in Kentucky very possibly as far as the perifery of the western coal field. Detailed mapping in eastern Trigg, Caldwell, Crittenden and Livingston counties may some day indicate smaller outliers of these sands and gravels of Cretaceous age and substantiate the premises. This being the case the northward migrations into Kentucky of the Cumberland and Tennessee Rivers over Upper Cretaceous sediments, for whatever structural or other causes, must have been effected subsequently to the uplift of these sediments during Tertiary time, probably since the withdrawal of the marine waters of the eocene.

Some Observations in the Life-history of the Praying Mantis: Miss Mary Didlake, Kentucky Experiment Station.

Two species, the common *Stagmomantis carolina* and a big

Chinese one, *Tenodera sinensis,* were carried through several generations in as many successive years, reared in the laboratory, individuals being kept separate, at first in homeopathic vials, then in 4-ounce, wide-mouthed bottles and finally in 6-inch stender dishes. Hatching, molting, regeneration of limbs and antennae, mating, egg-laying, all were frequently observed and recorded. It was found possible to distinguish the sexes after the first molt and with certainty after the second. The native species required about 80 days to become adult, males commonly molting only 6 times and females usually 7 times. The Chinese species averaged 78 days to adult emergence and both sexes molted 7 times, a few individuals requiring 8 molts.

Materia Prima: Rev. E. L. Van Becelaere, Cardome.

The medieval conception of the "Materia Prima" may appear thoroughly superseded by the discoveries of modern chemistry; however, such a conception, if properly understood, finds a confirmation in them rather than a disproof. The possession of a similar order of fundamental properties by each one of the elements recognized by modern chemistry, in spite of the differentiations peculiar to each of them, reveals one substratum common to all, although diversified in each one. That substratum is the "Materia Prima" accessible only to the mind, yet real and existing in each of the elements.

Some Interesting Fungi of the Kentucky Mountains. The Lichens of Cowbell Hollow: G. D. Smith, Eastern Kentucky State Normal School.

Nearly 100 excellent lantern slides in natural colors, prepared by the author, were exhibited and explained, illustrating fungi and lichens observed.

The Value of Memory Systems: J. J. Tigert, University of Kentucky.

An experiment is described with a class of 45 students in psychology. The test consisted in having the class memorize an extract from Keats, before studying the memory system, reproducing the words and ideas after three minutes and repeating the same process with a similar extract after studying the system. The result was negative.

A New Phyllopod Crustacean from Kentucky: By Harrison Garman.

The second crustacean to which attention is directed is a so-called fairy shrimp, once very numerous in early spring in the spring fed pools of Bluegrass Kentucky, now becoming scarce because of changed conditions. It is a near relative to the *Eubranchipus vernalis* of Eastern States, but quite different in the frontal appendages of the male, as will be apparent from figures of each presented. In all probability it will become extinct in course of time and on this account it seems worth while to call attention to it. In its habits it agrees with other species described from the Middle States, appearing while the water is ice cold in February or March, reaching maturity in April or May according to the forwardness of the season, then disappearing completely but leaving its eggs each spring in the mud of the stream beds, as the pools more or less completely dry out. When the pools fill again a new annual brood appears.

Excessive droughts exposing the soil for long periods to the hot sun appear to be the cause of the disappearance of these interesting crustaceans.

Eubranchipus neglectus, n. sp. Male with very strong large first antennae, measuring 7 millimeters across the bases from side to side, the slender distal portions turned forward between their bases and measuring about 4 millimeters in length, each laminate along one side and with a small oval expansion at the tip. Frontal appendage but little longer than the basal segment of the second antenna, broad, blunt, or obtusely angulate at the tip, where it lacks marginal serrations; one side evenly serrate nearly to the tip; opposite side provided with about nine long, fingerlike lobes; surface roughened with small tubercles and transversely grooved; length 1.71 mm; diameter 1.28 mm; Second antennae slender, the proximal segment measuring about 1.57 mm. in length; the second segment about 1.14 mm. Caudal appendages stout at base, gradually tapering, heavily fringed with plumose hairs along the sides; about 5 mm. in length, the hairs about 1 mm.

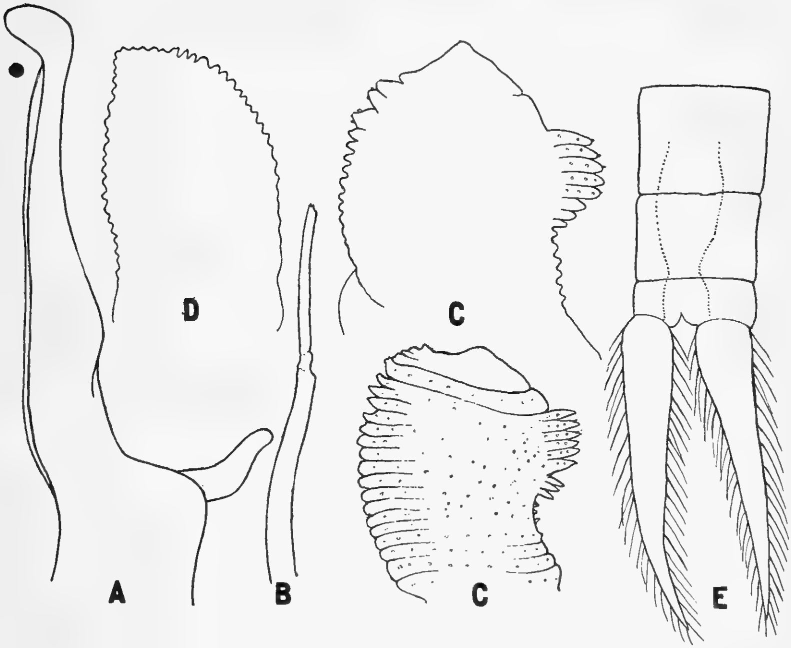
Female more slender. Ovisac measuring 2 mm. in width and

1.50 mm. in length. Genital dart slender, tapering, acute, one margin with minute retrorse denticles.

The sexes of the Kentucky species are easily distinguished by their colors. Males are much paler in the main, yellowish white, the conspicuous eyes deep blackish brown, the caudal appendages purple with white fringes. The female is the brilliantly colored sex. The front is sometimes touched with blue. The appendages of the body are either fuscus purple, or in the main yellowish with purple toward the bases. Egg pouch greenish at the sides dorsally, buffy yellow ventrally; the eggs, green at first, are kept rolling from side to side by the motion of the part to which they are attached. Abdomen touched with purple along each side, blue ventrally; caudal appendages as in the male, purple with white fringes.

A male taken March 10, measured 21 mm. in length; a female taken at the same time measured 26 mm.

In *Eubranchipus vernalis* from New England the frontal appendages of the male are relatively slender, lanceolate measuring 1.74 mm. in length by 0.65 mm. in width and quite regularly serrated along both margins from base to tip. The first antennae are like those of the Kentucky species in general shape, but are smaller, measuring 5 mm. across the bases and the slender distal part commonly extends backward instead of forward. The caudal appendages also are shorter. The small size of the frontal appendages and their bluntness and lack of serrations at the tip distinguish the Kentucky crustacean from *E. ornatus* and *E. dadyi*.



Explanation of figure:

A Distal segment of first antenna of male *Eubranchipus neglectus;* B. second antenna of same; C. C. outlines of frontal appendages of *E. neglectus*, from camera lucida sketches; D. outline of frontal appendage of *E. vernalis* from camera lucida sketch; E. Posterior somites and caudal appendages of *E. neglectus.*

A Little Known Cave Crayfish: By Harrison Garman.

Scattered references to crayfishes with developed eyes appear in the literature relating to cave animals, the authors having generally assumed that the individuals they observed had been the victims of chance, and would return to surface waters as soon as an opportunity was afforded them. There is nothing in the relation of our surface and subterranean streams to prevent at all times this passage of aquatic animals from one to the other. The underground channels and the dry parts of the caves themselves, in fact, are largely produced by the dissolving and eroding action of streams, at one time continuous with and constituting a part of the systems at the surface. The surface streams have in course of time cut their beds to lower levels and have in consequence become disconnected a part or all of the time from some of the underground channels.

When the water rises in winter or spring, however, underground channels partly or wholly empty during the summer, become filled again as they were originally. At such times the movement of animals from surface to underground streams, or the reverse, is unhindered. Animals adapted to these different conditions are not, however, disposed to take advantage of the opportunity, apparently recognizing the fact that they would be at a disadvantage as a result of the change. But in some instances they are caught in powerful currents and carried against their will either into or out of caves. Such individuals we know return to their normal habitats whenever they can, and a rather prolonged observation of cave animals and of light loving species in cave regions shows that the two faunae are somewhat sharply delimited by the nature and structure of their members, the true cave species never venturing voluntarily far into the light and surface water species showing a similar aversion to the darkness of the caves.

There is, it is true, an intermediate fauna living in partial darkness near the mouths of caves, but it is made up largely of species that habitually lurk under the banks and in deep holes of surface streams, and while it is interesting as indicating a probable course taken by species in becoming adapted to a cave existence, its members show little more disposition to go into the deeper parts of caves than those commonly living in bright light.

All of the eyed crayfish observed by the writer in caves during the past thirty years have proved to belong to one species. It is different in a number of features from the blind species (*C. pellucidus*). Its eyes are small, but evidently pigmented. The exoskeleton is deficient in pigment, but not completely devoid of it. Its general conformation is different, and some of the appendages of the male commonly depended on for the discrimination of these species, are so unlike as to place it in a different section of the genus Cambarus. Comparison of the two soon suggests that the immediate relationship must be sought in other directions.

It is of very great interest, notwithstanding, as a species in process of losing its eyes. It is already completely at home in our caves, living and breeding there at all times, but coming to the outlets of subterranean streams in the spring of the year, sometimes when the soil is saturated and the channels all filled, emerging thru holes in the bottoms of quarries and sinkholes in large numbers. On such occasions fine lots have been secured at Lexington, enough at times for use with classes in zoology. They retreat again beneath the surface as soon as these freshets subside. At other times only a few small individuals are to be found near the outlets of underground streams, while adults with eggs are only secured far beyond the reach of light.

Early explorers of caves referred the eyed crayfish observed by them in caves to a common and widely distributed surface water species *Cambarus bartoni,* but while the latter is a very variable species, the eyes of all those examined are much larger than those of this cave species, the general conformation different, the amount of pigment in the exoskeleton greater. Some of the features of the cave species might be assumed to be the direct effect of absence of light on individuals transferred to the caves but what we know of heredity implies that no such sudden reduction in the size of eyes occurs, and further that such an effect if it resulted, would not be transmitted to offspring, whereas the young found in the caves have the same small eyes and other peculiar features of the adult.

As a possible source from which the cave species is derived, chimney-making crayfish with small eyes have been closely compared with it. They belong to the same section of the family and are thus more closely related by structure with it than is the blind species (*C. pellucidus*) of Mammoth Cave. One of them (*C. diogenes*) occurs in Kentucky, yet has not so far as I know been observed in caves. The other (*C. dubius*) is West Virginian, and resembles our cave species in many respects, yet comparison with examples kindly loaned for the purpose from the National Museum collection shows it to be quite distinct.

W. P. Hay has described what is doubtless this species as *Cambarus bartoni* var. *tenebrosus,* basing his description on specimens obtained in Mammoth Cave. His types in the National Museum were compared with specimens from Bluegrass Kentucky recently and proved to be identical. In all probability some of the older references to *Cambarus bartoni* as occurring in Kentucky are based upon this small-eyed species, found near the outlets of underground streams, instead of typical *Cambarus bartoni,* for it appears that thru much of the region occupied by the cave species typical *C. bartoni* does not occur. It has not been seen for example in Bluegrass Kentucky. Unquestionable examples have however, been collected from springs in Carter County.

The surface of this crayfish is exceptionally smooth everywhere, a very alight roughness being apparent only on the sides of the carapace. The cephalothorax is peculiar in being more elongate, the sides more nearly straight and the dorsum more decidedly flat than in any other crayfish known to me. The nearly parallel sides are suggestive of the blind crayfish of our caves. The areola also partakes of this character, the sides being very nearly parallel and longer than in *C. bartoni* and *C. dubius.* The abdomen is broader in both male and female than in *C. dubius* approaching more nearly that of *C. bartoni.*

The forceps of the first pair of walking legs are large, smooth, rather slender in some examples, broader in others, but not so broad relative to their length as either *C. bartoni* or *C. dubius.* The movable finger is long, and tapers gradually. The claws are not depressed as in *C. dubius,* the first abdominal legs are of the *C. bartoni* group type, but the outer ramus is very thin and bladelike, its tip excised, its outer face striated. As a good species the subterranean crayfish may be described from material collected at Lexington, as follows:

Cambarus tenebrosus.—Smooth and glossy, with no very evident granulation of the surface of the carapace , a minute roughness only being visible under a magnifer on the ventral anterior part of the sides. Carapace with a characteristic elongation, the sides nearly parallel, the back decidedly flattened both anterior to and posterior to the cervical groove. Groove rather shallow. Areola of moderate width, the sides disposed to be parallel, but curved slightly inward. Antennal scale broad, truncate, the spine short. Rostrum moderately short, broad, converging to the acumen; no decided lateral angles; tip of acumen upturned. Epistoma apiculate in front and bluntly at base of each side; as broad as long. Postorbital ridge, grooved, without terminal spine, the groove cutting through at the tip. No decided angle behind the base of the antenna. Sides of carapace without spinules. Eye very small, much smaller than that of *C. bartoni,* being more like that of *C. diogenes* and *C. dubius.* Flagellum of antenna as long as the body to the base of the last segment. First pair of forceps large, long, often rather slender, but variable in width in both sexes. First pair of abdominal appendages of male with two blades curved backward, the posterior almost acute at tip, the anterior slightly cut out at tip, thin, blade-like and striated. Ventral annulus of female open in front and tending to be unsymmetrical. The color of living examples is dull olive green, varying to pale bluish, with obscure dusky mottlings.

With one exception, all of the large male individuals of *C. tenebrosus* examined are of Form 1. The exception, taken in 1913, measures 105 mm. in length. The first abdominal appendages are very much like those of *C. bartoni,* Form 1. Both rami are blunt pointed, the inner rather thick at the tip. The anterior forceps of this individual are noticeably long and slender (45.4 mm. by 15.8 mm), a feature sometimes observed in large individuals of Form 11.

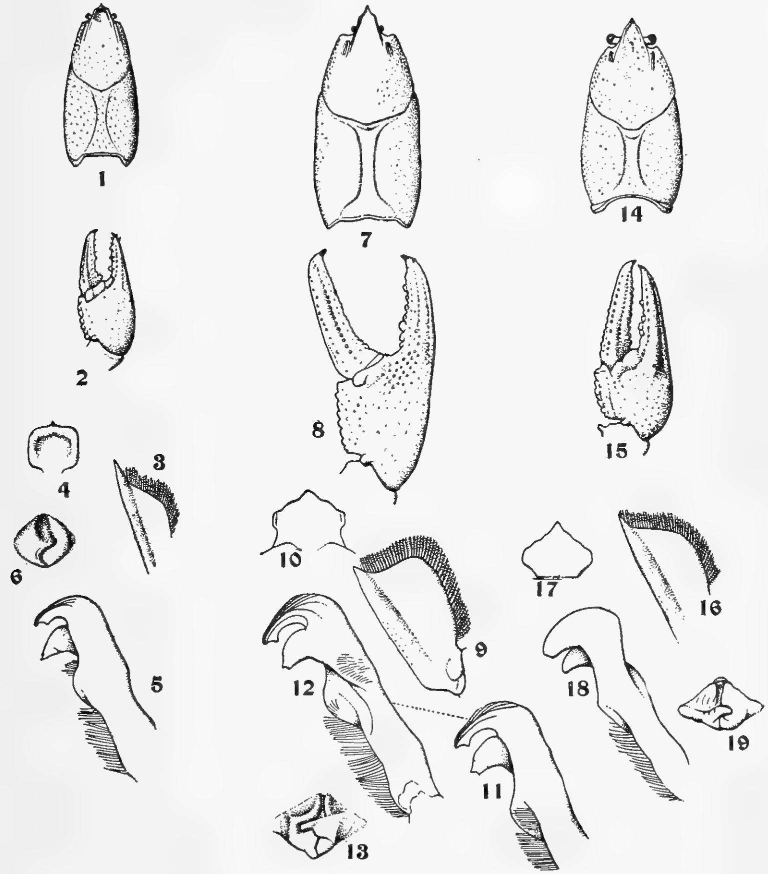
C. tenebrosus suggests the blind *C. hamulatus* from Nickajack Cave, Tennessee, as described and figured by Doctor Faxon and others. I have not seen this species, but judge that the Kentucky crayfish is intermediate in some of its characters between it and *C. bartoni.*

Measurements of several examples of *C. tenebrosus* are given below, together with others from *C. bartoni,* var *robustus,* and *C. dubius.* My thanks are due to Dr. Ruthven Dean, of the University of Michigan, for the opportunity to examine the former. The species received from him were collected in Big Creek, Oreada County, Michigan.

My thanks are due also to Doctors Harriet Richardson and Mary J. Rathbun of the U. S. National Museum for the privilege of examining the two specimens of *Cambarus dubius* collected in

Barrenshe Creek, West Virginia, and identified by Dr. Faxon, the describer of the species. It is much smaller and very different in many ways from either *C. bartoni* or *C. tenebrosus.*

After the above was written two examples of *C. bartoni* regarded as typical of the species were received for examination from the United States Museum. One of them (No. 44385, U. S. Nat. Mus., a male of Form 11) from Union Ridge, Maryland, approaches the Kentucky species more closely than any other I have seen in the width of the areola (2 mm with a length of body of 72.4 mm). Yet its eye is perceptibly larger as compared with specimens of *C. tenebrosus* of the same size; the angle behind the base of the antenna is decided; the rostrum is more extensively excavated; the sides behind the cervical groove are decidedly rounded. A female *C. bartoni* (No. 13964, U. S. Nat. Mus.) from Wytheville, Virginia, measures 86.8 mm. in length and has a wide areola 3.6 mm), being more nearly like those of other examples studied.



Explanation of Figures:

1. Cephalothorax of *C. dubius,* showing broad, blunt, deeply excavated rostrum; 2, anterior forceps of same; 3, antennal scale of same; 4, epistoma of same ; 5, anterior abdominal appendage of male of same; 6, ventral annulus of female of same.

7. Cephalothorax of *C. tenebrosus,* showing straight sides, and small eyes; 8, anterior forceps of same; 9, antennal scale of same; 10, epistoma of same; 11, 12, anterior abdominal appendage of male of same; 13, ventral annulus of female of same.

14. Cephalothorax of *C. bartoni,* var. robustus, showing rounded sides, broad areola, and large eyes; 15, anterior forceps

of same; 16, antennal scale of same; 17, epistoma of same; 18, anterior abdominal appendage of male of same; 19, ventral annulus of female of same.

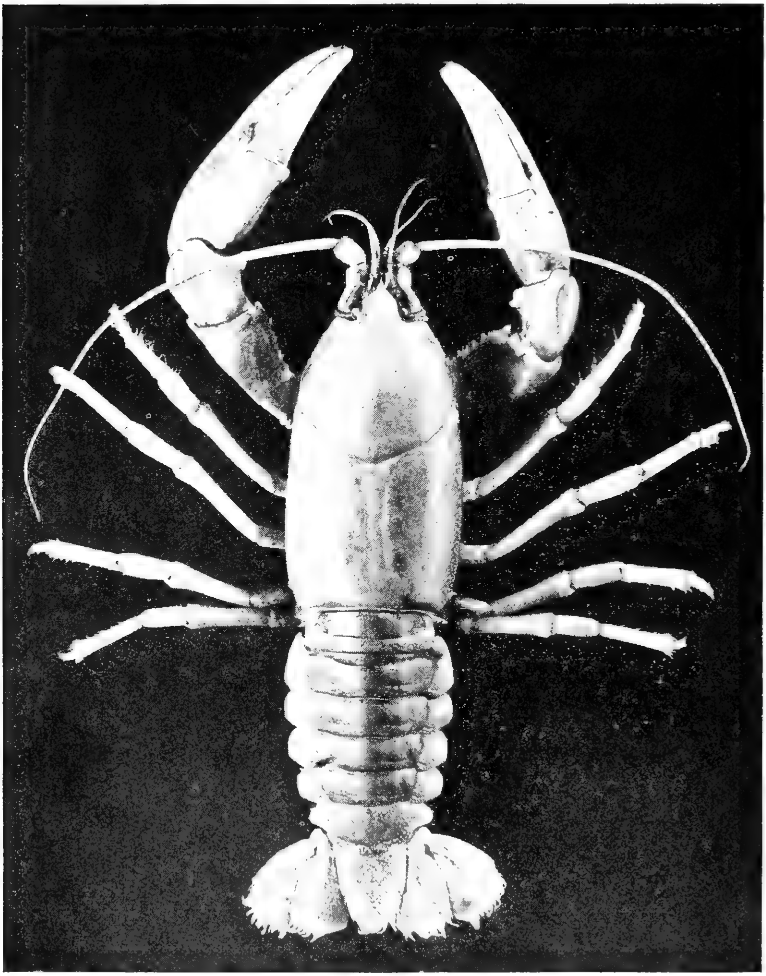


Figure 20. From a photograph of *Cambarus tenebrosus*. Natural size.

Studies in the Etiology of Infectious Abortion in Live Stock: E. S. Good, Kentucky Experiment Station.

Bacillus abortus Bang is the organism causing the disease in the cow, in the United States, the same as in foreign countries. In 1911, a bacillus was isolated at the Kentucky Station from an aborted foal which we placed in Sub-group 2 of the Colon-typhoid group, which was found to be the cause of the disease in mares and jennets in Kentucky. Since that time, this germ has been found to be the causative agent of the disease in different states of this country, also in Canada, Holland and Sweden. Our results in immunizing mares against the disease are encouraging. Our investigations, so far, show that the *Bacillus abortus* Bang is the causative agent of the disease in sows.

Mineral Constituents of the Paired Seeds of Cocklebur: J. S. McHargue, Kentucky Experiment Station. See Ecology, Vol. 2, No. 2, April, 1921, P. 110.

The impression is general that one of the two seeds of a cocklebur (*Xanthium*) will germinate the first spring after maturity and the second will remain dormant until the second spring thereafter. Previous investigators have attributed this apparent dormancy to inherent differences in the embryos and the seed coats. The writer finds that both seeds, if well devloped, will germinate at approximately the same time, if they are removed from the burs and planted in moist sand. If allowed to remain in the burs, only one seed germinates until the bur disintegrates and decays, when the second seed will germinate. The mineral constituents contained in the two seeds were found to be practically the same. The large seeds average about 65. mgs. and the small seeds about 45. mgs. The large seeds produce larger seedlings. This is accounted for by the fact that a large seen contains much more plant food than a small one.

Hydrogen Ion Concentration and Biological Reactions: D. J. Healy, Kentucky Experiment Station.

The fundamental importance of hydrogen ion concentration in the study of colloids, gels, enzymes and microbes was pointed out and illustrated by exhibits. An organic colloidal liquid at pH7.8 could not be past through a Pasteur-Chamberland F. bougie, but on adjusting the value to pH2, it passed easily. A 10 percent. bactogelatin at pH5 formed a perfect gel, but with acidity equal to N/2 HCl or alkalinity of pH10, there was no gel. The oxidase of raw potato or apple was quite active at pH1.7, as shown by change in color of slices exposed to the air, but when fresh slices were soaked 15 minutes in water adjusted to pH1 and pH1.4, respectively, they dried in the air, without material change of color. A bacillus isolated from the afterbirth from a mare grew readily on agar slants of pH6.8 but failed to grow on similar slants at pH6.4.

A Study of Inheritance of Coat Colors in Jersey Cattle: J. J Hooper, University of Kentucky. Bulletin 234.

Studies of inheritance of Jersey cattle coat colors by the author show that white spots are recessive to dominant solid color, and a white tongue and tail-switch also are recessive. Colors of 1,145 calves were tabulated and compared with those of their 2,290 sires and dams. Some bulls studied seemed to be pure dominants, as their calves were all solid in color, although as many as a hundred were sired by each bull. It was found that 66 per cent. of Jersey cattle are solid in color and have black tongue and switch, while 12 per cent, are broken and have white tongue and switch; 3.6 per cent. are solid and have white tongue and black switch, etc.

Animal versus Vegetable Proteins in the Ration of Laying Hens: J. Holmes Martin, Kentucky Experiment Station.

An experiment, now in its third year is described, in which 4 pens of 25 S. C. White Leghorn pullets, each, are being fed a basic ration of shipstuff and ground oats, supplemented by animal and vegetable protein carriers. The total egg production per pullet for the pen receiving buttermilk was 338 eggs; for that receiving tankage, 268; for that receiving tankage and cottonseed meal, 208; and for that receiving cotton-seed meal, 55. On reversing the rations in the cottonseed-tankage and cottonseed pens, the egg production was reversed, showing that the difference in production depended on the ration. All pens received oyster shell, grit and charcoal.

The Seed-corn Situation in Kentucky: W. D. Valleau, Kentucky Experiment Station.

Investigations carried on at the Kentucky Experiment Station indicate that practically all seed corn in the corn belt is infected with Fusarium moniliforme Sheldon, and that this organism is capable of causing a root and stalk rot of corn. Infection on an ear appears not to be localized. Slightly infected seed may show no signs of infection, if grown only for a period of seven or eight days. Reddish discolorations developing in the seed coats during germination are an indication of infection. Seed studied was obtained from Kentucky, Georgia, Mississippi, Tennessee, Kansas, Arkansas, Missouri and Minnesota.

Veterinary Science: W. W. Dimock, Kentucky Experiment Station.

The author stressed the pressing necessity for research upon the nature and causes of diseases in live stock. He showed that the future of animal industry depended upon the control of animal diseases and that control can be secured only after the cause is known. He cited as an example the need for exact knowledge of the life histories of the internal parasites known as nematodes and showed how extensive are their ravages in horses. He believes that here, in their life history and in their effect on the host, is a field holding great promise to the investigator.

Notes on the Rapid Analysis of Magnesian Limestone: S. D. Averitt, Kentucky Experiment Station. See Journal Ind. and Eng. Chem. Vol. 14, No. 12, P. 1139, Dec., 1922.

A differential method for the analysis of relatively pure magnesian limestone, without an actual determination of either Ca or Mg, which is quite rapid and sufficiently accurate for agricultural and most other purposes, is described. Determinations to be made are, A, neutralizing power of the limestone against N/2HCl, expressed as $CaCO_3$; B, weight of insoluble matter $+NH_4OH$ precipitate, from the same portion. Then

$$100-B=\%\ CaCO_3+MgCO_3,$$

and

$$5.35\ (A-(100-B)\ )=\%\ MgCO_3.$$

Notes on Light and Light Pressure: C. C. Kiplinger, Mt. Union College, Alliance, Ohio.

Some evidence is presented indicating that mass is not a universal property of light and certain photochemical absorption experiments are described which show no measureable increase in weight of the reagents, following the action of light.

Experiments with Lime, Acid Phosphate and Soil Fungicides on Land Infested with Root-rot Disease of Tobacco: G. C. Routt, Central Experimental Farm, Ottawa, Canada.

Experiments are described looking to the possible control of the root-rot disease by applications of lime, acid phosphate, mixtures of lime and sulphur, dilute sulfuric acid, land plaster, copper sulfate, potassium polysulfid, gas lime, ferrous sulfate and formaldehyde. Acid phosphate seemed to be very beneficial in some instances, as did sulfuric acid, but the majority of the experiments gave negative results. The author concludes that the disease can not be controlled in this way.

Plant Growth: G. D. Buckner, Kentucky Experiment Station.

Comparative study was made of the translocation of the ash, phosphorus, calcium and magnesium from the cotyledons of germinating garden beans. Phaseolus vulgaris, when grown in distilled water culture and in garden soil. In the distilled water culture 55 per cent. of the original ash, 57 per cent. of the phosphorus, 25 per cent. of the calcium and 59 per cent. of the magnesius was translocated to the seedling, while, in the seedlings grown in garden soil, 91 per cent. of the ash, 92 per cent. of the phosphorus, 78 per cent. of the calcium and 83 per cent. of the magnesium was utilized by the seedling. The abnormal condition caused by the distilled water culture is shown and that less calcium than any of the other elements studied was removed from the cotyledons by the growing seedling is suggestive of its insoluble form in the cotyledons and its structural function.

"The Twentieth Century's Contribution to our Knowledge of the Atom", Dr. R. A. Millikan, University of Chicago.

The physics of the last 20 years may be characterized as the physics of atomism. Ten important discoveries of this period bearing upon our knowledge of the atom are enumerated. (1) Einstein's mathematical analysis of the Brownian movement and the experimental demonstration by physicists of its correctness, affording direct experimental proof of the atomic theory. (2) The proof of the divisibility of the atom which grew out of the discovery of X-rays. (3) The discovery of radioactivity. (4) The discovery of the atomicity of electricity; i. e., that electricity is made up of a definite number of "specks of electricity", all exactly alike, and an electrical current is simply the passage of these "electrical specks" along a conductor. The speaker explained his method of demonstrating this. (5) The discovery of evidence for the electrical origin of mass. (6) The discovery of the nucleus atom. (7) The discovery of the nature of X-rays, by Barkla. (8) The discovery of crystal structure by means of X-rays, due to Laue, in Munich and Bragg in England. (9) Moseley's discovery of the relation between the radiations given off by different elements when acted upon by X-rays. (10) The discovery of quantum relations in photo-electricity, in X-rays and in optical spectra. The lecture was along the same lines as that by Dr. Millikan on "Twentieth Century Physics", Smithsonian Report for 1918, pp. 169-184.

The Auditing Committee reported that they had examined the Treasurer's statement and found it correct. The report was adopted.

The Resolutions Committee reported as follows:

"RESOLVED, that the Kentucky Academy of Science hereby accepts the terms of affiliation with the American Association for the Advancement of Science and directs the Council to take such steps as may be necessary to put such affiliation into effect.

"It is the sense of this Academy that two classes of members should be provided for: First, *Local Members*, those who belong to the Academy alone; and second, *National Members*, those who belong both to the American Association and to the Kentucky Academy."

(Signed) G. TERRELL, Chairman.

This involves the payment of $5.00 per year for membership in both Societies, $1.00 of which is to go to the Academy and $4.00 to the A. A. A. S., voted on and adopted.

"RESOLVED, that at future meetings of the Academy the number of papers be restricted and some time be given for the discussion of each paper."

(Signed) G. TERRELL, Chairman.

This was referred to the Council.

Prof. Miller made various suggestions in this connection.

"RESOLVED, that the Publications Committee take steps to provide for the publication of papers read or submitted by members of the Society."

(Signed) G. TERRELL, Chairman.

Voted on and adopted.

"RESOLVED, that it is the sense of this Society that we co-operate with the A. A. A. S. in the preservation of such natural features and curiosities in Kentucky, or in that territory which may seem best, as they may consider most worthy of preservation."

(Signed) G. TERRELL, Chairman.

Voted on and adopted.

A vote of thanks as given to Dr. Peter for his services as Secretary.

The Nominating Committee then made its report and the following officers for the ensuing year were elected by unanimous vote:

For President ....Prof. W. H. Coolidge, Centre College, Danville.

For Vice-President...Prof. George D. Smith, Richmond, Ky.

For Secretary.....Dr. A. M. Peter, Experiment Station, Lexington.

For Treasurer...Mr. J. S. McHargue, Experiment Station, Lexington.

Then followed the principal speaker of the day, Dr. R. A. Millikan, of the University of Chicago, whose subject was "The Twentieth Century's Contribution to our Knowledge of the Atom."

At this point President Coolidge took charge of the meeting.

A vote of thanks was given to Dr. Millikan for his scholarly address.

It was moved, seconded and passed that Dr. Millikan be made an Honorary Member of the Academy.

The meeting then adjourned.

(Signed) ALFRED M. PETER, Secretary.

MINUTES OF COUNCIL MEETING, JUNE 14TH, 1920

The Council met June 14, 1920, in Dean Boyd's office. Present; Messrs. Coolidge, Boyd, McHargue and Peter. Absent: Geo. D. Smith.

President Coolidge appointed the following committees: Membership: G. D. Buckner, Chairman; C. D. Lewis and J. S. McHargue. Publications: P. P. Boyd was appointed in addition to Messrs. Coolidge and Peter who are members under the constitution.

Legislative: C. A. Shull, Chairman; R. C. Ballard Thruston and Lucien Beckner.

It was ordered that the Academy of Science dues be payable in advance, October 1st of each year, to conform with the time of collecting annual dues of the A. A. A. S., and that the Secretary send out bills for the 1921 dues on October 1st, 1920, and that he make suitable arrangement for collecting the A. A. A. S. dues at the same time the dues for the Academy are collected. In this connection it is noted that the A. A. A. S. will remit to the Academy $1.00 per member for all Academy members of the Association who have paid 1920 dues to the Association, according to the letter of the permanent secretary, Burton E. Livingston, of May 19, 1920.

Upon motion of Dr. Boyd it was ordered that the Secretary prepare a printed circular, including a letter of President Coolidge, for the purpose of instituting a campaign for membership in the Academy and that the Secetary obtain a list of industrial plants from Prof. May and a list of science teachers in colleges and high schools from Prof. Gillis, to which the circular and other matter should be sent, but he advised that the letter be not sent to educational institutions until some time in September, after vacation.

The following proposed amendment to the constitution was approved, to be submitted to the membership in time for the next annual meeting:

Article III, paragraph 2, to read:

"Active members shall be persons who are interested in scientific work and are residents of the State of Kentucky. They shall be of two classes, to-wit: National members, who are members of the American Association for the Advancement of Science as well as of the Kentucky Academy of Science, and Local Members, who are members of the Kentucky Academy but not of the Association. Each active member shall pay to the Secretary of the Academy an initiation fee of one dollar, at the time of election. National members shall pay to the Secretary of the Academy an annual assessment of six dollars, payable October first of each year, four dollars of which shall be transmitted by the Secretary of the Academy to the Permanent Secretary of the Association, and two dollars shall be turned over to the Treasurer of the Academy. Local members shall pay an annual assessment of two dollars, payable October first of each year."

There being no further business, the meeting adjourned.

(Signed) ALFRED M. PETER, Secretary.

MINUTES OF COUNCIL MEETING, OCTOBER 5, 1920.

By unanimous agreement of President Coolidge and Messrs. Boyd and Peter, but without a formal meeting, it was decided to accept the resignation of treasurer J. S. McHargue who is taking a year's post graduate work at Cornell, and Prof. C. A. Shull of the University of Kentucky was appointed to fill the position of treasurer.

Dr. Shull was authorized to purchase for the Academy fifty reprints of an article entitled "Preserves of Natural Conditions" by Prof. Victor E. Shelford of the University of Illinois, for distribution among the membership of the Kentucky Academy in the interests of the work of the American Ecological Society and the A. A. A. S. referred to in a resolution passed at the last annual meeting. It was suggested that the name of the Kentucky Academy should appear on the covers if this can be arranged.

(Signed) ALFRED M. PETER, Secretary.

MINUTES OF COUNCIL MEETING, NOVEMBER 13, 1920

The Council met in Dr. Boyd's office—present Messrs. Coolidge, Boyd, Shull and Peter. Absent, G. D. Smith.

Dr. Peter turned over to Dr. Shull, the new Treasurer, the treasurer's books, together with his personal check for $82.90 to cover the balance of money on hand, and a check for $5.00 from P. E. Karraker for National Membership.

After some discussion about selecting a distinguished scientist to address the annual meeting, the council adjourned.

(Signed) ALFRED M. PETER, Secretary.

VIII.

MINUTES OF THE EIGHTH ANNUAL MEETING

The eighth annual meeting of the Kentucky Academy of Science convened in the Physics Lecture Room, University of Kentucky, at 9:30 o'clock A. M., on Saturday, May 14, 1921, president W. H. Coolidge presiding. Present, about 60 persons.

The President called for reports.

SECRETARY'S REPORT

In accordance with the resolutions passed at the last annual meeting of the Academy accepting affiliation with the American Association for the Advancement of Science the Council ordered that dues be payable in advance on October 1st of each year, thus making the fiscal year of the Academy coincide with that of the Association. Notices to this effect have been sent to all members and collections have been made accordingly. We now have 44 national members and 55 local members, making a total of 99 active members, 24 of whom are in arrears for one or two years' dues. The result of the affiliation with the American Association has been a distinct increase in the number of our members who belong to both organizations. We would like to see the proportion of national members increase so as to include practically all our membership. On the other hand, the Association list shows 27 members in Kentucky who do not belong to the Academy. All these should become members of the Academy and an invitation to join and attend this meeting has been sent to each.

Of the 25 persons nominated for membership at the last meeting, 23 paid their initiation fee and became active members of the Academy. We have lost one member by death, Hon. John D. White, of Louisville, who died in January, 1920. Ten members have been dropt from the list either for non-payment of dues or because of removal from the State.

The total membership is 127 and may be classified as follows:

Regular members in good standing..............	75
Regular members in arrears for dues............	24
Corresponding members	21
Honorary members	7
	127

The Secretary has sent three notices to each member in arrears. It is important that back dues be paid at this meeting, because all who are in arrears for two years will be dropt from the list of members, after the meeting, as provided in the by-laws.

Of the 37 different lines of activity represented, chemistry leads again with 26 members, followed by physics with 11, geology with 10, agriculture and agronomy with 8, mathematics and biology with 7 each, bacteriology with 6 and all the others with from one to four members each.

A broad classification might be made into:

Physical and mathematical sciences, including chemistry...	64
Biological sciences	48
Philosophical and educational sciences....................	15
	127

Classified geographically and as to educational institutions our active membership is as follows:

53 from the University of Kentucky, Lexington,
5 from the University of Louisville, Louisville,
4 from Centre College, Danville,
4 from Georgetown College, Georgetown,
2 from Berea College, Berea,
1 from Cardome, Georgetown,
1 from the College of Pharmacy, Louisville,
1 from the Western Kentucky State Normal School, Bowling Green,
1 from the Eastern Kentucky State Normal School, Richmond,
1 from Cumberland College, Williamsburg.

Not connected with educational institutions in the state are:

10 from Louisville,
4 from Lexington,
4 from Frankfort,
1 from Winchester,
1 from Bowling Green,
1 from Newport,
1 from Jenkins.

Four active members are temporarily out of the state.

Abstracts of papers presented at the last meeting were forwarded as usual to "Science" for publication and appeared in that Journal under date of July 9, 1920.

Upon request of the National Research Council, the Secretary sent an account of the organization and activities of the Academy and a list of members.

President Coolidge appointed the following committees at a council meeting on June 14, 1920:

Membership: G. D. Buckner, Chairman; C. D. Lewis and J. S. McHargue.

Publications: P. P. Boyd was appointed in addition to Messrs. Coolidge and Peter who are members under the constitution.

Legislative: C. A. Shull, Chairman; R. C. Ballard Thruston and Lucien Beckner.

Because of the absence from the state of Mr. J. S. McHargue, the Council of the Academy elected Dr. C. A. Shull treasurer, October 5, 1920.

Under the terms of affiliation with the A. A. A. S. the Academy is allowed a representative in the Council of the A. A. A. S. Such a representative should be elected at this meeting.

The constitution of the Academy should be amended to provide for this and any other changes required by the affiliation. The council of the Academy prepared such an amendment at a meeting on June 14th, 1920, but thru oversight the Secretary neglected to include it in the notice of this meeting, which prevents its being voted upon now, unless the resolution adopting the terms of affiliation may be construed as sufficient notice.

Of our 21 corresponding members, only one has ever sent a paper or attended a meeting, as far as the Secretary is aware, the several are interested enough to acknowledge receipt of programs and send good wishes. Your Secretary questions the advisability of carrying on our membership list indefinitely the names of those who are not interested. Perhaps we should add a provision to the by-laws for dropping the names of those corresponding members who have not been heard from in a stated number of years.

Respectfully submitted,
(Signed) ALFRED M. PETER, Secretary.

REPORT OF THE TREASURER FROM MAY 8, 1920, TO MAY 14, 1921

Charles A. Shull, Treasurer, in account with the Kentucky Academy of Science.

Receipts

May 8, 1920—Balance on hand	$ 21.84	
Initiation fees and dues	226.06	$247.90

Disbursements

Disbursements, including fees to the A. A. A. S.	153.00
Balance on hand	$ 94.90

The Membership Committee nominated 21 persons for active membership all of whom were duly elected.

The report of the Legislative Committee was read by Dr. C. A. Shull as follows:

Your Committee recommends the adoption of the following program for passage at the next meeting of the Legislature in 1922:

1—A law providing $1,000 for publication of the Proceedings of the Kentucky Academy of Science.

2—An increased appropriation for the hastening of the completion of topographic mapping of the State.

3—A request that a Soil Survey be begun, to follow as rapidly as possible the topographic and geological mapping of the State.

4—A law creating a Natural History Survey of the State, to center in the University, and to which all members of the Academy could contribute.

5—Legislation to provide a Natural History Museum, for preservation of the collections secured by the Natural History Survey. The museum should be located at the University, where students could make use of the results of the Survey collections.

6—A law to increase the teaching of Science in the High Schools of the State, and compelling Boards to appropriate more for scientific equipment.

7—A law establishing a prize to be given annually for research work, open to all competitors in Kentucky in every line of scientific endeavor, the recipient to be determined by a committee from the Academy of Science.

8—A law compelling each person or corporation drilling a well for oil or gas, or for other purpose to a depth greater than 100 feet, to file with the State Geological Survey a complete log of that well showing the formations gone thru, and a careful description of the location of the well so that it can be carefully mapped.

9—Endorsement of the law now before congress to make of Mammoth Cave and its environs, a national park.

10—An act enabling the State of Kentucky to acquire and set aside for the benefit of future generations, such areas as are deemed worthy of preservation in natural condition, for purposes of study and enjoyment of nature.

(Signed) CHAS. A. SHULL, Chairman.

The President then appointed the following committees:

Auditing Committee: A. M. Miller, Geo. D. Smith and E. S. Good.

Nominating Committee: P. P. Boyd, W. S. Webb, Henry Meier.

Two amendments of the constitution covering the affiliation with the A. A. A. S., as ordered at the Seventh meeting, were read by the Secretary and adopted as follows:

Article III, MEMBERSHIP, paragraph 2, to read:

"Active members shall be residents of the State of Kentucky who are interested in scientific work. They shall be of two classes, to-wit: National members, who are members of the American Association for the Advancement of Science as well as of the Kentucky Academy of Science, and Local Members, who are members of the Kentucky Academy but not of the Association. Each active member shall pay to the Secretary of the Academy an initiation fee of one dollar, at the time of election. National members shall pay to the Secretary of the Academy an annual assessment of five dollars, payable October 1st of each year, four dollars of which shall be transmitted by the Secretary of the Academy to the Permanent Secretary of the American Association for the Advancement of Science, and one dollar shall be turned over to the treasurer of the Academy. Local members shall pay an annual assessment of one dollar, payable October first of each year."

Article IV, OFFICERS, to read:

"The officers of the Academy shall be chosen annually by ballot, at the recommendation of a nominating committee of three, appointed by the President, and shall consist of a president, vice-president, secretary, treasurer, and councilor of the American Association for the Advancement of Science, who shall perform the duties usually pertaining to their respective offices. Only the secretary, treasurer and councilor shall be eligible to reelection for consecutive terms."

The following program was then rendered:

President's address: The Relation of Chemical Training to Industry: W. H. Coolidge. See Science, Vol. 54, No. 1399, p 367, Oct. 21, 1921.

An Experiment in Mental and Physical Correlation: J. J. Tigert, University of Kentucky, Lexington, Ky. By title.

Summary of the Thurstone Intelligence Tests for College Freshmen and High-School Seniors: Walter E. Ervin, Centre College.

The average of 58 freshmen tested was 83, ranging from 30-39 (one student) to 150-159. The author remarks that such tests are not conclusive as to the mental equipment of any boy or girl, but they are helpful by placing the student in the school with more fairness.

The Tragedy of the Passenger Pigeon: George D. Smith, Eastern Kentucky State Normal School.

The author described his observation of the wholesale destruction of the pigeons in their roosting place in a marsh, at night, by persons who came for miles around for this purpose, and hauled away the dead birds by the wagon load. This incident seems to have been one of the final stages in the extermination of the pigeon.

The Last Warning of the Rattler: George D. Smith, Eastern Kentucky State Normal School.

The paper describes a fight which the author observed between a diamond rattlesnake and a large blue racer. The fight was long and fierce and ended in the destruction of the rattler. During the fight the racer is badly bitten by the rattler, hastens to a patch of weeds and bites several of the weeds, sucking out the juice. He then hastens back to renew the combat. In the progress of the fight the juice of the weed was applied a second time and the racer rushed back to renew the fight as before.

Absorption in the Corn Grain: Charles A. Shull, University of Kentucky.

Orthogenesis in the Membracidae: W. D. Funkhouser, University of Kentucky.

The attempt to explain the remarkable developments of the pronotum in the family Membracidae by natural selection fails in the cases of the most bizarre and curious tropical forms. Poulton and others have suggested explanations based on protective coloration and mimicry which must be carried into the realm of speculation when applied to certain exotic species. Certain genera, including *Heteronotus, Centrotus, Pyrgonota* and *Spongophorus,* seem to show very regular pronotal development along definite lines when traced from the more generalized to specialized forms. This is particularly true of the length and position of the suprahumeral, dorsal and posterior horns. These developments seem in many cases to be entirely without regard to utility and even to threaten the existence of the species. In comparison with the classical example of the Irish elk, many species of Membracidae seem to show even greater evidence of orthogenesis.

The Progress of Kentucky in the Second Decade of the Twentieth Century: Edward Tuthill, University of Kentucky.

Kentucky Petroleum Problems: Lucien Beckner.

Kentucky offers many problems in petroleum geology which the consulting geologist and the geologist of the private company seldom have time to solve. The larger anticlines, the Cincinnati, north and south, and the Kentucky, east and west, present their peculiar characters that are not yet well understood. The author points out many problems which, could they be solved, would save the useless expenditure of thousands of dollars and probably result in the production of much wealth.

The First Food of Young Black Bass: H. Garman, Experiment Station, Lexington, Ky.

A study of the food by use of the microscope on the stomach contents of both large and small-mouthed black bass, taken from the State Hatchery pools at Forks of Elkhorn, Kentucky, showed that the dietary of both species during the first five weeks of their active lives consists of small crustaceans belonging to the orders Cladocera and Entomostraca, and of insect larvae belonging to the dipterous family Chironomidae. The percentages of the different kinds of food were determined, and, as far as practicable, an exact determination was made of the crustacean species most prevalent in the dietaries. The purpose of the study was to learn just what food was most relished and how it might be influenced artificially for the benefit of young fishes produced at the hatchery.

The Tolerance of Hogs for Arsenic: D. J. Healy and W. W. Dimock, Experiment Station, Lexington.

There is a popular belief that hogs are not very susceptible to arsenical poisoning and an examination of the literature failed to disclose a record of arsenical poisoning in hogs. The results of four tests made by administering arsenic trioxid are given. The total of 11 shoats received large doses of arsenic trioxid; in some cases the doses were enormous. Nine of the shoats received, in addition to the arsenic, hog cholera virus. One animal died from acute arsenical poisoning, one from acute cholera, and one from an undetermined cause. It would appear from these results that young hogs possess a marked tolerance for arsenic trioxid.

Growing Seedlings in Test-tubes with only Filter-paper Pulp and Distilled Water: Mary Didlake, Experiment Station, Lexington.

The lower third of a test-tube is filled loosely with crumpled strips of filter paper, enough water to cover the paper is added and the tube plugged with cotton and sterilized in the autoclav. Sterilized seeds may be dropped in and allowed to germinate and grow. Soybean, cowpea, garden bean, garden pea, Canada field pea, vetch, alfalfa, red clover, Japan clover, velvet bean, peanut, locust, acacia, corn, wheat, hemp, and morning glory have been grown successfully in this way. Plants will grow thriftily for a month or six weeks.

Effect of Frost and "Soil Stain" on the Keeping Quality of Sweet Potatoes: A. J. Olney, University of Kentucky.

When the vines were cut away before frost, only 4 per cent of the potatoes spoiled after storage at about 60 to 65 degrees F. When the vines were cut immediately after a freeze, no loss occurred. When the vines were cut 5 days after the freeze the loss was 88 per cent. Potatoes badly affected with soil stain (*Monilochaetes infuscans*) but otherwise sound, sustained a loss of 55 per cent, while healthy checks suffered a loss of 12 per cent. Potatoes wrapped with paper sustained a loss of 20 per cent., as against 12 per cent in those unwrapped.

Attempted Inter-species Crosses of the Genus Nicotiana: G. C. Routt.

Crosses were attempted among 7 species of Nicotiana. Of 911 flowers experimented with, 201 set seed. Only 4 of the 19 combinations proved fertile in both crosses and reciprocals, 4 proved fertile in one way only, and 11 proved infertile. Plants have not yet been grown from the seed obtained.

The Production of Antitoxin: Morris Scherago, University of Kentucky.

The method of producing diphtheria and tetanus antitoxin is described from the time the flasks of media are inoculated for the production of the homologous toxin until the antitoxin is ready for distribution. The factors influencing the potency of a toxin are discussed and the method of estimating the M. F. D. is outlined. The immunization of horses is discussed including the types of animals desired, preliminary treatment, dosage and time of injection. The time for taking trial bleedings and regular bleedings is indicated and the standardization of antitoxin is briefly discussed. The method of concentrating antitoxin is also described and discussed.

The Inefficiency of the Efficiency Expert: P. K. Holmes, M. D., Head of Department of Hygiene and Public Health, University of Ky.

Efficiency is the magic word today. It is caught up by every tongue. It is used most frequently and effectively in the business and industrial world. The head of the great business concern has to conduct the affairs of his great concern along approved lines of efficiency. There must be centralization of control; union to facilitate advantageous buying; stimulation toward increased production; methods for utilization of bi-products; constant improvement in the quality and quantity of goods turned out; lessening of waste; elimination of useless and time consuming steps and muscular efforts; the application of scientifically worked out rest periods to increase production by decreasing fatigue; shortening of hours and increase of pay to make employes more contented; the introduction of safety devices; and many other things for the sake of efficiency.

The whole keynote here is production—efficiency, the vision is focused only upon the product that is turned out, the "thing", and in the final analysis the money which the "thing" represents. In order to increase production mental and physical efficiency on the part of the employee must incidentally be increased.

The conception of such a well organized plan of efficient production and the capacity for putting it into operation comes from the master mind only. It is almost unbelievable to think that the master mind that conceives of high standards of efficiency fails completely to apply the same principles to the body containing the brain which initiated the original idea; in other words, our men of big business fail at the crucial point and apply the principles to the creation and not to the creator. It is safe to say that if our busy business men applied these principles to themselves they would be able, thru better health, to plan even more efficiently for others.

This plan of business efficiency will not permit of men who have to operate delicate and expensive machinery becoming incapacitated thru the effects of alcoholic poisoning. Quite a few heads of business concerns today are refusing to employ men or boys who use tobacco because indications point to a probable loss of working efficiency as a result of its use. It is probable that the person who largely depends upon coffee as an artificial stimulant to carry him thru his day's work is placing himself on a lower level of efficiency. The man with weak flabby muscles and shortness of wind cannot long meet the demands of manual labor. The man who is being continually poisoned as a result of chronic constipation which results in loss of mental keenness and physical endurance cannot efficiently sell the products created by the concern which employs him. The man who, thru keeping late hours, over indulgence in aimless amusement, excessive stimulation of the emotions, overdraws upon his bank account of nervous force, is thus incapacitated for doing his best.

These are some of the fundamental principles of business efficiency and repeated disregard of them by the employee means eventual loss of his position. But who is going to discharge the employer himself for falling below the standards of efficiency which he has set up for others? There is nobody to directly tell him that he will lose his "job" if he does not obey the "rules", but his business competitors who sometime will get this new conception, will force him out of his "job" in the keen struggle for business supremacy.

The average business man is probably not as clear a thinker and as enduring a worker by virtue of his natural endowments and observance of the laws of health as the average man he employs. The average man of big business does not have time to live according to the laws of health. Theoretically he thinks this important but practically he shows that it is not. The result is that he shortens his working life here, but lengthens it in the possible life elsewhere.

The average man of big affairs is one who has not paid much attention to the rules of health since he left college, if he happens to be a college man. He may have gone thru four years of strenuous athletics there, but has done nothing of that nature since. His big powerful heart has gradually deteriorated into a smaller and rather flabby muscle—a power engine of much less working capacity—his lungs, because of lack of normal exercise, have diminished in breathing capacity and power, but have increased in susceptibility to disease. His muscles are smaller and weaker because they have had comparatively little use. What would happen if he had to run half a mile at a fair pace to meet an emergency? In the first place he could not run that distance, but if he did attempt it he would be exhausted and perhaps seriously injured or possibly killed. There is no physiological reason why a man of forty or forty-five should not be able to safely and with positive benefit run a half mile or a mile at moderate speed. How many men can walk upstairs at a brisk pace to their office on the eighth floor without being out of breath for the next quarter of an hour He is very likely twenty or thirty pounds over weight, not of muscle or nerve or gland tissue, but of fat, and fat is an almost lifeless tissue—of no value in such excess—but a burden to carry as a pack on the shoulders of a civilian going about his daily work would be. Further, it is an indication of senility or premature old age and is so considered by the life insurance companies. Again the organs of elimination have not been kept up to the highest point of efficiency and the waste accumulations and poisons are not properly gotten rid of and he is fatigued and tired when he should not be. He who sits down all day in a luxuriously equipped office is often more tired at night than the employee who has been working hard on his feet all day in the machine shop or packing room. His appetite is poor; plain, coarse, wholesome food does not appeal to him. He must be tempted by delicacies or awakened by alcoholic stimulants. Any slight excess in eating causes a "hold-up" in the digestive machinery. There is no margin of safety there.

He is more susceptible to disease because the body defenses are unable to cope with invading disease germs. Because of nervous tension, resulting from great responsibility, he has to restore his nervous balance and comfort thru the use of artificial stimulants. He starts the day's work on caffein stimulation—gets up an appetite for dinner thru a cocktail—gets soothed from the irritations of the day's work thru nicotine—gets rid of the body waste products thru the use of a cathartic—chases business cares away by amusement at the theatres and is finally lulled to sleep until the next day thru the kindly action of a sedative. To say the least, efficient living does not necessitate such a daily program.

According to statistics, the death rate in America is higher for the middle period of life, which is around fifty, than in any other great nation in the world and this is more particularly true of men who carry great responsibility. Unfortunately this is the period of greatest usefulness.

The diseases which are peculiar to men of this age in America are called the "diseases of degeneration", some of which are heart disease, hardening of the arteries, apoplexy, Bright's disease or chronic inflammation of the kidneys, diabetes, etc. It is a matter of observation that an increasingly larger number of American men of prominence die as a result of one or more of these so-called "diseases of degeneration". What is the cause of these diseases? We do not as yet know. There is no one cause; it is probably due to a combination of causes and some of these which the indicator points to are: Lack of sufficient vigorous physical exercise, over-eating, use of stimulants such as coffee, tea, tobacco and alcohol; excessive social obligations, great professional and business responsibility, etc.

It is astounding to think that the efficiency expert is so in-efficient when applying his principles to himself. This is one of those strange human inconsistencies. Most men are content to live on a low level of mental and physical efficiency. If we are able to get out of bed, take our three regular meals and do our day's work, we say we are well, perfectly healthy. That is existence not health. Our standard of health should include bounding vitality and endurance, a spirit of optimism and invincibility resulting from efficiently working bodily organs. It should mean perfect digestion and elimination, capacity for restful sleep, an irresistible desire for muscular expression in the form of enjoyable athletic recreation or its equivalent, a contented and well poised mind and a joy in just being alive.

If a man is mentally efficient enough to create systems of efficiency in his business he should be efficient enough to apply them to his own life and follow them.

Happily there is an increasingly larger number of men who are learning to live efficiently by taking time to play golf, attend gymnasium classes in the club or Y. M. C. A., work gardens, eat more rationally, and in general to obey the simple and obvious laws of health that any man with ordinary horse-sense would find time to obey.

On the Trail of the Alaska Salmon: Dr. Henry B. Ward, University of Illinois.

The marvelous life history of the Alaska salmon has been worked out by the combined efforts of many investigators. In the early summer the adult fish appear off the coast, move forward into the inlets, start up stream, ultimately reach their spawning grounds, and having spawned, die. No adult salmon ever returns to salt water. The eggs rest in their gravel nests over winter and hatch out in the spring; the young fry play about in fresh water, descending slowly the streams until they disappear into the ocean. The markings on the scales carry a precise record of the age and wanderings of the fish in fresh water and in the ocean. Reasons for their movements in fresh water are not yet so well determined. The course they follow is very precise but the influences that direct it are still unknown. Partial explanations of the movements are to be found in the influences of the current of the stream and the temperature of the water. The application of these principles to special instances indicates the extent to which they serve to explain the complex problems involved in migration. The author described many of his observations while studying the salmon in Alaskan waters. He also brought out forcibly the importance of Alaska's natural resources, of which the salmon is one of the greatest.

A short business session was then held.

The President appointed a Membership Committee as follows: Dr. G. D. Buckner, Chairman; Dr. H. Garman and Mr. J. S. McHargue.

The Auditing Committee reported the Treasurer's accounts correct. Accepted.

The Nominating Committee reported the following nominations for officers:

For President..........Prof. George D. Smith, Richmond
For Vice-President......Mr. Lucien Beckner, Winchester
For Secretary ....Dr. A. M. Peter, Lexington
For Treasurer..........Dr. Charles A. Shull, Lexington.

The report of the committee was adopted and the officers were duly elected.

The new President then took the Chair, and made a short talk.

The meeting then adjourned.

(Signed) ALFRED M. PETER, Secretary.

IX.

MINUTES OF THE NINTH ANNUAL MEETING

The ninth annual meeting of the Kentucky Academy of Science convened in the Physics lecture room of the University of Kentucky at 9:45 o'clock A. M., on Saturday, May 20, 1922, President George D. Smith presiding. Present: about 40 persons in the morning and 75 in the afternoon. The minutes of the last meeting were adopted without reading. The report of the Secretary was read and accepted.

SECRETARY'S REPORT

Of the 21 persons nominated for membership at the last meeting, 15 paid the initiation fee and became active members of the Academy—9 becoming national members and 6 local members. We have lost one member by death since the last meeting, Dr. Alfred Fairhurst, formerly of Transylvania University. Four members have been dropped from the list on account of removal from the state and 9 for nonpayment of dues.

The total membership is now 128, including 54 national members, 46 local members, making a total of 100 active members; 20 corresponding members and 8 honorary members.

The membership may be classified as follows:

Regular members in good standing	79
Regular members in arrears	21
Corresponding members	20
Honorary members	8
	128

In accordance with a resolution passed at the last meeting, copies of a pamphlet entitled "Preservation of Natural Conditions," published by the Ecological Society of America, have been purchased and distributed to the membership.

President Smith, on December 29, 1921, appointed the following persons to co-operate with Dr. Middleton in his work for the Ecological Society of America: Prof. C. D. Lewis, Berea, and Prof. F. L. Rainey, Danville.

On account of Dr. Shull's removal from the State, President Smith appointed Dr. Wren Grinstead of Richmond in his place on the Legislative Committee and Prof. W. S. Anderson in his place as Treasurer.

Abstracts of papers presented at the last meeting were forwarded promptly to "Science" for publication and appeared in that journal under date of August 19, 1921. This being our only means of publication, it is important that members supply the Secretary with short abstracts of their papers for this purpose without delay.

(Signed) ALFRED M. PETER, Secretary.

The report of the Treasurer was passed as Prof. Anderson was not present.

The report of the Council was called for and the Secretary explained the activities of the Council were concerned mainly with arrangements for the annual meeting so no formal report seemed necessary.

The report of the Membership Committee was read by Dr. Buckner, Chairman. The report was adopted as read, after which the following were unanimously elected to membership: 15 active members, 3 corresponding members and 5 honorary members.

The report of the Legislative Committee was called for but it appeared that no business had been transacted in this committee.

The report of the Committee to co-operate with Dr. Middleton of the American Society of Ecology was called for but in the absence of the Chairman of this committee none was presented.

President Smith then appointed the following committees:

Auditing: Averitt, Vaughn and McHargue.
Resolutions: Meier, Healy and Gunton.
Nominations: McFarland, Valleau and W. S. Anderson.

Under the order of new business, Dr. Terrell moved that all papers be short, thus allowing time for discussion. Dr. Buckner moved to amend so as to limit the time for discussion. The amendment was lost and the original motion was carried.

The following program was then rendered:

The Boleti of Kentucky: G. D. Smith, Eastern Kentucky State Normal School (President's address).

Colored lantern slides and stereoscopic photographs of 37 species of boleti observed in the vicinity of Richmond were presented and explained.

Factors Affecting the Germination of the Sclerotia of Claviceps (Ergot of rye): Frank T. McFarland, University of Kentucky.

Most mycologists are fairly well acquainted with the method of germination of sclerotia of Claviceps, but there still remain several factors which are poorly understood. During the past two years, the writer has been engaged in a study of the sclerotia of ergot from various countries. In the course of these investigations it has been found that sclerotia more than one year old failed to germinate. Sclerotia sown out of doors, on the surface of the soil, without any covering showed good germination of the sclerotia with many well-formed stromata but the stalks usually are short. Some mycologists seem to have the idea that these sclerotia may have the power to retain their germination ability for more than one year. It is quite unlikely that any sclerotia under out-of-door conditions should remain dormant during the first spring after their maturity and germinate the second season. Sclerotia of Claviceps must go through a period of rest. The shortest period of rest so far found is about eight weeks. During this time when the sclerotia are at rest, they must be kept stratified in moist sand. Removal of the cuticle of sclerotia with a scalpel does not prevent the germination, but the stromata are nearly always deformed, and all seem to rise from a stromatic cushion. Treating the sclerotia with a 5 per cent and a 30 per cent. NaCl salt solution, and then completely removing all traces of the salt and stratifying the sclerotia in the usual manner did not injure their germination power.

The Role of Manganese in Plants: J. S. McHargue, Kentucky Agricultural Experiment Station. Jour. Amer. Chem. Soc. Vol. 44, No. 7, July, 1922, p. 1592.

The purpose of this investigation was to determine if manganese has any definite function to perform in plant economy. The method of attack has been the preparation of plant nutrient compounds and quartz sand, free from manganese, and the growing of plants in different portions of nutrient solutions or sand cultures from which manganese was withheld and in another equal number of portions of these media to which manganese was added. All the plants were grown until those that received manganese showed signs of fructification and a few to maturity. The plants from which manganese was withheld made a normal growth for about six weeks only. Thereafter they became chlorotic and the young leaves and buds died back and the plants made no further growth of any consequence, whereas the plants to which manganese was available grew in a normal way and fructified where the plants were grown to that state of maturity.

The author concludes that manganese is necessary in the plant economy and that, therefore, eleven elements are necessary for the normal growth of autotrophic plants, whereas it has been taught previously that only ten are necessary.

The Hydroxy-anthraquinone Derivatives in Plants: John Aberdeen Gunton, Transylvania College.

A resume was given of the various plants containing derivatives of this type as well as a description of the forms in which these occur. The cathartic principles of cascara, senna, rhubarb, aloes and buckthorn were shown to be irritant anthracene derivatives that exist in the plant in the form of glucosides to which the physiological action is presumably due. Plants containing these bodies are found widely distributed throughout the globe and present an interesting stage in the chemical evolution of plant life. Considerable remains yet to be done on this group from the analytical and synthetical standpoints.

Some Seed-borne Diseases of Agricultural Crops: W. D. Valleau, University of Kentucky.

Further studies on the extent of seed infection of corn with *Fusarium moniliforme* confirm previous reports that it is practically universal. The organism is carried between the various seed-coat layers and may extend in as far as the aleurone layer. In very flinty corn the organism remains dormant a longer period after the seed is planted than in the poorly filled starchy kernels. A preliminary study of 8 lots of barley from 3 states, 12 lots of oats from 4 states, and 38 varieties of wheat from 5 states indicates that small grains are infected to a higher degree with pathogenic organisms than has generally been suspected. Morphological studies of lettuce seeds have demonstrated the presence of an organism in a high percentage of seeds which is believed to be the causal organism of lettuce root rot. The universal presence of root rot on clovers and the results of preliminary tests of seed infection suggest that the causal organism is constantly present in clover seed. Observations on crops affected by seed-borne root disease organisms, grown under different seasonal conditions, suggests that these organisms may play an important part in geographical and seasonal distribution of certain wild and crop plants.

A Preliminary Report on a Study of Various Clovers as Found on Three Soil Experiment Fields of Kentucky with Special Reference to Root Systems: E. N. Fergus and W. D. Valleau, University of Kentucky.

An ecological and pathological study is being made of various clovers, particularly red clover, growing on three soil types of Kentucky, in order to determine the causes of clover failure. Actual counts showed that red and alsike clover stands were practically equal throughout the first year whether on productive or "clover sick" soils. Much diminution of stand occurs on most soils during the second summer, reaching 100 per cent. on the least productive soil. Root rot was present to some extent on all root systems examined. Those developed in least productive soils were badly diseased or dead at the end of the first season. All tap root systems examined were badly diseased or dead at the end of the second season. The persistence of a clover plant after death of the tap root system depends on its ability to produce new roots from the crown.

Extraction of Crude Oil by Means of Shafts and Tunnels: Henry Meier, Centre College.

This method of recovery of oil from beds has been successfully carried on in Alsace since 1917. Experience has shown that by means of wells and pumps not more than 20 per cent. as a maximum of the oil contained in a bed can be brought to the surface. The recovery by sinking a shaft and digging tunnels through oil-bearing sand enables the recovery by seepage and by treating the sand with hot water, of two and a half times as much oil as by means of wells. This method of recovery increases the value of a concession. It opens to countries whose oil-bearing regions seem to have reached the end of production, new and encouraging prospects.

Depletion of Kentucky Crude Oils: Willard Rouse Jillson, Director of the Kentucky Geological Survey and State Geologist.

Since the year 1900, when, with a production of 62,259 barrels, the petroleum producing industry may rightly be said to have gained its feet in Kentucky, there have been many who have held it impossible for the State to become an oil producer of national importance. Others on the contrary, and to them we owe unmeasured gratitude, have steadfastly claimed a bright future for the oil operator in Kentucky. An analysis of the crude oil production figures for Kentucky for the 22 years which have elapsed since 1900 will do much toward presenting the truth of the matter, and aid in arriving at depletion estimates of future petroleum production for the Commonwealth.

Although oil was first produced in Kentucky on the South Fork of the Cumberland River in 1819, nothing came of the discovery for many years. The increasing number of "wildcat" wells which were drilled in various parts of the State served to index oil producing areas rather than to augment the annual total of barrels produced. The earliest oil production figures of which we have an accurate account are for 1883, and show only 4,755 barrels for the whole State of Kentucky. From this time on until 1899 the total annual production of the State ranged up and down from 3,000 to 9,000 barrels. At the end of the eighth decade following the first oil strike in Kentucky, it would have been impossible for anyone to have predicted with accuracy what the future score of years, now passed, might have brought forth. In the same way it is hazardous at the present to predict the rise and fall of crude oil production in Kentucky, though with a certain fairly large production now established, and with the State pretty generally "wild-catted" by geologists and operators alike, there is considerably more to work upon now than there was 20 years ago.

Certain established factors based on the economic and industrial life of this country, such as the increasing demand for gas engine gasoline, industrial lubricants, and fuel oil, coupled with the central eastern location of this State will tend as the years go by to keep Kentucky well up in the ranks of the oil producing states. These factors have operated in New York and Pennsylvania for many years to put off the day of final and complete depletion. The same principles are now operating in Kentucky, and will continue to operate even more vigorously in the future.

A review of the production figures for Kentucky, when plotted in the form of a curve shows a well defined cycle of accelerated, followed by declining production extending from the year 1900 through to the year 1910. This period witnessed the development of Ragland, Wayne County, Campton, Irvine, Bussyville, and Fallsburg pools. From a minimum production of 2,259 barrels in 1900 oil production rose to a peak of 1,217,337 barrels in 1905, which was essentially maintained through the year 1906 when 1,213,548 barrels were produced.

Crude oil production then dropped until 1910 when only 468,774 barrels of petroleum were produced in the State of Kentucky. This figure continued to be about the index of production through to the year 1915, when the impetus brought about by the wartime prices of gasoline, lubricants, and fuel oils, expressed itself in a greatly renewed interest in "wild-catting", and resulted in a substantial increase immediately. Petroleum production jumped in 1916 to 1,144,750 barrels, and in 1917 and 1918 successfully passed the three and four million barrel mark. The peak of the recent extensive oil production in Kentucky was attained in 1919 when a total of 9,226,473 barrels, and a position eighth among the oil producing states were secured. This advance, great for any Appalachian State, carried with it a vast amount of speculation by Kentuckians and others, which was largely responsible for the development.

A slowing up of industry following the close of the war, shortly induced very much lowered prices for Kentucky crude oil and cast a doubt in the hearts of producers. In 1920 the total production of the State dropped to 8,546,027 barrels. The interest in oil development, however, had been sufficient during the five years preceding to bring about the discovery of several large producing pools widely distributed throughout the State of Kentucky. Chief among these in the order of their productivity were the Big Sinking, Ashley, Ross Creek and Station Camp; and other smaller pools in Estill, Lee, Powell, and Wolfe Counties; the grouped pools of Allen, Barren, and Warren Counties; the associated pools of Johnson, Magoffin and Lawrence Counties; and the widely extended pools of Wayne, Mc-

Creary, Clinton and Cumberland Counties. A strengthening of the price of crude oil resulted in the extension and stabilization of the oil producing industry in Kentucky during 1920. At the end of the year petroleum production amounted to 9,080,845 barrels, an increase of 534,818 barrels during the year.

To the casual observer this increase has little of significance, but when one considers that the principal producing pool of the State the ''Big Sinking'', in Lee County, decreased steadily at a rate averaging nearly 10,000 barrels a month, it will be seen that this increase really meant the discovery and large development of other new pools elsewhere in the State. These pools were those of the Johnson, Magoffin, and Lawrence County region, and those of the Allen and Warren County region. A statement of the amount of petroleum produced in Kentucky from 1883 to the present time follows:

PRODUCTION OF PETROLEUM IN BARRELS IN KENTUCKY FROM 1883 TO 1922*

1883	4,755
1884	4,148
1885	5,164
1886	4,726
1887	4,791
1888	5,096
1889	5,096
1890	6,000
1891	9,000
1892	6,500
1893	3,000
1894	1,500
1895	1,500
1896	1,680
1897	322
1898	5,568
1899	18,280
1900	62,259
1901	137,259
1902	185,331
1903	554,286
1904	998,284
1905	1,217.337
1906	1,213,548
1907	820,844
1908	727,767
1909	639,016
1910	468,774
1911	472,458
1912	484,368

*Figures for the year 1922 and 1923 have been added.—Ed.

1913	522,550
1914	479,609
1915	407,081
1916	1,144,750
1917	3,015,640
1918	4,035,950
1919	9,226,473
1920	8,546,027
1921	9,080,845
1922	*8,889,303
1923	*8,087,250

In predicting the figures of crude oil production likely to be obtained in Kentucky in the future, estimates of certain and sure depletion now in evidence in many of the oil pools of this State, must be coupled with an unknown fraction representing oil produced from new pools now undiscovered. This latter factor is very much more difficult to come by than is an estimate of depletion which may be figured with some reasonable degree of precision.

The price of crude oil is also an important factor in the ultimate amount of petroleum which will be produced in Kentucky. With a return at any time to extended low schedules for crude oil will come great demoralization in the producing industry in Kentucky, especially in the small and old well districts. On the other hand an increased price and a sustained demand for crude oil in the near future will tend to strengthen not only the entire industry as it now stands developed, but induce widespread "wild-catting". If the price of crude oil strengthens slightly and remains more or less stationary during the next several years, it seems reasonable to anticipate a production in Kentucky which will range between seven and nine million barrels, probably close to eight million barrels.

The tenacity of some of the older wells in Kentucky, especially in the "true sand" districts of eastern Kentucky, is surely indicative of a somewhat more sustained production for these districts especially; and in the end for the entire State, than had at first been assumed. Estimates of depletion for Kentucky made but a year ago, giving undue importance to the rapid decline of the "Big Sinking" and associated pools, and assuming that Warren County had reached its peak must now, it appears, be revised in consideration of the new elements of long life in-

*These figures supplied in 1924. Ed.

troduced by the proving up of the characteristic of Eastern Kentucky pools.

It is figured that the oil pools of Kentucky as now known and partly developed will still afford production through wells which are yet to be drilled, until the year 1980. For this period, 1922 to 1980 inclusive, it is figured that the known pools of Kentucky will produce 120,000,000 barrels of crude oil. Pools yet to be discovered in this State it is estimated will produce 80,000,000 barrels; a total of 200,000,000 barrels of petroleum now in the ground. A total volume of 44,655,145 barrels for the period 1883 to 1921 inclusive has been produced. The total production of petroleum from discovery in Kentucky from 1819 to date may be listed as follows:

Petroleum produced in Kentucky.

1819 to 1882 inclusive (unmeasured, estimated)	144,000 bbls.
1883 to 1921 inclusive (actual oil runs)	44,655,145 bbls.
1921 to 1980 inclusive (figured decline known)	120,000,000 bbls.
1922 to 1980 inclusive (estimated undiscovered new production)	80,000,000 bbls.
Total petroleum reserves	244,799,145 bbls.

Of the above total of approximately 205,000,000 barrels, 44,799,145 barrels has been produced and consumed. The figured depletion of 120,000,000 barrels is regarded as conservative. It amounts to about 1,500,000 barrels annually until 1980. The estimate of 80,000,000 barrels of unknown, undiscovered oil in Kentucky is probably well within reason and probability for the period for 1922 to 1980, though it affords, it must be admitted, the greatest element of probable error in these calculations. With something over 200,000,000 barrels of petroleum reasonably possible for this State, Kentucky's place among the oil producing states of the Union and especially those of the Appalachian district seems assured.

Oil Shales of Kentucky: C. S. Crouse, University of Kentucky.

The oil consumption in the United States is outstripping the domestic production, creating an alarming situation. New sources of oil must be found. Oil shale will solve the problem so soon as the extraction of oil from this source is made commercially feasible. A research has been in progress at the University of Kentucky for three years with the development of a commercial retort as its object. The results are more than encouraging. Kentucky has 90,000,000,000 tons of shale immediately available for steam shovel methods of mining. This shale, conservatively figured, represents 40,000,000,000 barrels of crude oil. Kentucky shales show marked superiority over shales in other parts of the United States. Such being true Kentucky is the logical place for the genesis of the oil shale industry in this country.

Model Showing Structure of Gainesville Oil Pool, Allen County, Ky: E. S. Perry, University of Kentucky.

The author exhibited the model showing the stratification and explained its construction.

Table Moving by So-called Spirits: Glanville Terrell, University of Kentucky.

An example of table-moving produced in daylight by a girl of fifteen and a boy of ten with no possibility of collusion, was described by the author, as having come under his observation. The author is convinced that the phenomenon was genuine but asserts his disbelief that it was a spiritual manifestation.

A Kentucky Chemist of the Old School: Alfred M. Peter, University of Kentucky.

(John) Lawrence Smith, M. D. (1818-1883), a citizen of Louisville, Ky., from 1854 to 1883, is most esteemed by the chemist engaged in mineral analysis by reason of the unique and very practical method for the determination of alkalies in silicates of his devising. Indeed, the extensive study of the potassium content of Kentucky soils, by the Experiment Station, was made practicable by the application of this method. Dr. Smith's publications number some 150 titles, a large proportion of which appeared in the American Journal of Science. His work was mainly in mineral chemistry. His investigations on emery led to the development of the emery industry in the United States. He made a life study of meteorites, of which he had a very fine collection, now owned by Harvard University. Dr. Smith occupied a high position in the scientific world and was an active member of many learned societies both foreign and American, including the National Academy of Sciences. The Lawrence Smith medal of the National Academy, a gold medal worth $200 to be awarded for research upon meteorites, was established by Dr. Smith's widow, who used for the endowment the sum of $8,000 received from the sale of his collection of meteorites to Harvard University. The medal has been awarded only twice: to H. A. Newton, in 1888, and to Dr. Geo. P. Merrill, in 1922. Dr. Smith was a man of means, charitable, public spirited, always ready to contribute his scientific knowledge for public good, and was held in high esteem in the community.

Home Economics as a Science: Margaret Whittemore, University of Kentucky.

Before considering home economics in relation to natural sciences it must be remembered that it has a vital connection also with social sciences and with the fine arts. For this reason, and also because it is distinctly an applied subject, its relation with the natural sciences should be chiefly that of producer and consumer. Home economics, however, should contribute to scientific knowledge by suggesting problems which need attention and by providing the situations for application and experimentation. The earnest attention now being given to home economics reveals several weaknesses. One is the fact that as a course of study it has been organized too much upon a logical in opposition to psychological basis. This seems still true of much of the teaching of the natural sciences, as shown by the requirement of inorganic before organic chemistry. Another cause of weakness is the failure to recognize the desirable limits of home economics and the frequent attempt to teach in the department the principles as well as the application of the arts and sciences involved.

The Measurement of the Mental Changes after the Removal of Diseased Tonsils and Adenoids: Gladys Marie Lowe, University of Kentucky.

A group of thirty-five school children operated upon for diseased tonsils and adenoids was compared with a group of twenty-five which did not undergo the operation. This study is unique in the use of a control group of children with diseased tonsils and adenoids but not operated upon. Three lines of evidence were used, namely, changes revealed by a scale of tests of mental alertness, by the teacher's estimate of certain traits, and by the actual scholarship records. The comparisons are made between data obtained just preceding the operation and those obtained one year after the diagnosis. The Stanford Revision of the Binet-Simon Scale for measuring mental alertness was used. The teacher's rating for each trait was obtained by estimating in which fifth of the class the pupils belonged. The traits estimated were: (1) companionhsip with fellows, (2) emotional self control, (3) initiative, (4) self expression (speech), (5) interest in school work, (6) attention and (7) scholarship. The results show that: (1) While the average scholarship of the operated group continued to be the same as that of all the classes represented, the average scholarship of the non-operated group fell one scholarship rank below the average of all the classes represented. (2) The operated group showed no more change in the mental age, or in "brightness" (I. Q.) than did the non-operated group. The differences compared with the error were so slight as to be negligible. (3) The teacher's estimates showed no significant change. (4) Pronounced improvement was found in three of four cases.

The Importance of Scientific Investigation in Marketing: O. B. Jesness, University of Kentucky.

Attention was called to the growing complexity of marketing methods and a comparison of present methods with the comparatively simple methods that sufficed a century ago was made in order to suggest some of the reasons why the marketing system of to-day necessarily is involved. Mention was made of the prevalence of loose thinking and talking on marketing questions. Emphasis was placed on the importance of scientific investigations in marketing. Facts are the only safe basis for action and careful studies are needed in order to obtain essential facts. Agricultural experiment stations and departments have studied production problems for years but have taken up marketing activities only recently. Much work in this field is now being undertaken and the future should witness the accumulation of much helpful material.

Factors Involved in the Standardization of Tobacco Grades: Erle C. Vaughn, University of Kentucky.

Standardization of tobacco grades is designed to avoid confusion, to stabilize prices, and to protect both producer and buyer. The factors involved are the conditions which must be considered in bringing about these results. The chief ones are: descriptive terms used, natural grades, manufacturers' grades, methods of buying and selling, interest of producer in grading, and the many variations which occur both in the product and in opinions and practices concerning it. These factors, their true value and their relation to each other must be carefully considered in establishing practicable standard grades of tobacco.

Factors which Influence the Cost of Gain in Feeding Cattle: Wayland Rhoads, University of Kentucky.

The foundation of the beef cattle industry is the production and sale of fat cattle for beef, so when cattle feeding is profitable, both the breeders of purebreds and the producer of feeder steers have a good market for their stock. Pasture is the basis of the cheapest gains while the winter feed lot is necessary to produce fat cattle at that time, in order to have an even supply of beef. The cost of putting gains on cattle varies with a number or a combination of things. They are the age of the cattle, the time of the year the cattle are fed, whether on grass or on dry feed, the length of the feeding period, the feeds fed, conditions under which the cattle are fed such as barn room and water supply, the daily gain which the cattle make, the quality of the cattle, the way they were fed before going on feed, the condition of the cattle and last the individual feeder himself. The old saying is true that "the eye of the master fatteneth the cattle".

Geology and Eggs: G. Davis Buckner and J. H. Martin, University of Kentucky.

An experiment was discussed wherein two lots of ten White Leghorn hens each, all hatched the same day and coming from a common parent stock, were fed rations consisting of: No. 1, corn, buttermilk and limestone, and No. 2, corn and buttermilk. During the first six months of laying lot No. 1 consumed 11.1

pounds of limestone and produced 651 eggs while No. 2 laid 343 eggs. Among other things it was shown that the average dried eggshell was 4.7 grams in lot 1 and 3.5 grams in lot 2. This means that lot 1 produced 1,789 grams of dried eggshell more than did lot 2. The relation of egg production to geology may be inferred.

Testing for Moisture in Transformer Oil: C. C. Kiplinger, Mt. Union College, Alliance, Ohio.

Freshly cut sodium dropped into the oil to be tested is a convenient and sensitive means of detecting traces of moisture. Evolution of gas bubbles is produced by smaller quantities of moisture than can be detected by the usual test of rubbing the oil with eosin.

A Simple Apparatus for Demonstrating Heat of Absorption: C. C. Kiplinger, Mt. Union College, Alliance, Ohio.

A Bunsen ice calorimeter with a long horizontal capillary tube attached serves as an air thermometer which may be used to demonstrate thermal changes due to absorption of liquids by charcoal.

The Present Status of the Cancer Problems: (lecture) Dr. H. Gideon Wells, professor of pathology, University of Chicago.

Many lantern slides, most of them from photomicrographs, were exhibited to show the nature of cancer, which may be described as the continued unnatural growth of cells. This growth cuts off the supply of nourishment for other cells and makes conditions more favorable for the growth of bacteria around the affected area. It seems to have been established that the disease is not caused by a specific parasite, nor has a specific causative agent been isolated. Improved methods in the use of radium and X-rays seem to give the best promise for the control of cancer, and great advances have been made in the last six years. Drugs are useless. A very important factor is education of the people to recognize superficial cancers and have them treated before they become serious. There is no evidence that cancer is ever acquired by contagion either in man or in experimental animals. It appears to follow the Mendelian law of inheritance when studied in mice, resistance to cancer being dominant, susceptibility being recessive. The application of these facts to human inheritance of susceptibility and resistance to cancer was discussed. A study of statistics shows that cancer is not on the increase, the apparent increase being accounted for largely by more exact diagnoses; the actual number of deaths caused by cancer is perhaps decreasing because of improved methods of treatment.

ALFRED M. PETER, Secretary.

The President then called for the reports of committees: Auditing Committee: Accepted the Treasurer's statement as given showing a balance in the treasury of $100.34.

Resolutions Committee:

It is recommended.

(1) That the technical papers be divided into two sections, to come after the business and general papers are presented; one for the pure science and one for the applied science.

(2) That the time schedule for the main divisions be part of the program.

(Signed) HENRY MEIER,
DANIEL J. HEALY,
J. A. GUNTON.

The Nominating Committee then reported:

We, the undersigned committee, duly appointed and after consideration, desire to nominate the following persons for officers of the Kentucky Academy for next year:

For President, Mr. Lucien Beckner,
For Vice-President, Dr. John A. Gunton,
For Secretary, Dr. A. M. Peter,
For Treasurer, Prof. W. S. Anderson.

(Signed) FRANK T. McFARLAND, Chairman.
W. S. ANDERSON,
W. D. VALLEAU.

The meeting then adjourned.

(Signed) ALFRED M. PETER, Secretary.

X.

MINUTES OF THE TENTH ANNUAL MEETING

The tenth annual meeting of the Kentucky Academy of

Science was called to order by President Lucien Beckner at 9:45 o'clock in the Physics lecture room, Universtiy of Kentucky, about 100 members and visitors being present.

The Minutes of the last meeting were read and approved.

The report of the Secretary was read and approved.

SECRETARY'S REPORT, 1922-1923

Of the 15 persons nominated for active membership at the last meeting, all but 2 have paid the initiation fee thereby adding 13 active members to the roll of the Academy, 11 national and 2 local. We have lost 2 members by death since the last meeting: Miss Cora Williams of Bellevue, Ky., and Mr. A. T. Parker, of Lexington, our oldest member. Two members have dropped from the list on account of removal from the state, J. B. Nelson and George H. Vansell.

The total membership is now 149, including 65 national members and 48 local, making 113 active members; 23 corresponding members and 13 honorary members.

The membership may be classified as follows:

Active members in good standing................	89
Active members in arrears for 1 year...........	12
Active members in arrears for two years..........	12
Corresponding members	23
Honorary members	13

Members in arrears have been notified several times. The names of those who are 2 years in arrears after this meeting will be dropped automatically.

Our members represent 38 lines of activity. About half belong to the group of physical sciences and about one-third to the biological sciences.

Classified geographically and as to educational institutions our active membership includes:

55 from the University of Kentucky, Lexington.
7 from the University of Louisville, Louisville.
5 from Centre College, Danville.
4 from Georgetown College, Georgetown.
2 from the Eastern Kentucky State Normal School, Richmond.
2 from Berea College, Berea.

2 from Transylvania College, Lexington.
1 from the Western State Normal School, Bowling Green.
1 from the Louisville College of Pharmacy, Louisville.
1 from Cumberland College, Williamsburg.
1 from Cardome, Georgetown.

Not connected with educational institutions in the State are:

9 from Louisville.
5 from Lexington.
3 from Frankfort.

and 1 each from Ashland, Wallins Creek, Harlan, Henderson, Winchester, Bowling Green, Newport, Jenkins and Carrollton. Total 26. Besides these there are 6 active members outside the State.

Two new national members were elected since the last meeting by action of the council, viz., Mr. Ralph F. Schneider and Mr. Leonard P. Benjamin, both of the Public Service Laboratory of the Experiment Station. Their names will be presented by the Membership Committee to make their election entirely regular.

In this connection I suggest that our constitution be amended so as to enable the council to elect new members in the interim between meetings of the Academy. This is for the benefit of any who may want to join as national members between the time of the Academy meeting and the end of the year, so as to be qualified to attend the December meeting of the A. A. A. S. as members.

Notice has been received from the Permanent Secretary of the A. A. A. S. in Washington of a change in the method of collecting the dues of national members. Beginning October 1, 1923, dues of national members will be paid directly to the Washington office instead of to the Academy. The Permanent Secretary will remit monthly, to the Secretary of the Academy, so much of his collections as is due us; that is, one dollar out of every five, paid him as annual dues by our national members and all initiation fees ($5.00 each) paid by new national members. Under this arrangement, a newly elected member of this Academy who wants also to become a member of the A. A. A. S. (national member) remits ten dollars to the Permanent Secretary of the A. A. A. S. covering initiation fee ($5) and annual dues ($5) for one year in advance, beginning October 1st. The Permanent Secretary records the new member as being fully paid for one year, enters his subscription for the journal and, in due time, remits six dollars to the Secretary of the Academy. Two dollars of the six the Academy claims; one for the new member's initiation fee and one for one year's dues, in advance. The remaining four dollars your Secretary regards as a credit due the new member, to be applied according to that member's wishes, unless the Academy instructs otherwise. Secretary Livingston's letter announcing the new arrangement is made part of this report.

I wish to call the attention of the Academy to the annual meeting of the A. A. A. S. to be held in Cincinnati beginning December 27, 1923. This is an unusual opportunity for our Kentuckians to participate in this important gathering of scientists and every member of the Kentucky Academy should make an effort to attend at least part of the time. It has been suggested that we hold an extra meeting of the Academy at that time, in Cincinnati.

The President appointed Dr. J. J. Tigert to represent the Academy at the Spencer F. Baird Memorial Celebration in Washington on February 3rd last. A letter from Dr. Tigert in regard to this is made part of this report.

The President appointed the following membership committee: P. E. Karraker, Chairman; W. R. Jillson and A. W. Homberger.

Abstracts of papers presented at the last meeting were forwarded promptly to "Science" for publication and appeared in that journal, July 21, 1923.

Finally, in arranging the program, your Secretary was not able to place the titles in two groups, "pure science" and "applied science" as determined by resolution at the last meeting, this distinction seeming to afford no practical line of division. If the Academy desires to consider the papers in two groups, they may be rearranged to conform to the wishes of those present.

Respectfully submitted,

(Signed) ALFRED M. PETER, Secretary.

The report of the Treasurer was received and referred to the Auditing Committee to be appointed by the President. The report shows receipts $343.59, disbursements $279.25, balance on hand $64.34.

The report of the Membership Committee was read by Dr. Jillson, in the absence of Chairman Karraker, and accepted.

No reports were presented by the Publications Committee and the Legislation Committee.

Upon motion, duly seconded and carried, the Secretary was ordered to cast one ballot for all the persons proposed for membership by the Membership Committee. Thereupon the Secretary reported that the ballot had been cast and that 33 persons were elected to active membership and Dr. William Benjamin Smith of New Orleans, La., and Lexington, Ky. to honorary membership.

Dr. Middleton, Chairman of the Committee to co-operate with the American Society of Ecology, reported verbally that the work of his committee had consisted in sending to the Society the names of persons and organizations in the state that might be interested in the work of the society. Dr. Middleton's report was accepted.

The President appointed the following committees:

Nominations: A. M. Miller, C. S. Crouse, A. R. Middleton.

Resolutions: W. R. Jillson, W. H. Coolidge, F. T. McFarland.

Auditing: H. Meier, George Roberts, W. D. Iler.

The Secretary offered the following obituary notice of Mr. A. T. Parker, the oldest member of the Academy, which was adopted as part of the Minutes.

OBITUARY

A. T. Parker

During the middle decade of the last century, when educated persons took a lively interest in all scientific subjects, the development and improvement of the miscroscope stimulated popular interest in microscopy.

Many persons possessing means and leisure developed valuable technic and acquired real scientific knowledge. Such a person was Alexander T. Parker, friend of Robert Peter and Albert R. Crandall, and enthusiastic amateur of science, who prepared the way for the modern professional scientist.

Mr. Parker died last November (1922) in his 90th year, and the Kentucky Academy of Science lost a valuable member who had followed with keen appreciation the development of modern scientific thought.

Born January 1st, 1832, in Culpepper, Virginia, Mr. Parker came, as a young man, to Kentucky and for many years was a successful merchant in Lexington. During the seventies and eighties when few physicians were trained microscopists Mr. Parker, by miscroscopical examinations of pathological material, afforded the Lexington physicians valuable assistance in their work. When the Kentucky Agricultural Experiment Station was organized in 1885, Mr. Parker was appointed microscopist of the Station, and his name appears as one of the Staff in the early bulletins of the Station.

Mr. Parker retained his interest in scientific subjects, and especially in microscopy, to the end. He visited the Experiment Station from time to time and, at the age of 90, possessed much of the keen interest and enthusiasm which had been his happy possession during a long, honorable and useful life.

CONSTITUTIONAL AMENDMENT

The Secretary announced that the following proposed amendment to the constitution had been published in the call for the meeting, explaining that its purpose is to enable the Council to elect members in the interim between meetings of the Academy and that this is desirable because persons may want to become National members in the latter part of the year in order to attend the December meeting of the A. A. A. S., as members. Upon motion, duly seconded the amendment was adopted unanimously, as follows:

Amend Article III of the constitution by changing the last paragraph to read:

"For election to any class of membership the candidate must have been nominated in writing by two members, one of whom must know the applicant personally, receive a majority vote of the committee on membership and a three-fourths vote of the members of the Academy present at any session or, in the interim between meetings of the Academy, the unanimous vote of the members of the council, present or voting by letter.''

President Beckner delivered his address upon ''Eastern Kentucky's Seashore,'' illustrated by a geological map of the state showing underlying formations at certain points as inferred from the records of deep wells. The ancient shore line was described as parallel, generally, with the axis of the Cincinnati anticline and to the east of it. The general thickening of the strata eastward, with increasing distance from the shore line was pointed out and evidence was cited of the presence of estuaries of great rivers. A very peculiar and interesting feature of the geology (stratigraphy) of Eastern Kentucky was shown by a vertical cross-section of the rock formations, extending from Lee County into Pike County, constructed by plotting well records graphically. The section shows that the deeper rocks (Devonian) continue their eastward dip into Pike County but that this is not the case with the surface formations; and that all of the rock systems thicken towards the southeast, save possibly the Mississippian series of the Carboniferous system, causing the deeper strata to have increasingly greater angles of dip.

The following papers were read:

''The Occurrence of Two Fern Rusts in Kentucky:'' Dr. Frank T. McFarland, Botany, University of Kentucky.

So far as the writer has been able to learn, no rusts of the Pteridophytae have ever been reported for Kentucky. While on a collecting trip to Cumberland Falls the writer found several patches of Pteridium aquilinum (L) Kuhn bearing rust sori. On examination this rust proved to be Uredinopsis pteridis Diet. and Holw. collected at Cumberland Falls, Ky., August 31, 1922. While the writer was working in the University greenhouse the first day of December, 1922, his attention was attracted by some whitish spots on the under surface of the leaves of a potted Pellaea atropurpurea (L) Link, fern. Cross sections of these spots revealed a rust known as Hyalopsora cheilanthis (Pk.) Arth. No teliospores were found in either collection. Specimens are in the writer's herbarium and that of the University of Wisconsin.

"Association of Manganese with the So-called Vitamins:" J. S. McHargue, Kentucky Experiment Station.

The author presented further data which confirmed his previous conclusions that manganese is an essential element for plant growth and has a function in the synthesis of chlorophyl. Data were presented which show that in the modern process of milling rice, barley, wheat and corn, the greater part of the manganese contained in the pericarp and germ is removed in the offal when these cereals are prepared as highly milled products for food. Analyses were presented which showed that in the animal body manganese occurs in the largest amounts in the liver, kidney, pancreas, heart and brain. Since these organs are also richest in vitamins the author concludes that manganese is in some way responsible for the presence of the vital factors in these organs. It was also shown that egg yolk contains an appreciable amount of manganese whereas the white of the egg contains no manganese—a fact in harmony with the observation that the yolk of eggs contains vitamins whereas the white is deficient in vitamins. Similar parallelisms were shown in cod livers, cod liver chum and refined cod liver oil; also in tomatoes, oranges and lemons. The author concludes that manganese is closely associated with vitamins and is responsible for the origin of the vitamin factors in some way as yet undetermined, probably catalytically.

Jeptha Knobs of Shelby County: Walter H. Bucher, University of Cincinnati.

The geological structure of Jeptha Knob was described as that of an upthrown concentric fault block. The formations of which the Knob itself is composed were described as horizontal and of Ordovician age. On either side of the Knob evidence of faulting was observed. It was inferred that only the area included by the Knob was effected by the upward movement.

Late Frost Injury to Some Trees in the Bluegrass Region: A. F. Hemmenway, Transylvania College.

The Easter freeze of 1921 injured the woody tissue of several kinds of shade and fruit trees in this region. The writer has examined three conifers, twelve deciduous shade trees and twelve varieties of fruit trees. The Trancendent crabapple, Black Tartarean cherry, linden, and hard pines were most noticeably injured. The injury is more severe in twigs less than five years old. Twigs injured by frost may render the tree much more susceptible to attacks by fungi.

The Social Significance of Psychological Tests for College Students: Prof. J. B. Miner, Psychology, University of Kentucky.

Three statistical pictures of the results of the Army Alpha test conducted at the University of Kentucky were presented. The first shows how closely the scores of the freshmen parallel the distribution curve of the officers in the American army. This indicates the high type of individual which the University has to train and the importance of clear recognition by the student body that it is fitting itself for positions of leadership and responsibility. The second compares the seniors with the freshmen in the College of Engineering. It furnishes a start toward the problem of defining the minimum essential of intellectual capacity necessary for completing the engineering course. The third shows tests of the twelve Kentucky candidates for the Rhodes Scholarship in the recent award. The results corroborate the opinions of the Committee which made the selection after an elaborate comparison of the personal histories and the scholarship records of the candidates, supplemented by a half-hour interview with each man. It shows strikingly that high records on the psychological tests are correlated with the sort of personal characteristics sought in making this appointment.

Market Milk—Free From B. Coli: E. J. Gott and L. A. Brown, Public Service Laboratories, Kentucky Agricultural Experiment Station.

This department has made a B. coli count as a routine procedure in the examination of milks for the past eleven years. In order to determine if market milk was absolutely free from members of the B. coli group, 5 to 10 cc portions of a number of samples of milk were incubated at 37½° C. for 18 to 24 hours. Out of eighty-seven samples the authors failed to obtain B. coli in thirty-one, or thirty-five per cent. Forty original pints and quarts of milk from two dairies were incubated one day at 30° C. and the next day at 37½° C. After the final incubation, thirty-one (77 per cent) were found to be free from members of the B. coli group. It is possible for dairymen to produce milk free from B. coli. The B. coli count is of distinct advantage in the sanitary scoring of dairies and dairy products.

The Hydnaceae of Kentucky: Prof. G. D. Smith, Western Kentucky Normal School, Richmond.

The occurrence of the following species was noted and colored lantern slides representing one or more forms of each were shown and explained. Hydnum repandum, Linn.; Hydnum coralloides, Scopoli.; Hydnum imbricatum, Linn.; Hydnum albonigrum, Pk.; Hydnum adustum, Schw.; Hydnum caput-ursi, Fr.; Hydnum erinaceus, Bull.; Hydnum caput-medusae, Bull.; Hydnum septentrionale, Fr.; Hydnum zonatum, Batsch.; Hydnum putidum, Arkinson.

Notes on the Constitution of Benzene: C. C. Kiplinger, Mount Union College, Alliance, Ohio.

The author attempts to prove that Kekule's vibration hypothesis, with a slight modification, is still as fruitful in affording explanations of the chemical behavior of benzene and related structures as the more complex hypotheses of later development. It is a fallacy to expect two ortho di-substitution products of benzene, since these could be but two special phases of the vibration cycle of a Kekule molecule, which cycle probably occurs very rapidly. The Thiele molecule becomes a special phase of this cycle. The structures of naphthalene and anthracene are discussed briefly along the same lines. The paper is speculative and presents no new experimental evidence.

A Method of Demonstrating Seed Infection in Supposedly Disease-Free Corn: W. D. Valleau, Kentucky Experiment Station.

Comparative ear-to-row tests of heavily infected and so-called disease-free corn have indicated that yield will not be increased by the selection of ears which appear freest from infection. Seed from ears which appear freest from infection show, when grown in sterile sand a sufficient time, definite evidence of being infected internally with fungi. A microscopic study of serial sections of corn seeds which appeared disease-free when cultered in agar often showed extensive development of hyphae between any parts of the pericarp and seed-coat walls. In seeds which appeared to be free from infection for long periods in the sand box the hyphae were found to be extremely small and less extensive but always present in the seeds examined. It is concluded that negative evidence obtained by petri plate or test-tube cultures of corn seeds are valueless as an indication of freedom from fungi.

Effect of Developing Fetus on Production of Milk of Dairy Cows: Prof. J. J. Hooper, Dairy Husbandry, University of Kentucky.

Records of 24 cows studied indicate that the growing fetus, 5 or 6 months after conception, exerts a decided influence in checking milk secretion of the mother cow. When left unbred for most of the lactation, cows maintained a higher milk yield during the last months than when bred early. The author infers that the 6-months old fetus secretes something that dries off the cow preparatory to rest and calving.

Ulcerative Cloacitis in Chickens: M. Scherago, Bacteriology, University of Kentucky.

This is either a rare disease in Kentucky or it is not readily recognized by the poultryman. If the latter, the number of cases must be very few and the disease itself of little importance. The rather sporadic occurrence of ulcerative cloacitis in a flock and failure to transmit the disease to healthy fowls seem to indicate that it is not contagious and is not transmitted by coitus. Birds affected may be treated with a single cleansing of the anal region and cloaca and one or two applications of a 1-1000 solution of mercuric chlorid; they recover without further treatment. An attack of this disease does not seem to affect the future laying capacity of the hen.

Land of Ten Thousand Sinks: W. R. Jillson, State Geologist.

The pitted or sink hole characteristic of the St. Louis, Ste.

Genevieve, and Chester divisions of the Mississippian System in Kentucky has long been recognized. The widely ramifying sub-surface drainage developed in these limestone rocks, which are frequently of high purity, is well exemplified in the karst and cave region of Edmonson and Hart Counties, Ky., and in the natural sewage channels of the City of Bowling Green, Warren County, Kentucky. The peculiar topographic figure of the "sink" country is well shown on either side of the Louisville and Nashville Railroad, and the Dixie Highway from Munfordville in Hart County to Bowling Green.

The recently completed Mammoth Cave topographic sheet exhibits 2833 sink holes, and is regarded as a model for students. The number of sinks on other completed quadrangles follows: Brownsville 1150, Bowling Green 2563, Princeton 1429, and Monticello 1096, giving a total of 9071. The Brownsville topographic sheet shows the largest mapped sink hole just south of the Dripping Springs escarpment, and located between Girkin and Tuckertown postoffices. This gigantic sink has an area of 4.865 square miles or 3,114 acres. It is estimated on a basis of mapped areas that the Mississippian plateau in Kentucky contain between sixty and seventy thousand sink holes of varying size and description.

The Haddix—Coalburg Geosyncline: W. R. Jillson, State Geologist.

During recent years much interest has been evinced by geologists, engineers and others in the exact location and nature of the geosyncline of Eastern Kentucky. It was shown by the writer in 1919 that this geosyncline, so evident in the surface rocks (Pennsylvania), was in fact a feature of economic importance only in the Coal-measures, since their great and rapid thickening to the southeast obliterated it in all Mississippian and older strata. Structural work now approaching completion in the trough portion of the Eastern Kentucky coal field—all elevations being reduced to the Fire Clay Coal as the key horizon—shows definitely that the line of low points in the Coal-measures, known in the Kentucky literature as the Haddix or Eastern Kentucky Geosyncline, enters the State from Tennessee at an elevation of 1,600 feet in the vicinity of Jellico, Whitley

County, and progresses irregularly northeastward through Knox, Clay, Perry, Breathitt, Magoffin, Floyd and Martin Counties. In the southwestern part of Martin County this major syncline narrowly escapes a plunge to the north through Martin County to join the deep geosyncline which progressing southwestward through West Virginia terminates abruptly in Lawrence County, Kentucky.

The Eastern Kentucky geosyncline (Haddix) leaves Kentucky just south of Wolfe Creek on the Tug Fork of the Big Sandy River at an elevation of 580 feet, and continues on to the northeastward as the Coalburg Syncline of West Virginia, passing through Mingo, Logan and Boone Counties into Kanawha County where it dies out in a broad monocline on the headwaters of Blue Creek of Elk River at a point about 12 miles east of Charleston. Where it crosses the Kanawha River at Coalburg it has a computed elevation of about 540 feet indicating a drop of 1,060 feet in the Fire Clay Coal in course. Of this great northeastward fall, 1,020 feet were completed in Kentucky.

A study of the profile of the Haddix-Coalburg Geosyncline (plotted by the writer to scale) brings out clearly for the first time the following facts:

I. This geosyncline is divisible into three units: (1) Kanawha River westward to Tug Fork. Low elevations between 580 and 540 feet. (2) Tug Fork southwestward to Middle Fork of Kentucky River in Perry County. Low elevations between 855 and 580 feet. (3) Middle Fork of Kentucky River to Jellico region (Tennessee line). Lowest elevation 855 feet and highest elevation 1,600 feet.

II. Regional coincidence of pronounced structural highs in Floyd and Clay Counties with important developed gas fields, and lack of coincidence with large and important developed oil pools in all of its course until the Cabin Creek region of southern Kanawha County, West Virginia, is entered.

III. Coincidence of synclinal structure with all lines of major drainage from the South Fork of the Kentucky River northeastward to the Kanawha River.

A Gigantic Slate Slide: W. R. Jillson, State Geologist.

The largest and most destructive "slate slide" in the history of mining operations in Kentucky occurred at Burdine, Letcher County, on the waters of Elkhorn Creek adjoining the northwest flank of Pine Mountain, on February 3, 1923. About 125,000 cubic yards of "slate" taken from the parting of the Elkhorn coal (Pottsville) at Mine No. 201 of the Consolidation Coal Co. and gobbed in Slate Hollow became supersaturated with rainwater and wash during an abnormal precipitation of 3.27 inches for the 48 hours immediately preceding the slide.

The direct causes of this slide were: (1) abnormal precipitation combined with inadequate sub-slate drainage, (2) unstable angles of rest (35°) on the breast of the fill, (3) excavation and ditching operations following the first minor slips, (4) seismological disturbances of record, and (5) unusual regional geotectonic relationships. The total length of the slide was 929 feet. The semiliquid "slate" moved out fan-shaped entirely across the bottom of Elkhorn Creek to a maximum depth of 75 feet. The movement was entirely within the "gobbed" slate and did not affect the underlying country rock or soil. Casualties were narrowly avoided.

The Largest Fort of the Mound Builders in the Knobs of Kentucky: Wilbur Greeley Burroughs, Asst. Geologist, Ky. Geological Survey.

The fort is in Madison County, Kentucky, 3½ miles southeast of Berea, on the flat top of a mountain, 620 ft. vertically above the surrounding valleys. It covers about 250 acres. Rough stone barricades guard each of 13 possible approaches and cliffs 100 to 180 feet high form the other sides. Even certain accessible joint planes four feet wide are barricaded with regularly laid rough stone walls. Piles of stone "ammunition" occur at intervals. The author made the first detailed survey and explored this fort in 1922-23, for the State Geological Survey. With voluntary assistants he has excavated in the caves and rockhouses of the fort in search of remains of the prehistoric people.

The Academy adjourned for lunch at 1 P. M. Upon reassembling after lunch Dr. E. N. Transeau, Head of the Department of Botany, University of Ohio, addressed the Academy upon "The Postglacial History of the Vegetation of Ohio," illustrating his lecture with many fine stereopticon views.

The lecturer presented results of studies of the influence of the Glacial period on the vegetation of Ohio, pointing out the fact that during glacial times much of Ohio was covered by an ice cap and that the distribution and character of the present ultimate or climax flora is not so much due to influences coming from geological formations, from soils or from moisture conditions, as from a migration of plants that followed up the ice as it disappeared. The vegetation now consists largely of plants derived from a few outside centers of dispersal, a southeastern, roughly represented by the Allegheny Mountain region, a western prairie center from which many plants have come in by way of the western end of the state, and a boreal center, the latter during the Glacial period being pushed southward and now furnishing a few species, remnants of those that during the Glacial period hung on the flanks of the ice and followed it up as fast as it retreated. Some of these plants are still to be found in isolated and protected spots. The lecture was highly appreciated by those present because of its bearing on the flora of Kentucky, a region which was profoundly influenced by the same conditions, though only touched by the ice sheet. The vegetation of the state, it had been noted, was derived largely after Glacial times from the centers that have furnished most of the plants of Ohio; for while its surface was not as greatly affected by the ice, its climate and such vegetation as existed must while the ice remained have been decidedly boreal in character.

The Auditing Committee reported that they had examined the Treasurer's books and found them correct. Accepted.

The Resolutions Committee reported that the Kentucky Academy of Science approves the recent action of the Council of the A. A. A. S. with respect to the facts of organic evolution and the teaching of the same in the public schools and that suitable resolutions be drawn by the committee and forwarded to the Council of the A. A. A. S. Upon motion, duly seconded, the report was adopted unanimously.

The resolutions submitted by the Committee several days after the meeting are as follows:

Resolution:

Whereas: A group movement is recognized in the United States, seeking to restrict by legislation the content of science teaching in our schools and colleges, and

Whereas: This constitutes an open attack on the freedom of scientific teaching, whether the schools or colleges be tax supported or privately endowed, without which freedom there can be no true scientific progress, and

Whereas: The Council of the American Association for the Advancement of Science, at its last meeting, passed resolutions in which it repudiates the charge that leading scientists are abandoning the doctrine of evolution and

Whereas: The forenamed Council affirmed that, per contra, "no scientific generalization is more strongly supported by thoroughly tested evidence than is that of organic evolution;" and

Whereas: The same Council deplored as "a profound mistake" the attempt to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution, which, if it should succeed, "Could not fail to injure and retard the advancement of knowledge and of human welfare, by denying the freedom of teaching and inquiry which is essential to all progress."

Now, therefore, be it Resolved:

That the Kentucky Academy of Science, an organization affiliated with the American Association for the Advancement of Science, does hereby concur in the forenamed resolutions of the Council of that Association in its affirmation of belief in evolution and in the stand it takes for freedom in scientific inquiry, teaching and research.

For the Kentucky Academy of Science.
(Signed) W. R. JILLSON, Chairman,
FRANK T. McFARLAND,
W. H. COOLIDGE.
Committee on Resolutions.

May 12, 1923

Lexington, Kentucky.

Resolutions adopted by the Council of the A. A. A. S., as published in "Science," January 26, 1923, pages 103-4.

RESOLUTIONS ADOPTED BY THE COUNCIL

A Statement on the Present Scientific Status on the Theory of Evolution:

Inasmuch as the attempt has been made in several states to prohibit in tax-supported institutions the teaching of evolution as applied to man, and

Since it has been asserted that there is not a fact in the universe in support of this theory, that it is a "mere guess" which leading scientists are now abandoning, and that even the American Association for the Advancement of Science at its last meeting in Toronto, Canada, approved this revolt against evolution, and

Inasmuch as such statements have been given wide publicity through the press and are misleading public opinion on this subject.

Therefore, the council of the American Association for the Advancement of Science has thought it advisable to take formal action upon this matter, in order that there may be no ground for misunderstanding of the attitude of the association, which is one of the largest scientific bodies in the world, with a membership of more than 11,000 persons, including the American authorities in all branches of science. The following statements represent the position of the council with regard to the theory of evolution.

(1) The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a "mere guess". No scientific generalization is more strongly supported by thoroughly tested evidences than is that of organic evolution.

(2) The council of the association affirms that the evidences in favor of the evolution of man are sufficient to convince every

scientist of note in the world, and that these evidences are increasing in number and importance every year.

(3) The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience; it has promoted the progress of knowledge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

(4) The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress.

Upon motion, duly seconded, it was voted to hold an extra meeting in Louisville to be devoted to a symposium on evolution, arrangements to be made by the Council of the Academy, it being understood that the annual meeting will be in Lexington as usual.

Upon motion, duly seconded, Dr. Jillson's proposal to underwrite the cost of publication and edit Volume I of Transactions was accepted unanimously by the Academy.

The Nominations Committee reported:

For President:............Dr. W. R. Jillson, Frankfort
For Vice-President:.......Dr. A. R. Middleton, Louisville
For Secretary................Dr. A. M. Peter, Lexington
For Treasurer ....Prof. W. S. Anderson, Lexington
For Councilor to the A. A. A. S...Dr. A. M. Peter, Lexington.

The report was adopted unanimously and upon motion, duly seconded, the Secretary was ordered to cast one ballot for all the nominees. This having been done, the Secretary reported them elected unanimously.

There being no further business, the Academy adjourned without date.

(Signed) ALFRED M. PETER, Secretary.

INDEX

END OF VOLUME I

TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

VOLUME TWO
(1924—1926)

Eleventh, Twelfth and Thirteenth Meetings

LEXINGTON, KY
1927

TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

VOLUME TWO
(1924—1926)

Eleventh, Twelfth and Thirteenth Meetings

This Volume was Edited by
A. M. PETER and ETHEL V. T. CASWALL

LEXINGTON, KY
1927

Printed by
James M. Byrnes Co.
Lexington, Ky.

3

CONTENTS

Kentucky Academy of Science

OFFICERS

1923-1924

President, W. R. Jillson, State Geologist, Frankfort.
Vice-President, Austin R. Middleton, Univ. of Louisville, Louisville.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. M. Peter, Lexington.

1924-1925

President, Cloyd N. McAllister, Berea College, Berea.
Vice-President, Sam F. Trelease, Univ. of Louisville, Louisville.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. M. Peter, Lexington.

1925-1926

President, A. R. Middleton, Univ. of Louisville, Louisville.
Vice-President, W. G. Burroughs, Berea College, Berea.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. M. Peter, Lexington.

CONSTITUTION OF THE KENTUCKY ACADEMY OF SCIENCE

(As adopted May 8, 1914, and subsequently amended.)

ARTICLE I.—NAME. This organization shall be known as The Kentucky Academy of Science.

ARTICLE II.—OBJECT. The object of this Academy shall be to encourage scientific research, to promote the diffusion of useful scientific knowledge and to unify the scientific interests of the State.

ARTICLE III.—MEMBERSHIP. The membership of this Academy shall consist of Active Members, Corresponding Members and Honorary Members.

Active members shall be residents of Kentucky who are interested in science, or other persons actively engaged in scientific investigation within the state. Active members are of two classes, national and local. National members are members of the Academy and of the American Association for the Advancement of Science; local members are members of the Academy but not of the Association. Each active member shall pay to the Academy an initiation fee, upon election, and annual dues beginning October 1 next after election, the amounts to be fixed in the by-laws. The amount of annual dues to be paid by a national member shall equal the difference between the amount to be paid by a local member and the amount allowed per member by the A. A. A. S. Any member in good standing may become a life member by payment at one time of a suitable sum, prescribed in the by-laws, and is thereafter relieved from payment of dues.

Corresponding Members shall be persons who are actively engaged in scientific work not resident in the State of Kentucky. They shall have the same privileges and duties as Active Members but shall be free from all dues and shall not hold office.

Honorary Members shall be persons who have acquired special prominence in science not residents of the State of Kentucky and shall not exceed twenty in number at any time. They shall be free from dues.

For election to any class of membership the candidate must have been nominated in writing by two members, one of whom must know the applicant personally, receive a majority vote of the committee on membership and a three-fourths vote of the members of the Academy present at any session or, in the interim between meetings of the Academy, the unanimous vote of the members of the council, present or voting by letter.

ARTICLE IV.—OFFICERS. The officers of the Academy shall be chosen annually by ballot, at the recommendation of a nominating committee of three, appointed by the President, and shall consist of a president, vice-president, secretary, treasurer, and councilor of the American Association for the Advancement of Science, who shall perform the duties usually pertaining to their respective offices. Only the secretary, treasurer and councilor shall be eligible to reelection for consecutive terms.

ARTICLE V.—COUNCIL. The Council shall consist of the President, Vice-President, Secretary, Treasurer and President of the preceding year. The council shall direct the affairs of the Academy during the intervals between the regular meetings and shall fill all vacancies occurring during such intervals.

ARTICLE VI.—STANDING COMMITTEES. The Standing Committees shall be as follows:

A Committee on Membership appointed annually by the President consisting of three members.

A Committee on Publications consisting of the President, Secretary, and a third member chosen annually by the Academy.

A Committee on Legislation consisting of three members appointed annually by the President.

ARTICLE VII.—MEETINGS. The regular meetings of the Academy shall be held at such time and place as the Council may select. The Council may call a special session, and a special session shall be called at the written request of twenty members.

ARTICLE VIII.—PUBLICATIONS. The Academy shall publish its transactions and papers which the Committee on Publications deem suitable. All members shall receive the publications of the Academy gratis.

ARTICLE IX.—AMENDMENTS. This Constitution may be amended at any regular annual meeting by a three-fourths vote of all active members present, provided a notice of said amendment has been sent to each member ten days in advance of the meeting.

BY-LAWS

I—The following shall be the order of business.

1. Call to order.
2. Report of Officers.
3. Report of Council.
4. Report of Standing Committees.
5. Election of Members.
6. Report of Special Committees.

7. Appointment of Special Committees.
8. Unfinished business.
9. New business.
10. Election of Officers.
11. Program.
12. Adjournment.

II—No meeting of this Academy shall be held without thirty days' notice having been given by the Secretary to all members.

III—Twelve members shall constitute a quorum of the Academy for the transaction of business. Three of the Council shall constitute a quorum of the Council.

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

V—The initiation fee for active members shall be one dollar. Annual dues shall be two dollars and fifty cents, for local members, and two dollars for national members. A life membership shall be fifty dollars.

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

VII—The President shall annually appoint an auditing committee of three who shall examine and report in writing upon the account of the Treasurer.

VIII—The Secretary shall be free from all dues during his term of office.

IX—All papers intended to be presented on the program or abstract of same must be submitted to the Secretary previous to the meeting.

X—These by-laws may be amended or suspended by a two-thirds vote of the members present at any meeting.

XI—The program committee shall consist of the Secretary of the Academy and the Secretaries of the divisions with the President of the Academy, **ex officio.** They shall serve from one annual meeting to the next.

In Memoriam

They have crossed the river and are resting
in the shade of the trees.

Percy Kendall Holmes, 1882-1924

Malcolm H. Crump, 1849-1925

Oscar C. Dilly, -1925

Albert Rogers Crandall, 1840-1926

COMPLETE MEMBERSHIP LIST OF THE ACADEMY OF SCIENCE FOR YEARS 1923-4, 1924-5 and 1925-6

"c" indicates Corresponding member.
"h" indicates Honorary member.
"l" indicates Life member.
"*" indicates No longer a member.
"§" indicates Deceased.

The date denotes the year of election to membership.

Name and address	Branch of Science
*-Allen, Harry, '20, Experiment Station, Lexington	Chemistry
Allen, W. R., '23, University of Kentucky, Lexington	Zoology
Anderson, H. C., '23, W. Ky. State Normal School, Bowling Green	Physics
Anderson, W. M., '14, University of Louisville, Louisville	Physics
Anderson, W. S., '15, University of Kentucky, Lexington	Genetics
Averitt, S. D., '14, Experiment Station, Lexington	Chemistry
Baer, Louis, '23, University of Louisvlile, Louisville	Chemistry
Baker, Alson, '26, Berea	Anthropology
Bales, C. E., '23, Louisville Fire Brick Co., Louisville	Chemistry
c-Bancroft, George R., '19, Univ. of West. Va., Morgantown, W. Virginia	Chemistry
Bangson, John S., '26, Berea College, Berea	Biology
Barbour, Henry G., '25, Univ. of Louisville, Louisville	Physiol
Beckner, Lucien, '20, Winchester	Geology
Beebe, Morris W., '23, Univ. of Kentucky, Lexington	Mining & Metallurgy
*-Benjamin, Leonard, '23, Kessler-Hatfield Hospital, Huntington, W. Va.	Bacteriology
*-Best, Harry, '21, Univ. of Kentucky, Lexington	Sociology
c-Blumenthal, P. L., '16, 176 Franklin St., Buffalo, N. Y.	Chemistry
Boggs, Jos. S., '23, State Dept. Roads & Highways, Frankfort	Engineering
Boyd, P. P., '14, Univ. of Kentucky, Lexington	Mathematics
Branham, J. C., '24, Massie School, Versailles	Science
Brauer, Alfred, '26, University of Ky., Lexington	Zoology
§-Brookover, Charles, '23, Univ. of Louisville, Louisville	Medicine
Brown, L. A., '15, Experiment Station, Lexington	Chemistry
Browning, Iley B., '22, Ashland	Geology
c-Bucher, Walter, '22, Univ. of Cincinnati, Cincinnati, O.	Geology
Buckner, G. Davis, '15, Experiment Station, Lexington	Chemistry
Bullard, John F., '26, Experiment Station	Vet. Science
*-Bullock, H. E., '22, Lexington	Geology

Burroughs, W. G., '22, Berea College, Berea ....Geology
*-Butler, J. E., '24, Stearns Coal & Lumber Co., Stearns..........................
h-Butts, Charles, '22, U. S. Geol. Survey, Washington, D. C......Geology
Caldwell, Morley A., '15, Univ. of Louisville, Louisville ....Psychology
Carmichael, H. T., '24, Ky. Asphalt Co., Kyrock, Ky. ....
Caslick, Edward A., '26, Clairborne Stud, Paris ....Vet. Med.
Chalkley, Lyman, '22, Univ. of Kentucky, Lexington ....Law
c-Clark, Friend E., '15, Univ. of W. Va., Morgantown, W. Va..... .... Chemistry
*-Coolidge, W. H., '17, Kenyon College, Gambier, Ohio.........Chemistry
Cooper, Dr. Homer E., '26, Dean State Normal School, Richmond ....Education
Cooper, Mrs. Clara C., '26, Wallace Court, Richmond.............Education
Cooper, Thomas P., '18, Director Experiment Station, Lexington ....Economics
h-Coulter, Stanley, '14, LaFayette, Indiana, Purdue Univ...........Botany
c-Cox, Benjamin B., '22, Univ. of Iowa, Iowa City, Iowa.............Geology
Cox, Meredith, '24, E. Ky. State Normal School, Richmond.....Chemistry
Craig, W. J., '20, W. Ky. State Normal School, Bowling Green ....Physics and Chemistry
§-Crandall, Albert R., '15, Milton, Wisconsin.................................Geology
Crooks, C. G., '15, Centre College, Danville ....Mathematics
Crouse, C. S., '21, Univ. of Kentucky, Lexington.................Mining Eng.
c-Currier, L. W., '22, Syracuse, N. Y..Geology
Davies, P. A., '26, Univ. of Louisville, Louisville...........................Biology
*-Davis, J. Morton, '14, Univ. of Kentucky, Lexington.........Mathematics
h-Day, Arthur L., '14, Director Geophysical Laboratory, Washington, D. C. ....Geology
h-Detlefsen, J. A., '18, Wistar Inst. Anatomy and Biology, Philadelphia, Pa. ....Genetics
Didlake, Miss Mary L., '14, Experiment Station, Lexington........ ....Ent. and Botany
§-Dilly, O. C., '19, Louisville College of Pharmacy, Louisville .... Pharmacology
Dimock, W. W., '20, Experiment Station, Lexington.............Vet. Science
Downing, H. H., '14, Univ. of Kentucky, Lexington............Mathematics
*-Duffield, Will Ward, '22, Harlan..Engineering
Edwards, Philip R., '26, Experiment Station, Lexington....Vet. Science
Erikson, Miss Statie, '26, Univ. of Kentucky, Lexington ....Home Ecs.
Eyl, William C., '22, Lexington ....Geology
Fehn, Arthur R., '24, Centre College, Danville ....Mathematics
Fergus, E. N., '21, Experiment Station, Lexington.................Agronomy
Flexner, Dr. Morris, '26, Francis Building, Louisville...............Medicine
Foerster, M. H., '16, Consolidation Coal Co., Jenkins..................Forestry
c-Fohs, F. Julius, '15, 60 Broadway, New York..........................Geology

Ford, M. C., '23, W. Ky. State Normal School, Bowling Green .... Agriculture
Frank, Dr. Louis, '26, Francis Building, Louisville........Medicine
*-Franklin, Samuel, '24, Ky. College for Women, Danville....Philosophy
*-Freeman, W. E., '14, Univ. of Kentucky, Lexington........Elec. Eng.
Funkhouser, W. D., '19, Univ. of Kentucky, Lexington........Zoology
c-Gardner, J. H., '15, 843 N. Cheyenne St., Tulsa, Okla........Geology
Garman, H., '14, Experiment Station, Lexington........Biology
Gentry, H. V., '23, Louisville Gas & Electric Co., Louisville....Chemistry
Giovannoli, Leonard, '26, S. State St., Ann Arbor, Mich........Zoology
h-Glenn, L. C., '22, Vanderbilt University, Nashville, Tenn........Geology
Good, E. S., '14, Experiment Station, Lexington........Animal Husb.
Gott, E. J., '18, Experiment Station, Lexington........Bacteriology
Graham, Charles, '25, Berea College, Berea........Science
*-Green, R. P., '20, Frankfort........Geology
Grinstead, Wren James, '21, E. Ky. State Normal School, Richmond ....Psychology
Guilliams, John Milton, '25, Berea Normal School, Berea........ Mathematics
l-Guthrie, Dr. William A., '26, So. Ky. Sanatorium, Franklin ....Med. Science
Hamilton, W. F., '26, Univ. of Louisville, Louisville........Geology
Harms, Miss Amanda, '19, Experiment Station, Lexington........Biology
h-Hart, E. B., '19, Univ. of Wisconsin, Madison, Wis........Nutrition
c-Havenhill, Mark, '19, Woodland High School, Woodland, Cal. .... Farm Mechanics
Healy, Daniel J., '14, Experiment Station, Lexington........Bacteriology
c-Hendrick, H. D., '14, Takoma Park, Washington, D. C.....Agronomy
*-Henry, Miss Ruby A., '23, 517 West Oak St., Louisville........Science
Hinton, Robert T., '14, Georgetown College, Georgetown........Biology
§-Holmes, P. K., '21, Univ. of Kentucky, Lexington........Sanitation
Homberger, A. W., '19, Univ. of Louisville, Louisville........Chemistry
Hooper, J J., '17, Univ. of Kentucky, Lexington........Biology
Hopkins, Miss Mariel, '26, Univ. of Kentucky, Lexington......Home Ecs.
Hudnall, James S., '21, Geological Survey, Frankfort........Geology
Hull, F. E., '26, Experiment Station, Lexington........Vet. Science
Hutchins, William J., '25, President Berea College, Berea........
Iler, W. D., '18, Experiment Station, Lexington........Chemistry
Ingerson, M. J., '23, Centre College, Danville........Geology
Irvine, George A., '24, Ky. Utilities Co., Danville ....
*-Jackson, Eugene L., '20, Emory University, Atlanta, Ga. .... Vegetable Histology
Jewett, H. H., '21, Experiment Station, Lexington........Entomology
l-Jillson, W. R., '19, State Geologist, Frankfort........Geology
Johnson, E. M., '25, Experiment Station, Lexington........Agronomy

Jones, S. C., '14, Experiment Station, Lexington........................Agronomy
Karraker, P. E., '15, Experiment Station, Lexington..............Agronomy
c-Kercher, Otis, '19, Pike Co. Farm Bureau, Pittsfield, Ill......Agriculture
Killebrew, C. D., '15, Alabama Polytechnic Institute, Auburn, Ala. .... Physics
King, Miss Effie, '25, Morehead State Normal School, Morehead ....Biology
Kinney, E. J., '15, Experiment Station, Lexington..................Agronomy
c-Kiplinger, C. C., '18, Mt. Union College, Alliance, Ohio.......Chemistry
c-Knapp, R. E., '14, 2232 Cliff St., San Diego, Calif..............Bacteriology
Koffman, Gladstone, '23, Principal High School, Frankfort.........Physics
Koppius, O. T., '25, Univ. of Kentucky, Lexington..........................Physics
Kornhauser, S. I., '23, Univ. of Louisville, Louisville..................Anatomy
Lane, R. C., '26, Univ. of Kentucky, Lexington...........................Geology
Lee, F. S., '23, Middlesboro ....Geology
c-Leigh, Townes R., '19, Univ. of Florida, Gainesville, Fla......Chemistry
Lester, William J., '26, 909 Frederica St. Owensboro....................................
LeStourgeon, Miss Elizabeth, '24, Univ. of Kentucky, Lexington ....Mathematics
Lewis, Charles D., '15, Dean Morehead Normal School, Morehead ....Natural Science
Lynch, John T., '26, Road Engineer, Frankfort........................Engineering
McAllister, Cloyd N., '17, Berea College, Berea.......................Psychology
McCormack, A. T., '20, State Board of Health, Louisville....Sanitation
McFarlan, Arthur C., '24, Univ. of Kentucky, Lexington..............Geology
McFarland, Frank T., '14, Univ. of Kentucky, Lexington.........Botany
McHargue, J. S., '14, Experiment Station, Lexington.............Chemistry
MacIntyre, Miss Thelma, '26, Univ. of Pittsburg, Pittsburg, Pa. ....Zoology
c-McKinnon, Miss Jean, '19, Univ. of Illinois, Urbana, Ill.....Home. Ecs.
McNamara, Miss Catherine B., '25, Geological Survey, Frankfort ....Geology
McVey, Frank L., '18, President, Univ. of Ky., Lexington....Economics
*-Madison, J. T., '23, Frankfort....................................Road Engineering
*-Maney, Charles A., '23, Transylvania College, Lexington.........Physics
Martin, J. H., '15, Experiment Station, Lexington.....................Chemistry
Mathews, C. W., '16, Univ. of Kentucky, Lexington.............Horticulture
*-Maxson, Ralph N., '23, Univ. of Kentucky, Lexington.........Chemistry
Mayfield, Samuel M., '23, Berea College, Berea.............Natural Science
Meader, A. L., '23, Experiment Station, Lexington..................Chemistry
Meier, Henry, '15, 1820 Date Ave., Sanger, Calif.....Math. & Astronomy
Middleton, Austin R., '22. Univ. of Louisville, Louisville.........Biology
Miller, A. M., '14, Univ. of Kentucky, Lexington..........................Geology
h-Miller, Dayton C., '15, Cleveland, Ohio......................................Physics
Miller, J. W., '23, Univ. of Louisville, Louisville..........................Medicine

Miller, Raymond, '26, Univ. of Kentucky, Lexington................Geology
Miller, W. Byron, '22, Wallins Creek................................Engineering
h-Millikan, R. A., '20, Calif. Inst. of Technology, Pasadena, Calif. ....Physics
Miner, J. B., '22, Univ. of Kentucky, Lexington......................Psychology
c-Morgan, Thomas H., '15, Columbia University, New York........Biology
h-Moulton, F. R., '16, Univ. of Chicago, Chicago, Ill.............Astronomy
Newton, H. P., '21, Chattanooga, Tenn.................................Chemistry
Nicholls, W. D., '14, Univ. of Kentucky, Lexington................Farm Ecs.
Nickell, Clarence, '25, Morehead Normal School, Morehead.... .... Chemistry
c-Nollau, E. H., '15, Newburg, N. Y. ....Chemistry
Norwood, C. J., '14, Univ. of Kentucky, Lexington................ ....Mining and Metallurgy
O'Bannon, Lester S., '23, Univ. of Kentucky, Lexington......Engineering
Olney, Albert J., '20, Univ. of Kentucky, Lexington.............Horticulture
Parker, George H., '26, Ky. Actuarial Bureau, Louisville........ .... Engineering
Payne, V. F., '24, Transylvania College, Lexington.................Chemistry
Pence, M. L., '14, Univ. of Kentucky, Lexington.........................Physics
Peter, Alfred M., '14, Experiment Station, Lexington.............Chemistry
Pierce, J. Stanton, '26, Georgetown College, Georgetown.........Chemistry
Piper, W. C., '23, Danville..Physics
Porter, R. E., '23, Ashland Leather Co., Ashland.....................Chemistry
Posey, M. E. S., '25, Dept. Roads & Highways, Frankfort....Engineering
Pryor, J. W., '14, Univ. of Kentucky, Lexington.....................Physiology
Pyles, Henry M., '26, Wesleyan College, Winchester.................Biology
Rainey, F. L., '14, Centre College, Danville............Biology and Geology
Rees, E. L., '14, Univ. of Kentucky, Lexington.................Mathematics
Rhoads, McHenry, '21, Supt. Public Instruction, Frankfort....Education
Rhoads, Wayland, '22, Experiment Station, Lexington........Animal Hus.
h-Richardson, Charles H., '22, Sycracuse Univ., Syracuse, N. Y....Geology
h-Ries, H., '22, Cornell University, Ithaca, N. Y.........................Geology
Roberts, George, '14, Experiment Station, Lexington.............Agronomy
c-Roe, Miss Mabel, '19, 257 Roswell Ave., Long Beach, Calif. ....Plant pathology
Rogers, John C., '22, Lab. Preventive Medicine, Univ. of Chicago ....Medicine
Routt, Grover C., '14, County Agent, Mayfield, Graves Co..........Biology
c-Ryland, Garnett, '14, Richmond College, Richmond, Va........Chemistry
Sandstrom, W. M., '23, Univ. of Louisville, Louisville.............Chemistry
Saunders, J. M., '25, 339 Park Ave., Lexington..
Scherago, Morris, '23, Univ. of Kentucky, Lexington........Bacteriology
Schneib, Miss Anna A., '26, E. Ky. State Normal School, Richmond ....Psychology

Scott, Miss Hattie M., '25, Ky. Geological Survey, Frankfort..................
Shelton, William A., '25, Prin. High School, Vine Grove....Education
Siff, Louis, '15, Univ. of Louisville, Louisville......................Mathematics
*-Slade, D. D., '19, Kentucky Hatchery, Lexington......................Poultry
Smith, George D., '20, E. Ky. State Normal School, Richmond
.... Natural Science
c-Smith, N. F., '15, Citadel College, Charleston, S. C..................Physics
h-Smith, William Benjamin, '23, New Orleans, Lr..............Mathematics
Solomon, Leon L., '20, The Solomon Clinic, Louisville.........Sanitation
South, Lillian H., '20, State Board of Health, Louisville....Bacteriology
c-Spahr, R. H., '14, 237 Willow Ave., Takoma Park, D. C.........Physics
States, M. N., '17, Univ. of Kentucky, Lexington..........................Physics
c-Stiles, Charles F., '14, A. & M. College, Stillwater, Okla......Entomology
Strandskov, Herluf H., '25, Univ. of Louisville, Louisville............
.... Plant physiology
Suter, Arthur Lee, '20, Suter's Drug Store, Washington,
D. C. ....Pharmacology
*-Sweeney, Miss Mary E., '20, Lexington......................Home Economics
c-Tashof, Ivan P., '14, 724 Ninth St., N. W. Washington, D. C.
....Mining and Metalurgy
Taylor, William S., '26, Univ. of Kentucky, Lexington.........Education
*-Thrun, W. E., '23, Univ. of Louisville, Louisville.................Chemistry
Thruston, R. C. Ballard, '15, Louisville...Geology
*-Tigert, J. J., '14, Com'r. of Education, Washington, D. C.
.... Psychology
Todd, E. N., '25, Dept. Roads and Highways, Frankfort.......Engineering
*-Travis, Boyd W., '24, Marlington, W. Va...............................Chemistry
Trelease, Sam, '24, Columbia University, New York......Plant physiology
Tuttle, F. E., '14, Univ. of Kentucky, Lexington......................Chemistry
Valleau, W. D., '20, Experiment Station, Lexington.........Plant pathology
*-Van Becelaere, Rev. E. L., '15..Philosophy
*-Vance, Miss Sarah H., '20, State Board of Health, Louisville
Van Slyke, Edgar, '26, Centre College, Danville..............................Biology
Van Winkle, John S., '42, Centre College, Danville ....Geology
Vaughn, Erle C., '14, Experiment Station, Lexington.........Ent. & Botany
Walker, William H., '26. Berea College, Berea........................Psychology
h-Ward, Henry B., '21, Univ. of Illinois, Urbana, Ill...................Zoology
Waugh, Karl, '23, Berea College, Berea.....................................Psychology
Webb, William S., '14, Univ. of Kentucky, Lexington..................Physics
h-Weller, Stuart, '22, Univ. of Chicago, Chicago..........................Geology
Williams, A. B., '24, Ky. Geological Survey, Frankfort.............Geology
Williams, Charles W., '23, 215-25 Central Ave., Louisville....Chemistry
Wilson, A. H., '24, 41 S. 17th St., Richmond, Ind.....Geology & Zoology
Wilson, Samuel M., '26, Lexington...Law
Wyckoff, Richard Tyson, '26, Indiana Univ., Bloomington,
Ind. ....Education

MINUTES OF THE ELEVENTH ANNUAL MEETING

The Eleventh Annual Meeting of the Kentucky Academy of Science was called to order by President Jillson at 9:45 o'clock in the Physics Lecture room, University of Kentucky, May 10th, 1924, about 50 members and visitors being present.

On motion of Dr. Meier, the reading of the Minutes was dispensed with.

Dr. Peter read the Secretary's report in outline. Upon motion, the report was adopted.

SECRETARY'S REPORT, 1923-1924

Of the 33 persons nominated for active membership at the last meeting all but 3 have paid the initiation fee thereby adding 30 active members to the roll of the Academy, 14 national, 16 local, and one honorary member. We have lost one member by death since the last meeting, Dr. P. K. Holmes. Seven members have been dropt from the list on account of removal from the state and 5 for nonpayment of dues.

The total membership is now 162, including 75 national and 50 local members, making 125 active members; 23 corresponding members and 14 honorary members.

Classified geographically and as to educational institutions our active membership includes:

56 from the University of Kentucky, Lexington,
11 from the University of Louisville, Louisville,
5 from Centre College, Danville,
4 from Berea College, Berea,
3 from Georgetown College, Georgetown,
3 from Western State Normal School, Bowling Green,
2 from the Eastern State Normal School, Richmond,
2 from Transylvania College, Lexington,
1 from Cardome, Georgetown,
1 from the Louisville College of Pharmacy.

Not connected with educational institutions in the state are:

Ten from Louisville, 7 from Frankfort, 4 from Lexington, 2 from Ashland, and 1 each from Shively, Danville, Winchester, Bowling Green, Middlesboro, Wallins Creek, Mayfield, Harlan and Jenkins.

Four new members have been elected since the last meeting by action of the council, viz:

Mr. R. E. Porter, of the Ashland Leather Co., Ashland, Ky.

Dr. Sam Trelease, of the University of Louisville, Louisville.

Dr. William Belknap, of the University of Louisville, Louisville.

Dr. V. F. Payne, of Transylvania College, Lexington.

The new method of collecting dues from national members went into effect October 1st—that is, national members pay their dues now directly to Washington instead of thru their local Academy, the permanent secretary sending check once a month for our share of the dues collected. Article III, paragraph 2 should be amended to cover this new ruling, and notice of such an amendment has been given, in the announcement of the 11th annual meeting.

The President appointed Dr. J. J. Tigert to represent the Academy at the Joseph Leidy celebration in Philadelphia on December 6, 1923. Dr. Tigert was not able to attend, however, because of another engagement, and your Secretary sent the following telegram to the Corresponding Secretary of The Academy of Natural Sciences of Philadelphia: "Congratulations of the Kentucky Academy of Science on the occasion of the celebration of the Joseph Leidy centenary". Signed by A. M. Peter, Secretary. This was duly acknowledged by the Philadelphia Academy.

The President appointed the following Membership Committee: Erle C. Vaughn, Chairman, Henry Meier and W. G. Burroughs.

Abstracts of papers presented at the last meeting were forwarded to "Science" for publication and appeared in that Journal of Sept. 7, 1923. The editor of Science has informed your Secretary that it may not be possible to continue this custom of publishing our abstracts as it takes up too much room in the journal. This is another reason why we should make a special effort to finance our own publications in the form of "Transactions". To this end, we should seriously consider increasing our annual dues.

The extra meeting voted upon at the last meeting, to be held in Louisville, and to be devoted to a symposium on evolution, was not held.

In compliance with the resolution past at the last meeting, Volume I of the Transactions has been published. This has been accomplished thru the kindness of President Jillson in underwriting the cost of publication. Each member in good standing is entitled to one volume free and other copies can be obtained at $1.25 each. The book is bound in paper and contains 150 pages and 5 halftones. Five hundred copies were printed, at a cost of a little more than $600, making the actual cost $1.25 per volume. Inasmuch as the Treasurer has not more than $100 that can be used to pay for this publication, we will owe President Jillson about $500 on the transaction. It will be very helpful, therefore, if the members buy as many extra copies as possible.

Announcements of the Cincinnati meeting of the A. A. A. S. were sent to all local members, who were urged to attend. Our Academy was well represented at this meeting.

No meetings of the council were held, all business, including the election of new members, having been done by correspondence and conference.

At the suggestion of President Jillson, the council, by unanimous letter vote, approved a donation of $25 to the American Institute of Sacred Literature, in aid of their work against anti-evolution legislation. Accordingly, President Jillson mailed our treasurer's check for this amount to Professor Shailer Mathews on March 5th, 1924, and received due acknowledgement.

In accordance with a suggestion from the Committee on Preservation of Natural Conditions, of the Ecological Society of America, a letter was mailed April 3, 1924, in favor of that Society's project of having the region about Glacier Bay, Alaska, reserved as a national monument. A letter of thanks was received from William S. Cooper, Chairman of the Committee of the Ecological Society of America having this project in charge, and one from Arno B. Cammerer, Acting Director of the National Park Service, stating that the land in question had been temporarily withdrawn for classification and determination as to the advisability of its permanent reservation as a national monument. The correspondence is attached to this report.

A request for cooperation has been received from the society of Friends of Medical Progress, Boston, of which Dr. Charles W. Eliot is honorary president. This is a lay society founded for the purpose of counteracting the organized efforts of anti-vivisectionists and others who are trying to hinder scientific investigation in medicine and the application of modern methods of preventing disease. The society works by giving publicity to sane views upon the subject and to the truth as to what investigators really are doing. The society desires an expression from this Academy in approval of this work and also desires to increase its membership. Accordingly, your Secretary has prepared appropriate resolutions for your consideration and has sent a list of our membership to the Secretary of the Society for use in distributing its literature. The correspondence is attached.

An invitation has been received from the general secretaries of the British Association for the Advancement of Science to attend the meeting of that Association in Toronto, August 6 to 13, inclusive, 1924. This means is taken of calling the attention of our membership to this meeting, which will afford an excellent opportunity for coming in contact with leading scientific men and women from abroad. The letter of invitation is attached.

One life membership has been accepted at $25.00, with consent of the Council, and the Treasurer has invested the money in a Federal savings certificate. Our constitution does not provide for life memberships, so I think an amendment should be adopted to cover that point.

Respectfully submitted,

ALFRED M. PETER, Secretary

The Councilor of the A. A. A. S., Dr. Peter, stated that he was not able to attend any of the council meetings and therefore had no report.

Dr. Jillson, for the Committee on Publications, reported that Volume I of the Transactions, covering the first 10 meetings of the Academy, had been in the hands of the printer for some time and soon would be ready for distribution. He urged members to take extra copies to help meet the cost of publication.

Dr. Middleton reported verbally that the work of the committee to cooperate with the Ecological Society of America was about completed.

The President appointed the following committees:

Nominations: Prof. Burroughs, Chairman, Dr. Middleton and Dr. Meier.

Resolutions: Messrs. Beckner, Chairman, and Crouse.

A proposed amendment to Article III of the constitution was read by the Secretary. After some discussion, Mr. Beckner moved that the dues be increased to $2.50. This motion was seconded by Dr. Middleton and adopted unanimously.

The amendment to the constitution, including this change, was adopted unanimously, to read as follows:

Article III—second paragraf:

> "Active members shall be residents of the State of Kentucky who are interested in scientific work. They shall be of two classes, to-wit: National members, who are members of the American Association for the Advancement of Science as well as of the Kentucky Academy of Science, and Local Members, who are members of the Kentucky Academy but not of the Association. Each active member shall pay to the Secretary of the Academy an initiation fee of one dollar ($1.00), at the time of election. National members shall pay to the Secretary of the Academy an annual assessment of one dollar and fifty cents ($1.50) due October first of each year. Local members shall pay to the Secretary an annual assessment of two dollars and fifty cents ($2.50) due October first of each year. Any member in good standing may become a life member by payment of fifty dollars to the Secretary at one time."

The program was then taken up and completed, with an intermission for lunch.

At the afternoon session Dr. L. C. Glenn, of Vanderbilt University, Nashville, Tennessee, addressed the Academy on "Stratigraphy and Structure of the Western Kentucky Coal Field," illustrated with lantern slides depicting some aspects of the human and economic geography of the region.

Upon motion, $80.00 was appropriated from the treasury to be applied upon the cost of Volume I of the Transactions.

The Resolutions Committee reported as follows:

"Whereas, Professor A. M. Miller, a charter member of this Academy and its third President, has been sick for the past two years and is now being treated in a hospital in Indianapolis, the Academy desires to express its sympathy and hopes that the present treatment will prove efficacious and that he will be restored to complete health.

"Whereas—A number of organizations professing various objects, such as vivisection, antivaccination, medical liberty, new thought, christian science and others, have put on foot a wide-spread and dangerous movement to discredit the medical profession and to procure legislation which would prevent the progress of medicine and surgery; and

"Whereas—This movement has come to pass mainly because kindly and well-meaning persons are being misinformed and misled by a few ignorant or fanatical leaders; and

"Whereas—Scientific investigation, including experimentation with animals, has supplied the principal means by which diseases that formerly took fearful toll of human and animal life are now checked or prevented; therefore, be it

"RESOLVED—That the Kentucky Academy of Science strongly approves the efforts of the Society of Friends of Medical Progress to guide public sentiment in the right direction by means of a popular presentation of the facts in the case: that we earnestly oppose the enactment of legislation which would prevent intelligent scientific experimentation with animals and the production and use of vaccines, serums and antitoxins; and that all clear-thinking persons, whether scientists or not, should place themselves on the side of the Society, either by taking membership or by lending moral support.

"That the Academy approves the efforts of Dr. W. R. Jillson, State Geologist, to secure a complete topographical base map of the State, a necessity for so many industrial enterprises.

"That whereas it is impossible to report many of the most important activities of our members in ten minute addresses, and

"Whereas, time should be allowed for the discussion of papers that are read at our meetings, and

"Whereas, this situation discourages many from attempting papers that should be read, thus having a bad effect on our membership, "Therefore be it resolved, that a committee be appointed to work out a system by which this trouble can be remedied or reduced to a minimum and report to the council in time to effect the necessary changes at the next meeting.

(Signed) C. S. CROUSE
LUCIEN BECKNER, Committee

The resolutions were adopted unanimously.

The Resolutions Committee also drafted a letter to be sent to Professor Miller, which was done.

The Nominations Committee reported as follows:

For President, Prof. Cloyd N. McAllister, Berea.
For Vice-President, Dr. Sam F. Trelease, Louisville.
For Secretary, Dr. A. M. Peter, Lexington.
For Treasurer, Prof. W. S. Anderson, Lexington.
For Councilor to the A. A. A. S., Dr. A. M. Peter, Lexington.

The report was adopted unanimously and the Secretary was directed to cast one ballot for the nominees and they were declared unanimously elected.

The Membership Committee recommended the following persons for election to membership in the Academy, and they were duly elected, by unanimous vote.

A. B. Williams, Kentucky Geological Survey, Frankfort.
W. H. Lambeth, Kentucky Geological Survey, Frankfort,
A. C. McFarlan, Department of Geology, University of Kentucky, Lexington,
B. W. Pirtle, Department of Geology, University of Kentucky, Lexington,
H. D. Crider, Department of Geology, University of Kentucky, Lexington,
John S. Van Winkle, Department of Geology, Centre College, Danville
Arthur R. Fehn, Dept. of Mathematics, Centre College, Danville

George A. Irvine, Dist. Mgr. Ky. Utilities Co., Danville

J. E. Butler, Supt. Stearns Coal & Lumber Co., Stearns, Kentucky

Samuel F. Franklin, Kentucky College for Women, Danville

Boyd W. Travis, Asst. in Chemistry, Centre College, Danville

Elizabeth LeStourgeon, Asst. Prof. Math., University of Kentucky, Lexington

Everett A. Carlton, Ky. Rock Asphalt Co., Kyrock, Ky.

H. T. Carmichael, Ky. Rock Asphalt Co., Kyrock, Ky.

V. F. Payne, Transylvania College, Lexington.

J. C. Branham, Head Science Dept., Massie School, Versailles, Ky.

Meredith Cox, Dept. of Chemistry, Richmond Normal School, Richmond, Ky.

A. H. Wilson, Transylvania College, Lexington, Ky.

There being no further business, the Academy adjourned without date.

ALFRED M. PETER, Secretary

The following papers were presented:

President's address. Geology of some proposed State Parks. W. R. Jillson. (The address was published by the Kentucky Geological Survey in a volume entitled "Kentucky State Parks" Frankfort, Ky., 1924, pp 92, 34 illustrations, to which reference is made.

"Cumberland County Oil Horizons;" Lucien Beckner.

Cumberland County is the oldest commercial oil field in the world, its first commercial well coming in in 1839 and pumped thence to about 1860, producing about 50,000 barrels of oil. It experienced "booms" in 1858, 1866, 1894, 1901, and the present one which began in 1920. It may be said at present to be about ten percent developed. It may also be said to be the oldest oil field in the world geologically since many of its best sands are below the Trenton and the deepest one perhaps in the Cambrian. The first well was drilled for salt and its oil production was a calamity, the gullibility of the public permitting it to take commercial rank as the producer of a quack medicine or "cure-all." But long before Col. Drake began the Pennsylvania "boom" which is popularly supposed to begin the drilling for oil in America men were drilling with the set purpose of finding oil in Cumberland County which was to be used for delousing hogs, building fires, burning in lamps, and for internal and external remedies for all the ills the flesh is heir to. But after having been discovered, the field was forgotten; and geologists working on the analogy of the Pennsylvania geology of oil are said to have refused at first to consider the possibility of oil occurring in the Trenton rocks of Ohio because of their age and lack of silica content, knowing nothing about the old Trenton fields of southern Kentucky, America's first producer. Possibly had the geologists given their first study to the Trenton field of southern Kentucky, the development would have spread first into Ohio, the sandstone sands of Pennsylvania would likely have been spurned because of their too great youth and silica content, we may have been just bursting into those rich horizons. What a reversal of history this would have been. But the old lost field has been found again and is pouring out its golden flood, by pumpers and gushers, thru a forty mile pipe line to the railroad at Glasgow, where it goes into the world's business to try and keep John D. Rockfeller and Henry Ford out of the Poor House.

Geologically speaking, the "sands" of Cumberland County fields are all Ordovician save the lowermost which are probably Cambrian and the oldest rocks producing oil commercially in the world.

All surface structure is worked on the bottom of the Chattanooga black shale of Devonian Age. This is a coal black, carbonaceous, fissile shale, so distinctive in appearance, topography, agricultural value and the springs along it, that its outcrop is easily followed. It is from 20 to 30 feet in thickness, averaging 22 to 24 feet. It rests upon rocks of the Richmond stage of the Cincinnatian series of the Ordovician.

All of the Silurian and most of the Devonian do not occur in the County, which is why the Devonian shale rests upon the Ordovician limestone. From the base of the Chattanooga down the rocks encountered by the driller are limestones, sandy, shaly, massive, blue, black, brown, with the exception of the thin stratum of bentonite, a light green to white shale, having a curved pencil like fracture, composed of volcanic ash with minute specks of iron ore, running from 0 to 10 feet and averaging 2 to 3 feet, which is found at about 550 feet under the Chattanooga in the southern part of the County and from 600 to 650 feet in the northern part. This is known to the drillers as the "Pencil Cave" and is the base of the Trenton formation which bears so abundantly in Ohio. Upon it, all the sub-surface structure work is based, the sands being correlated by their distance above or below the Pencil Cave.

Oil seeps occur in several places immediately below the Chattanooga and were the rocks in which such occur covered over with an unbroken rock mantle instead of being cut thru everywhere by the drainage, they might produce commercially. About 40 or 50 feet under the Chattanooga is a "sand" that shows oil in many places and is the oil horizon in the old Phelps well on Oil Fork, the depth of which was 47 feet. At about 160 feet to 190 feet under the Chattanooga is a sand that is usually covered and has produced small commercial wells, the latest well on Fanny's Creek being a 17 barrel producer in it. But these upper sands are so shallow that they have been injured by the surface weathering or by the diastropic movements in which, having no overburden to hold them down, they find their quickest relief in cracking. The first one is Saluda sub-stage of the Richmond; the second is at the base of the Richmond or top of the Maysville; and the last is either Eden or Cynthiana

(Catheys), probably the former. It is often a calcareous sand with grains rounded and fine.

The greatest producing sand in the County to date is the "Upper Sunnybrook" which lies about 250 feet beneath the Chattanooga shale. This is the best producer to date **only** because it is the one first encountered and consequently is the one most developed. The recent well on Galloway Creek that produced over 1,000 barrels the first six hours was in this sand and, owing to its anticlinal position, only 100 feet deep.

The next sand is the "Anderson", about 325 to 350 feet below the Chattanooga. This has produced a number of good wells and is often taken for the Upper and Lower Sunnybrook, so similar is it in appearance.

The next is the "Lower Sunnybrook," about 250 feet below the Upper and about 450 to 500 feet below the Chattanooga. It runs from 30 to 70 feet above the Pencil Cave. The three last sands are known as the Sunnybrook series and are very similar in appearance and performance, but the middle one is the least valuable. They are all dolomites of a rich brown color except that the Upper Sunnybrook is frequently a light gray shelly lime, with streaks of what seem to be pure white sand but which are only slightly quartzitic; none of the sands of the County being more than about 15 per cent quartz. The two Sunnybrooks will run from 5 to 30 feet thick, perhaps averaging 15 feet, but not drilled thru enough to define positively. The Anderson sand is not so thick, running from 5 to 10 feet only.

Beneath the Lower Sunnybrook are 40 or more feet of black lime at the top of which is a black pencil cave, with a fracture similar to the green, and perhaps containing a large proportion of volcanic ash but also containing carbonaceous material and lime. In the bottom of this the Fudge sand, from 5 to 10 feet thick, that has produced commercial wells, notably the Fudge gusher on Dutch Creek, and is watched closely when drilling. Beneath this, usually immediately, lies the green Pencil Cave.

Just under the green Pencil Cave lies the "Judie Sand," named for the Creek upon which it is now producing some wells that come in (rather low on the structure) at about 40 to 70 barrels and settle to 5 to 15 barrels. So far this sand has not gushed but it seems a very steady producer. It is also a dolomite, a brown "sugar sand" and very porous in its type locality.

At 90 feet below the Pencil Cave comes the "Modoc" sand. This is another dolomite and has been drilled to so rarely that it is not well understood as yet but is thought to be about as thick as the Sunnybrooks. In drilling of former years, it was not fully appreciated for it is undoubtedly a permanent sand under the field and has some splendid results to its credit. It first attracted attention last year in No. 1 well on the wonderful Huddleston lease of the Morris Petroleum Company on Sulphur Creek, one of the best wells in the field; and later in the Modoc well of Treat-Simmons & Company in the southern Bear Creek area where it flowed for a time at the rate of a barrel a minute.

Beneath the last sand the oil formations are but poorly known, but in the former drilling campaigns a sand was developed at from 175 to 225 feet below the Pencil Cave, notably in the wells on the Heard lease, from which I have called it the "Heard" sand. The thickness and performance of this sand are unknown to us of this generation but it has been noted lately.

Beneath the Heard sand there is one that ranges from 375 to 425 feet below the Pencil Cave that was developed in some of the former drilling campaigns, notably in the wells on the Cloyd farm, from which I have called it the "Cloyd" sand. Little is known about it save that it has produced some wells. The Kanawha Oil Company has a producer in this sand in their No. 1 John Groce on Upper Sulphur Creek. The Morris Petroleum Company drilled to it in its No. 1 Anderson on Galloway Creek and got a show of oil and a good showing was also obtained in this sand by the Oil Fork Development Company in their No. 1 Bud Huddleston on Bear Creek.

Somewhere below this comes the division between the Ordovician and Cambrian systems; and in the Cambrian, and about 700 to 800 feet below the Pencil Cave, is a sand that is producing in the Kanawha Oil Company's Williams lease on upper Sulphur Creek. This is probably the oldest producing sand in the world. It is the sand that produced the gusher of many years ago on the A. W. Bryant lease on Dutch Creek in the northern part of the County, and the Zach Cloyd No. 3 in 1903, in the Salt Lick Bend pool. It is also doubtless the sand that produces the oil at 1,000 feet below the Pencil Cave in the deep wells of the Illiken Oil Company at Mill Springs in Wayne County, 30 miles east of this field, the normal thickening of the measures to the east accounting for the increased distance from the Pencil Cave.

There is no shallow field in North America with so many pays in the same well, for, while not all of these will pay in the same well, more than one can be counted on for a certainty and sometimes more than two. Another feature is that the Upper Sunnybrook is inclined to be a synclinal sand as well as anticlinal one so that structure is not essential, such synclinal fields as Bear Creek, Neeley's Ferry and Salt Lick Bend proving this to be so. Nor is that the only sand so inclined.

The recent structural work shows that the great structures have been merely touched here and there and that if they will pay as such structures do elsewhere this field has its greatest wells and greatest production in the future and that the excitements of the past will be rivaled and exceeded in the years before us.

"Geographic Influences in the Kentucky Knobs,"* Wilbur Greeley Burroughs.

The Kentucky Knobs are a belt of conical and flat-topped hills and mountains with a narrow strip of rolling land forming their inner margin, which extends in the form of a horseshoe from near Vanceburg on the Ohio River in Lewis County thru portions of the counties of Fleming, Rowan, Bath, Montgomery, Clark, Powell, Estill, Madison, Rockcastle, Garrard, Lincoln, Boyle, Marion, Nelson, Bullitt, Jefferson, to the northern part of Oldham, a distance of 233 miles.

Within the horseshoe formed by the Knob Belt lies the Bluegrass.

Outside of the curve on the east and southeast the Knobs merge into the Eastern Kentucky Mountains. On the south and west the Knobs pass into the Mississippian Plateau. Along the northern ends of the Knob Belt Quaternary and Recent deposits form a narrow strip between the Knobs and the Ohio River.

The strata from which the Knobs are sculptured by erosion extend in age from the base of the Silurian into the Mississippian and in some places into the Pottsville of the Pennsylvanian System.

The principal rivers of the Knobs are the Ohio which flows past the northern extremities, the Licking, Red, Kentucky, Dix, Rolling Fork, and Salt River. These rivers have cut important gateways for commerce thru the Knob Belt, thereby connecting the Bluegrass with the Mountains and Plateau regions. Railroads wind along these river valleys, and tunnel thru the passes as at Boone's Gap. They connect the Knobs with markets in Kentucky and other States.

*This paper is a condensed summary of an investigation carried on for the Kentucky Geological Survey. It was read by permission of Dr. W. R. Jillson, Director, and State Geologist of the Kentucky Geological Survey.

Boats ply back and forth upon the Ohio and Kentucky Rivers.

Numerous smaller streams are also eroding the Knob areas. The gradient of many of the streams is so steep that sudden fluctuations in the volumes of the lower creeks occur after heavy rains or melting snows. The rapid run-off increases soil erosion, thereby ruining large areas of Knob land which under correct farm management could have been made to pay a net income. The valleys and divides have controlled the location of the trails and wagon roads. Streams serve as boundaries between many of the Knob Counties.

The Knobs have a humid, temperate, continental type of climate. The prevailing annual winds are from the southwest, except during a few months in certain sections. The Knobs as a whole have a mean annual temperature of 55.7 degrees. The annual minimum and maximum means are 44.0 and 67.5 degrees, respectively. Killing frosts in the Spring cause damage chiefly to fruits. Fall frosts damage corn and tobacco. The climate permits of the growing of a variety of crops of which corn is the chief cereal. Little rain falls during the Autumn. Snow remains on the ground only a few days at a time. The ground is often frozen as much as six inches deep, but it does not remain frozen continuously, and the process of freezing and thawing is repeated during the Winter. This results in a greater amount of soil erosion than would occur in the Northern States under similar physiographic conditions.

The Knob soils, taken as a whole, are naturally poor and thin. Over most of the area residual soils occur. Those derived from the Ohio shale are usually considered especially poor for agricultural purposes. The soils, however, can be built-up to produce good crops. Fruit-growing on the limestone soils of the tops of some of the knobs is an industry that has yielded excellent returns in certain instances. Soil erosion is rapid on the steep, bare slopes. Unless the land is forested, cover crops should be planted when the land is not in cultivation.

The Knobs contain enormous quantities of excellent shale and clay suitable for the manufacture of many different kinds of clay products. Pottery clay is found near Waco, Madison County. The clay products industries are especially important in the Knob Belt near Louisville, as for example at Coral Ridge.

Sand and gravel are obtained from the rivers, and from weathered Pottsville conglomerate outcrops. The glass sand district of Carter County extends into Rowan County. Sandstone and limestone formations occur in the Knobs. They are suitable for the construction of buildings, foundations, culverts, road metal, etc. The limestone is also used for interior decoration, lime, natural cement, Portland cement, agricultural lime, and many other purposes. Great reserves of stone, favorably situated as to transportation and markets, yet remain untouched.

Coal occurs in small quantities in limited areas near the tops of the highest knobs. It is not an important resource. Oil has been found in large amounts in Knob Counties. It is obtained chiefly from the Onondaga limestone of the Devonian. Oil doubtless still exists in the Knobs in areas as yet untouched by the drill. Oil shale occurs in enormous quantities and is a potential source of wealth for the not distant future. Iron ore occurs, but it is too low grade to compete at present with the high grade ores of other States. In time, however, it also will be a valuable mineral resource.

The water supply of the Knobs is obtained from streams, springs, artificial ponds, and wells. In the Autumn many of the smaller streams dry up. This necessitates driving the cattle of that area to larger streams, generally some distance away. Springs are found in many places. Wells of water can be obtained at a depth usually less than 50 feet. Care should be taken to investigate before using spring or well water for it may have become contaminated and contain typhoid germs.

Pure spring water, and mineral waters containing sulfur, iron compounds, salt and other chemicals occur. Large quantities of spring water are shipped to nearby cities for table use, and the medical waters have earned a well deserved reputation. Salt has been obtained from saline springs and wells since early pioneer days.

The native forests have to some extent been protected by the more rugged topography. The rougher surfaced areas still have a higher proportion of forests per square mile than occurs on the more level districts. The sawmills which cut the logs into smaller sizes or rough lumber, are located in the Knobs and Mountains. Logs are still floated down the Kentucky River to mills at Irvine and farther downstream, but large amounts of rough lumber and logs are carried by rail to the sawmills and planing mills near the cities, as it has been found that transportation by rail has many advantages over transportation by water, especially since the locks have been constructed in the Kentucky River.

In the Knobs the larger trees have been mostly cut, and the slopes are being ruined by erosion or covered by second-growth of less value than the original forests. Correct forestry methods should be practiced and the lumber industry revived in the Knobs. The vanishing of the forests is even reflected in the fewer number of wooden fences and log cabins that are seen on the more level and scantily forested areas, as compared with the more rugged and heavily wooded lands.

The wild animal life of the Knobs consists of birds, rabbits, squirrels, and other small creatures, gray and red foxes and an occasional wildcat. Copperheads and rattlesnakes are sometimes seen. The streams that flow intc the Kentucky River afford good fishing, particularly near their mouths. Here and there are found ponds which have been stocked with fish.

The more level or rolling areas have a higher percentage of land improved, than the rougher districts. Drainage of swamp land is not a problem often met in the Knobs on account of the rapid fall of the streams. An extensive swamp, however, once existed in the vicinity of South Park, Jefferson County. It is now drained and the land is being farmed. Tile and other forms of drainage will improve the crop yield of the Knob soils even where the ground is not actually swampy.

The total number of farms increased during the last decade. At the same time the average farm became smaller by subdivision. On the richer limestone soils it was possible to reduce the size of the farm without unduly lowering the standard of living to the extent it might have been lowered if the country had been entirely rough knob or Ohio shale topography. Cultivation of tobacco often enabled the farmer to make a living from fewer acres of land than otherwise might have been possible.

The per cent of increase in land values bears a relation in most of the Knob Counties to the increase in the number of farms. Increase in the number of farms coincided with increase in the average value of farm property. Discoveries of oil in Estill County had a greater influence, however, upon the increase in value of farm land than did the additional number of farms formed in that county.

The topography also greatly influences the value of the land. Rugged counties with their poorer soils and more numerous difficulties in farming and in reaching a market, have lower land values, other things being equal, than the more level Knob Counties.

The per cent of increase in valuation bears a relation to the amount of improved land per farm. In the more rugged counties the per cent of increase in valuation from 1910 to 1920 was large, but the actual increase in valuation was a fewer number of dollars per acre and there was a smaller number of improved acres per farm, than in the more level

Knob Counties. Of course, the greater acreage of improved land per farm usually was dependent upon the fertility of the soil and the ease with which the land could be cultivated, so that the increase in valuation per acre was determined fundamentally by the geographic conditions.

The increase in price of all farm products a few years ago caused an increase in land values. The per cent of in crease in land values was greatest, with few exceptions, where tobacco was grown extensively. This was because the value of an acre of land is dependent largely upon the net earnings which can be secured from it.

The decline in price of farm products which followed the period of prosperity resulted in a sharp decline in land values. The more mountainous counties which did not raise so much tobacco and other crops that had a severe fall in price, did not have their land values decrease as much as the richer, more level areas where tobacco and other crops which had fluctuated widely in price, were raised extensively. The assessed value of all farm property per farm, and the farm incomes from gross crop returns, are larger in the richer, more level Knobs than in the hilly districts.

The principal crop is corn. Other cereals raised are oats, wheat, rye, and barley. The reasons that corn is grown so extensively on the more level, richer soils is because the yield per acre is good, being above the average for these counties and one man can farm many acres with machinery. Thus a greater number of tractors are used on the farms of the more level Knob Counties than in the rougher surfaced counties. Corn is fed to the live stock in the richer farming districts of the lowlands where animal husbandry is carried on more than in the hilly districts. In the rougher surfaced areas of poorer soils, corn is grown because it requires but few and inexpensive tools to plant, cultivate, and harvest this cereal. The steep slopes make farming with machinery not advisable and often economically impossible. Corn yields more per acre than the other small grains which might be raised. It yields fairly well even when poorly cultivated, provided the soil has not already been cropped too many years in succession. Corn can be stored readily and fed to the animals on the farm. Thus transformed into meat on the hoof, it can be gotten to market more easily than raw corn. Also corn is of less value per pound than the meat into which it can be changed on the mountain and knob farm. It is thus more economical to transport as meat, especially when the animal is made to walk to market. Corn is ground at the local mill and used for food by the farmer's family.

Irish potatoes are produced in large quantities near Louisville, where two crops of potatoes are raised the same year. The nearness to transportation lines and to large markets are important factors in locating the potato industry in Jefferson County.

Sorghum is raised in greater amounts in the more remote and inaccessible areas where all of the necessities of life are produced as far as possible on the farm, than in the districts nearer to the outside world.

Tobacco is the chief cash crop on many of the farms. If the patch is large and the farmer does not hire help, the work is performed by the entire family. Tobacco furnishes quite steady employment thruout the year, but it exhausts the soil rapidly. Unless the soil is cared for properly, erosion completes the ruin of the field. Farmers who depend almost entirely upon their tobacco patch for their ready money are unwise, as unfavorable climatic conditions may cause a loss. The average yield of tobacco per acre in the Knob Counties is decreasing. The price of tobacco has an important influence upon the acreage planted and on land values.

Truck garden crops and small fruits are raised mostly near the large towns and cities, such as Louisville, where a good market is assured. Orchard fruits are grown quite extensively in the Knobs. The climate is suitable, but frosts sometimes cause considerable damage.

The animal industries are increasing in the Knobs. Dairy and beef cattle are found in the more level areas in greater numbers than in the hilly districts. Dairy cattle are kept, especially for the sale of whole milk, near the large cities. Butter, cream, and cheese, for well known economic reasons, can be produced with a profit farther from market than can whole milk. Beef cattle are fattened in greater numbers on the richer, more level Knob and Bluegrass soils than in the hills. The more level counties which had the greater number of cattle, also raised more hay and forage per square mile in 1919 than was grown in the hilly districts.

More horses are kept per square mile in Knob Counties which have wider areas of level and rolling land than in the rougher regions. Horses, however, are decreasing, due to automobiles, better roads, tractors, and by mules displacing horses. Mules, which can do heavier work than horses and are considered surer footed on the steep, rough knob and mountain slopes, increased from 1909 to 1919. This increase was greatest in the hilly Knob Counties.

The sheep industry is often associated with hilly land, but due to losses incurred by dogs where the sheep are not carefully fenced and guarded, sheep are kept in greater numbers on the richer, more level farms than in the rougher districts. Swine, in general, are raised and fattened in greater numbers on the richer, more level farms. On the average, counties containing the largest numbers of swine also produced heavy yields of corn per square mile of territory. Poultry and bees are profitable industries in the Knobs. The hilly counties have increased their production of honey greatly since 1909. Poultry products and honey are products of high value per pound that can be brought to market over rough roads and shipped economically long distances.

The summits of flat-topped knobs in certain regions still have the remains of forts which were built by the pre-historic inhabitants of Kentucky. Such a fort is that of Indian Fort Mountain, near Berea, Madison County, which was described by the author at the tenth meeting of the Kentucky Academy of Science.*

The rockhouses in the cliffs of the higher knobs, and mounds in the stream valleys and on the crests of even the lower knobs, are the graves of these first Kentuckians. In the graves can still be found the bones of these people, together with their implements of peace and war. Also in the graves are layers of charcoal which are the remains of fires that burned at the time of burial. Bones, apparently from sacrifices, have been found by the author in the charcoal of certain graves.

Most of the rural population of the present day come from Scotch-Irish, Irish, and English settlers of pioneer times. The names of these inhabitants of the Knobs bear evidence of their direct descent from these early settlers. At present native white farmers are increasing in numbers in the Knobs, and the few negro and other non-white farmers are decreasing in numbers.

Living conditions, especially on Ohio shale soils, are difficult for the farmer of small means. The limestone soils usually have more prosperous farms. The farm income might be increased by weaving and basket making which are industries that can be developed in the home. Better roads will greatly improve farm life and increase farm incomes and farm values. These better roads are gradually being made. As it is, the inexpensive, light weight automobile, the United States Rural Free Delivery, and the radio have brought the country people into closer union with the towns and outside world.

Illiteracy exists to a higher per cent in the more rugged counties than in the level and rolling counties. It has decreased during the last decade. The rural schools are a fundamental factor in the educational development of the

*Transactions, Vol. 1, P. 146.

Knobs. They should be aided in every way. Roads should be improved so that the children can attend school even in bad weather. Reading circles are being organized under the auspices of the Berea College Library. In this way many of the older members of the community are being educated. High schools, academies, normal schools, and colleges are located in many of the Knob towns.

Health conditions can be improved. The death rates from tuberculosis and pneumonia are both greatest in the Bluegrass with its large cities, the Knobs ranking second, and the Mountains third. A breeding place for germs in the Knobs is the ill-lighted, poorly ventilated and aften overcrowded one-room dwelling.

Typhoid fever is more prevalent in the Knobs than in the Mountains or Bluegrass. The reason may be that in the Knobs the dwellings are often nearer together than in the Mountains. Thus unsanitary conditions would tend to spread disease more easily than in the sparsely populated Mountain areas. In the Knob Belt contaminated water readily seeps along the joint and bedding-planes of the Ohio shale and enters wells and springs. Polluted water is carried underground in streams in the limestone formations of the Knobs. The better sanitary conditions and city water supplies of the Bluegrass cause a lower death rate in that physiographic division.

Hookworm and trachoma occur and cause much suffering. Hookworm can be easily cured, as also can trachoma in the early stages. Both diseases can be avoided.

The more hilly counties, with their low average value per acre, do not have nearly so high a percentage of tenants on the farms, as do the counties containing large areas of more level land of a much greater value per acre. Jefferson County, however, has a rather small per cent of tenancy even tho the average land value is high. This is due to the nearness to Louisville and the intensive farming that is practiced in this county where numerous owners care for their own truck farms. Tenancy in the Knob Counties has increased 30.2 per cent during the last twenty years. This increase in tenancy has been chiefly in counties containing rich, level soils.

The Knob Belt contains the cities of Irvine and Lebanon. Irvine owes its rapid growth to the discovery of oil in Estill and adjacent counties. Railroad shops are now located near Irvine. Part of Louisville is built on Knob strata.

The density of the rural population in the Knob Counties in 1920 was 47.1 per square mile. The rural population to a small extent during the last decade has moved from the farms to the cities.

Counties having large areas of level or rolling land with richer soils, rank highest in total taxable wealth both per square mile and per capita.

In conclusion it should be remembered that great as has been the development of the Knobs up to the present time, enormous undeveloped natural resources yet remain in the form of clay, shale, building stone and rock for other purposes, oil shale, oil, gas, and farm land that will yield well under scientific management. The steep slopes await modern forestry methods. Sheep and other livestock can be increased. Poultry and bees will add to the farm income. Fruit growing can be developed still further. Near the cities market gardening can be carried on. Good roads will aid in every way. If the potential possibilities in the Knobs are developed, an increasing revenue will result to the individual citizen, to the County, and to the State..

Hydro-Electric Development of Dix River: John S. Van Winkle.

The builders of Kentucky's first large water driven electric power plant give their tribute to Daniel Boone, who first discovered the power possibilities of Dix River. In 1784 a pamphlet was printed at Wilmington, Delaware, entitled the "The Discovery, Settlement and Present State of Kentucky," wherein the intrepid Boone gives a statement, which follows: "Dick's river runs through a great body of first rate land, abounding with cane, and affords many excellent mill seats. Many mills are already built on this stream x x x and will have a plentiful supply of water in the dryest season." Two items above stated must have passing reference, the first relating to a change in spelling the name "Dick's", now expressed with three letters "Dix". The old way was altered by usage, as appears in County records, as far back as 1830. As to the second item, unfortunately, there is not a plentiful supply of water in the dryest season in the streams of our State in these days, owing to depletion of the forests. The same quantity of water falls, but races away to the seas in floods, carrying precious soil with it. The Dix river dam will be of such great height that all water will be arrested and held back for driving the turbines thruout all seasons, even dry ones. Early Kentucky history, and Daniel Boone a history maker, thus have recognition in the modern life in our Commonwealth.

This generation presents another pioneer in the person of Mr. L. B. Herrington who, while yet quite a young man, and aided by a group of supporters, caused the researches which convinced finally the present-day builders that Dix river should be the site of a great "mill seat".

Nearly 15 years before construction commenced, geolegists were called to study the rock formation. In this direction the Departments of Geology of the State of Kentucky and of the University of Kentucky sent qualified men to examine the structure to ascertain whether there might be caverns in the massive limestone cliffs that would permit an escape of impounded water; and, to test the quality of the rock which would be covered, and possibly disintergrate, by constant exposure to water under high pressure. This work was done with the care and thoughtful consideration which commends the geologist as a "practical" man to modern men who supply the finances for great enterprises like this. The reports of the geologists gave assurance that the rock walls of Dix river canon had no caves that would lead the water, behind the dam, into channels of escape; and, further, that the stone underneath the proposed dam site might be relied upon to sustain in safety any weight that was imposed there by the structures contemplated.

Other men of science, eminent engineers, were called many years ago to apply the rules of their calling to the problem of constructing a dam and placing water wheels in Dix river to the end that its destructive tides might be turned into useful electricity.

Before engineers may discover the capacity of a stream in terms of electric energy, they must know what has been the rainfall, and consequent "run-off" of water for a long period of years. Records of rainfall were at hand, showing the daily precipitation within the watershed of Dix river, since 1892. In company with rainfall statistics, there must have been simultaneous records of the amount of water which flowed thru the channel, before the engineer can compute the result in electric energy. This information was not lacking, for the stream gage had been installed. In course of their studies the engineers also found that Dix river was worthy of its early reputation as a source of power, hence they made maps of the strangely sinuous canon thru which it flows, measuring its width and finally computing the areas to be occupied by impounded water in billions of cubic feet. A sentence description of the windings of this river may be compassed in this statement: from the dam to the limit of the pool back water will be 35 miles by way of the channel, whereas a straight line between these extrems will be little over 10 miles.

Gathering of data mentioned consumed several years, for such information can only be had from the records of accumulated seasons; therefore, the decision to erect a hydro-electric project may not safely be hurried. In the year 1915 the interest of Mr. Samuel Insull and his brother, Mr. Martin J. Insull, of Chicago, was drawn to the Dix river project. This marked the beginning of still further thoro investigation, a first step in which was to have cores taken from below the surface at the dam site. Many holes were drilled with the usual diamond core bit, some to the depth of 200 feet, with the result that firm stone was found to the lowest level touched. Dams, these days, are not built until the diamond drill has explored the sub-structure, bringing up samples for testing. Some of the disasters which have followed the construction of dams, so often discussed by the people when a new dam is begun, would never have occurred had the builders drilled deep at their foundations.

Next came the delay caused by the great War, during which, and for the unsettled period immediately following, little was done save maintain the gage station whereby still more information was gained as to the quantity of water that passed down the river at all seasons.

After a delay of some five years, progress became possible and here enter the lawyers with the task of looking into the title records of three counties. This work went along rather constantly many months, for there were near 200 tracts of land to be acquired. In most cases but a small portion of an owner's property was needed, that part which was along the river bank and in the cliff adjacent. Exploring the bed of Dix river, in the records, revealed many of the ancient mill seats forecast by Daniel Boone. There remained, however, but one mill dam still intact. Steam, electricity, gasoline and modern transportation leave small business to the slow wheels of a water-mill.

Early in 1923 enter again the men of science, this time engineers fresh from similar hydro-electric projects, situated in many portions of the United States. The problems of a high dam, types of structure, designs of turbines and all the intricate, delicate details of electric machinery are but parts of a day's work with them. Applying themselves to the collected data, making new observations of the materials provided by Nature, using the experiences of other engineers and builders of great dams in many remote parts of the earth, they assemble and balance all elements, physical and financial, and prepare a plan. After many weeks of constant study, a report is ready which recommends the construction of a rock-fill dam, which is to be the highest yet constructed in all the earth, 270 feet from its base to crest. Safety is the first consideration; the dam must be so secure and dependable that the dwellers in the valleys of the Kentucky and Ohio rivers may sleep with no thought of danger because of the vast lake of water above their cities.

Representing the United States, in this demand for safety, came Mr. Arthur P. Davis, then chief engineer of the U. S. Reclamation Service, under whose direction about 100 dams had been built by that single branch of our Government, one of which (in Idaho) is full 300 feet in height. Besides requiring the highest factor of safety in the dam itself, a by-pass for any overflow water was specified, this spilway to be cut so wide and its floors so inclined that it would readily carry a flood produced by the fall of 20 inches of rain in a period of 24 consecutive hours. Such a by-pass is being cut thru solid limestone, 250 feet in width, and will have walls 100 feet in height. The lower end of this by-pass will discharge into a natural ravine which enters the gorge of Dix river half a mile below the dam. No one need fear that this dam will ever menace the life or property of those who live below it.

To the capable minds of Mr. Geo. W. Hamilton, chief engineer of Middle West Utilities Company and Mr. L. F. Harza, consulting engineer, both of Chicago, had been intrusted the problems of construction and design. They have called from California a well trained assistant in Mr. Geo. W. Howson, as resident engineer, to watch every detail. Final plans call for three turbines, each of 10,000 horsepower, to be installed in connection with a like number of electric generators in the power house to be situated at the mouth of a tunnel, immediately at the foot of the dam. This tunnel is to be 900 feet in length, cut thru the solid rock on the level of the river bed, at the upper end opening thru a control valve into the water of the lake, and at the other end terminating in three penstocks, each eight feet in diameter, one for each turbine.

Despite the many years that have been required to promote and bring into active construction this great project, the lapse of time should not be considered a loss. Aside from well considered plans, preceding actual work, a decided improvement has been made in both the water turbines and electric equipment with which this plant will be equipped. This will be a gain for the generations to be served by this truly great enterprise.

Marine Invasions in Eastern Kentucky in Pennsylvanian Times: J. S. Hudnall

Marine invasions in Pennsylvanian times in Eastern Kentucky were numerous, as evidenced by thin limestones and carbonaceous shales laid down during this great coal forming period. The time of these invasions is given below in ascending order with mention of the character of the strata formed.

1. Below the Pottsville Conglomerate. The carbonaceous and calcareous shales below the conglomerate indicate a marine invasion during the initiation of the Pennsylvanian sedimentation.

2. Inter-conglomerate. Between the Corbin conglomerate and Rockcastle conglomerate, members of the Pottsville conglomerate there is from 0 to 50 ' of black calcareous shale, containing Lingula, which is of marine or brackish water origin.

3. On top of the Pottsville Conglomerate. Following the formation of the conglomerate there was a time of marine invasion more widespread than any preceding it, as shown by the widespread carbonaceous and calcareous shale containing marine fossil brachiopods.

4. Campbell Creek Limestone. Above the Pond Creek Coal and below the Wayland Coal is a thin limestone 2' in thickness interbedded in a marine shale containing many limestone concretions and fossil brachiopods.

5. Kendrick Shale (Dingess Limestone). Immediately following the formation of the Amburgy coal the sea was widespread covering all of Eastern Kentucky and most of West Virginia. Many brachiopods, molluscs, and cephalopods give testimony to this time of epicontinental sea expansion. From 2' to 5' of limestone and 100' to 150' of calcareous shale were formed.

6. Fossil Limestone. Following the formation of the limestone coal (second coal above the Fire Clay Coal) the epicontinental sea again spread over Eastern Kentucky, parts of West Virginia and Eastern Tennessee. This invasion was perhaps of longer duration than any previous and teemed with marine life.

7. Kanawha Black Flint. Following the formation of the Hindman coal a marine invasion of considerable consequence occurred. During this time the Kanawha Black Flint of West Virginia was formed.

8. Flint Ridge Limestone. Late in the Allegheny or early Conemaugh times the epicontinental sea perhaps reached its maximum expansion during the Pennsylvanian times in Eastern Kentucky. From 10' to 40' of limestone was formed rich in marine fossils.

9. Conemaugh Invasion. In what is now the youngest formation in the Pennsylvanian sediments is a marine limestone interbedded in red shale in Boyd County. The extent of this invasion can only be inferred.

Present data indicate that there were two areas from which expansion of the seas occurred during the Pennsylvanian time: (1) Northeastern Kentucky (in Boyd and Lawrence Counties) and (2) Southwestern Kentucky. Perhaps the latter invasion crossed the Cincinnati Arch between the Nashville and Rutherford dome thru Cumberland, Clinton, and Russell Counties, Kentucky.

The Proportion and Significance of Copper, Iron, Manganese and Zinc in Some Mollusks and Crustaceans.* by J. S. McHargue, Research Chemist, Department of Chemistry, Kentucky Agricultural Experiment Station.

The purpose of this paper is to report analyses which show the proportions of copper, iron, manganese and zinc in a few species of mollusks and crustaceans and to point out the significance of the occurrence of these metals in animal life. In considering the data presented it is important to keep in mind two facts: first, that small amounts of these elements are widely distributed in nature and can be found by chemical methods in rocks, soils, waters, plants and animals; and, second, that some of these elements occur in greater proportion in some species of animals than in others—a fact which suggests the idea that compounds of these metals perform important functions in the metabolism of the animals in which they are found.

Bradley[1] analyzed for manganese several hundred specimens of the mollusks, Unio and Anodonta, from streams and lakes in the northeastern and north central parts of this country and determined the amount of manganese in more than 60 independent samples. His results show about one per cent of manganese in the dry matter, or about four per cent in the ash. He states that manganese is constant and uniform in its occurence in these mollusks, and concludes that this element has important functions in the metabolism of these two genera.

Griffiths[2] studied the composition of the blood of the mollusk, Pinna squamosa, and isolated from it a compound which he has named pinnaglobin. According to his results

---

*Read also at the Fall Meeting of the American Chemical Society.

[1]Bradley. H. C., Jour. Biol. Chem., Vol. VIII, p. 237-249. 1910-11.

[2]Griffiths. M. A. B. Paris, Academie des sciences, Compt. Rend. V. 114, p. 840, 1892.

the pinnaglobin molecule has the composition, $C_{724}H_{935}$-$N_{183}MnS_4O_{210}$. He states that pinnaglobin has a respiratory function in the blood of Pinna squamosa similar to that of hemoglobin in red blood and hemocyanin in blue blood. Pinnaglobin, therefore, affords an example in which manganese apparently replaces the respiratory function that iron performs in red blood. The blood of the fresh-water mollusks Unio and Anodonta is colorless and because of this fact one would infer that it contains very little of either iron or copper.

Willard[3] determined the copper content of thirty-four samples of oysters obtained at New York, Manhattan, Philadelphia, Baltimore, and Washington. His results show a minimum of 50 parts per million, a maximum of 1,700 parts per million and an average of 480 parts per million of copper in the dry matter. He states that in no instance was copper absent and because of the uniformity of the presence of this metal he concludes that copper is a normal constituent of oysters.

It is generally assumed that certain species of crustaceans contain the most copper of any shellfish. The lobster and the crab have been referred to as examples of animals having blue blood, the blue color of their blood being due to the presence of the respiratory pigment, hemocyanin, whose molecule has the composition, $C_{867}H_{1363}N_{223}CuS_4O_{258}$ in which copper is supposed to perform a similar function to that of iron in hemoglobin and manganese in pinnaglobin.

For the purpose of determining the proportion of copper, iron, manganese and zinc in a few of the more important edible species of mollusks and crustaceans the following samples were obtained for analysis, all but the first having been bought of a local dealer in sea foods:

Unio and Anodonta. A sample consisting of about twenty-five specimens, some of which were small, others medium

[3]Willard J. T. Jour. Amer. Chem. Soc. Vol. 30, p. 902, 1908.

and a few full size, was collected on April 12, 1924, from North Elkhorn Creek near its intersection with Russell Cave Pike. The exterior surfaces of the shells were cleaned by means of tap water and a brush and the bodies dried at 110° C. The fresh bodies contained 86.1 per cent of water. The moisture-free bodies were ashed and the amount of copper, iron, manganese and zinc determined by means of standard methods of chemical analysis.

Clams (Venus mercinaria) One hundred clams obtained at Crisfield, Maryland, were delivered at the laboratory alive and in good condition. They were cleaned and dissected from their shells and dried at 110° C in the same way as the mussels. They contained 88.3 per cent of water.

Oysters (Bluepoints). One hundred oysters, from Baltimore, were delivered at the laboratory alive and in good condition. Their shells were cleaned and the bodies dissected and dried at 110° C in the same way as described except that a further dissection was made of a few of the oysters after they were removed from their shells. The digestive organs which have a dark brown color, including the stomach and liver, were dissected from the rest of the body, and each of the two parts placed in a separate, clean dish, dried at 110° C and ashed, for analysis. Some liquid was lost in the process of dissection. The fresh whole bodies contained 89.7 per cent of water.

Lobsters (Homarus americanus). Two medium-sized lobsters, having a total weight of 1466 grams, were obtained from Baltimore, Maryland. They had been killed and packed in ice, and were in a fresh condition when delivered at the laboratory. The bodies were rinsed with distilled water and dissected into three parts, shell, thorax and abdominal contents, and tail and leg meat. Each of the three portions was dried at 110° C and analyzed separately. The tail and leg meat contained 80.75 per cent water; the thorax and abdominal contents, 78.4 per cent; and the shells, 40.2 per cent.

Crabs (soft shell) One dozen soft shell crabs, obtained from Norfolk, Virginia, were delivered at the laboratory alive and in good condition. Their bodies were washed under the tap, rinsed with distilled water, placed in a clean porcelain dish and dried at 110° C, for analysis. They contained 86.7 per cent of water. The results recorded in Table 1 represent the entire crab.

Table No. 1.—Copper, iron, manganese and zinc, in parts per million of the moisture-free substance:

	Copper	Iron	Manganese	Zinc
Fresh-water mollusks, Unio and Anodonta, in a mixed sample	12.3	1,325.0	5,424.0	750.
Salt-water mollusk, Clam (Venus mercenaria)	16.1	711.0	42.5	1,359.
Salt-water mollusk, Oyster (blue points)	230.7	207.6	49.4	4,284.
Oyster stomach and liver	117.0	91.6	13.5	2,970.
Oyster mantle, etc.	174.0	233.1	34.8	3,793.
Lobster, tail and leg meat	85.0	53.8	12.0	160.
Lobster, thorax, stomach, etc.	160.0	134.4	64.0	128.
Lobster, shell	35.0	112.0	40.0	202.
Crabs, whole	68.0	134.4	16.0	1,216.

In the foregoing table some of the results appear to be outstanding in their significance and therefore worthy of comment. The mixed sample of the fresh-water mollusks Unio and Anodonta contains more than four times as much manganese as iron. The manganese content represents a little more than one-half of one per cent of the dry matter. The proportion of manganese is a little less than those reported by Bradley. The blood of the mollusks Unio and Anodonta is colorless and therefore apparently contains little, if any, hemoglobin, altho considerable iron is present in the tissues of their bodies. It is stated that the corpuscles in the blood of fresh-water mollusks are similar in structure to the white corpuscles in the blood of man. It is to be assumed that these two species of fresh-water mollusks also contain in their blood a manganese globin which performs a respiratory function in their metabolism. Their habitat and method of locomotion is such as to make the respiration of oxygen indirect and therefore requiring different and perhaps a more efficient means for the transfer of oxygen than would be the case if their blood contained hemoglobin.

It is also of interest to note that these mussels apparently assimilate small amounts of copper and zinc from fresh water which contains only very small amounts of these elements, and that they contain more than one hundred times as much manganese as the clam, altho it appears that the environment may have been more favorable for manganese assimilation in the case of the clam than in the case of the fresh-water mussel.

The iron content of the clam is a little more than half the iron content of the mussel, and the zinc content of the clam is nearly twice that of the mussel.

The copper content of the clam is only a little more than that of the mussel, altho the opportunity for copper assimilation must have been much more favorable in the case of the salt-water mollusk.

The results obtained on the sample of oysters are of particular interest because of the relatively large amounts of copper and zinc contained in the bodies of this mollusk. Zinc exceeds copper nearly twenty times and copper exceeds manganese by nearly five times. The blood of the oyster is colorless, which indicates that very little, if any, either of hemoglobin, which is red, or of hemocyanin, which is blue, is present in the blood of the oyster. That copper does function in the metabolism of the oyster there can be little doubt, tho from the color of its blood it appears that copper is in some other form of combination than as hemocyanin.

The fact that the oyster is richer in zinc than in any other metals considered and that its blood is colorless indicates that zinc probably plays a predominating role and copper a role second only in importance to it in the metabolism of this species of mollusk.

The analyses of separate parts of the oyster show that the mantles and gills etc. are richer in the different metals than are the digestive organs. This fact indicates that these metals have been assimilated in the metabolism of the oyster and are not accidental in their occurrence.

The results also show that two different species of salt-water mollusks, the clam and the oyster, living under a similar habitat, utilize the elements copper, iron, manganese and zinc in quite different proportions in their metabolism.

The lobster has long been regarded as the king among blue bloods. However, judging from the amount of copper found in the different portions of the lobster, it is apparent that the oyster contains considerably more copper than the lobster, neither is the blood of the oyster blue. The stomach and thorax of the lobster appear to be richer in copper than the other parts analyzed. It is quite probable that the liver of the lobster is richer in copper than any other of its organs. The edible portion or tail meat contains quite appreciable amounts of both copper and zinc.

The crab contains appreciable amounts of copper and considerable zinc. The soft-shelled crab contains perhaps as much copper in its edible tissues as the lobster and considerably more zinc. Since the shell was included in the analysis of the crab it is quite probable that the edible meat would give a larger figure for copper than that in this analysis.

The writer has shown that the leafy parts of plants and the germs and pericarps of seeds contain small amounts of the elements copper, manganese and zinc and in highly milled cereal products most of these elements are eliminated in the bran and offal. Heretofore it has not been generally accepted that the small amounts of copper, manganese and zinc known to occur in the higher forms of animal life, including man, have any particular function to perform in metabolism. However, recent investigations tend to show that small amounts of these elements perhaps are essential in the metabolism of higher animals, including man. It is evident that the consumption of oysters, clams, lobsters and crabs and other sea-foods will supply the minerals which have been eliminated in the highly milled and demineralized cereal products which form a very important part of our diet.

Summary and Conclusions

(1) Of the shellfish tested, manganese occurs in largest amount in the fresh-water mollusks Unio and Anodonta and is undoubtedly an essential factor in their metabolism. It is to be assumed that the blood of these mollusks contains a globin in which manganese performs a respiratory function similar to that of iron in hemoglobin of red blood and of copper in hemocyanin of blue blood.

(2) Different species of mollusks living under a similar habitat apparently assimilate different proportions of the elements copper, iron, manganese and zinc.

(3) From the relatively large amounts of copper and zinc found in the oyster it is reasonable to assume that each of these elements performs a vital function.

(4) The samples of lobster and crab analyzed did not contain as much copper and zinc as the oyster, a fact which probably explains the more general use of the latter in the diet.

(5) Further work is contemplated on the proportion of copper, iron, manganese and zinc in vertebrates and invertebrates.

Physiological Balance and Antagonism in Nutrient Solutions for Wheat: Sam F. Trelease, Helen M. Trelease, and Joseph Carmin, University of Louisville.

Studies have been made of growth in very young wheat seedlings supplied with solutions containing one or more of the salts, potassium dihydrogen phosphate, calcium nitrate, and magnesium sulfate. One of the principal aims of these studies was to attempt to work out a method which would allow some of the problems of the salt nutrition of plants to be attacked in their very simplest form. Many of the inconsistencies encountered in the study of experimental results with solution cultures are due unquestionably to the extreme complexity of both the internal and the external complexes of environmental conditions. A study of the initial behavior of germinating seeds may be expected to involve less complexity, within as well as outside the organism, than would be involved in a study of later phases of growth. Notably the experiment period could be very short in the experiments here briefly described, thus practically avoiding many of the alterations in organisms and solution that increase with time. Also, the whole question of photic environment was avoided, since such tests can be carried out in darkness. It appears that this general type of experimentation is very promising indeed and that really reliable solution-culture results may be secured if attention is confined to the first few days of seed germination.

In the first set of experiments, 37 different solutions were tested, each with a total concentration of 0.06 gram-molecule per liter. Besides 3 single-salt solutions, the series included 9 two-salt solutions and 25 three-salt solutions. The results are presented by means of triangular coordinates. It was found that marked retardation of root elongation did not occur unless the volume-molecular concentration of at least one of the three salts constituted less than about 15 per cent of the total volume-molecular concentration. The roots were not very sensitive to small differences in salt proportions except when the partial concentration of calcium nitrate in the solution was below about 5 per cent of the total concentration. It is apparent from the data that no three-salt solution of this type, with a total concentration of 0.06 gram-molecule per liter, if tested with these seeds and these non-solution conditions, would be apt to give markedly more rapid root elongation than actually was observed from either of the solutions: (1) $0.018M$ $KH_2PO_4 + 0.033M$ $Ca(NO_3)_2 + 0.009M$ $MgSO_4$, or (2) $0.033M$ $KH_2PO_4 + 0.018M$ $Ca(NO_3)_2 + 0.009M$ $MgSO_4$.

In the second set of experiments, a study was made of top and root elongation in very young wheat seedlings supplied with single-salt solutions of potassium dihydrogen phosphate, calcium nitrate and magnesium sulfate, ranging in concentration from $0.0005M$ to $0.1200M$. For roots, all tested solutions were found to be toxic, in the sense that root growth in salt solution is less rapid than in distilled water. At the lowest concentration potassium dihydrogen phosphate was most toxic for roots and the other two salts were much less toxic, while at higher concentrations magnesium sulfate was most toxic, potassium dihydrogen phosphate less toxic, and calcium nitrate least toxic. Lateral roots grew more rapidly than principal roots in solutions of magnesium sulfate; they grew less rapidly than principal roots in solutions of calcium nitrate and in the lower concentrations of potassium dihydrogen phosphate. The tips of the roots became swollen in solutions of magnesium sulfate and hook-shaped in those of potassium dihydrogen phosphate; branch roots were developed in solutions of calcium nitrate. It was noted that the variability of the seedlings was greater in lower than in higher concentrations of the salts. For tops, magnesium sulfate was distinctly toxic and calcium nitrate slightly toxic in all tested concentrations, while potassium dihydrogen phosphate accelerated growth, in comparison with that occurring in distilled water.

In the third set of experiments, several series of two-salt solutions were tested. In each series one salt was held at a constant concentration and the other salt was added in concentrations ranging from $0.0005M$ to $0.1200M$. The growth rate in every two-salt solution was compared with that in a simple solution of the first salt in the concentration in which it existed in the mixture and with that in a simple solution of the second salt in the concentration in which it existed in the mixture. Since every tested single-salt solution was toxic for roots (in the sense that it retarded growth more than did distilled water), antagonism was regarded as existing in a two-salt solution if the growth in the latter was more rapid than in the more toxic single-salt solution. By this criterion marked antagonism for root growth was shown by two-salt solutions of magnesium sulfate and calcium nitrate and by solutions of potassium dihydrogen phosphate and calcium nitrate. In each case, solutions were found which allowed as rapid growth as did distilled water. Two-salt solutions of potassium dihydrogen phosphate and magnesium sulfate showed clear antagonism, but the growth rate in these was less rapid than in the preceding cases. The growth responses of tops were very different from those of roots, but antagonism was indicated for all three sets of two-salt solutions. The growth of principal roots was different from that of lateral roots.

The Last Wild Pigeon in Kentucky: by Lucien Beckner.

So much of our native flora and fauna are vanishing that it behooves any of us who knows aught of it to put that knowledge on record that the coming generations may have an idea of what they were and the causes of their disappearance to the end that in the future such calamities may be avoided.

In my short life I have seen vanish from the north American continent and its islands a number of interesting species and from the state of Kentucky the bear, the panther, the wolf, the otter, the deer, the beaver, the prairie chicken, the wild pigeon, the swan, the crane, the ivory-billed woodpecker, and many others, and see approaching extinction for the beautiful wood-duck, the ruffed grouse, the eagles, and perhaps others of which I can not now think. History records the passing of the bison and wapiti or elk as we called it, two of the noblest of creatures.

On or about the 20th of November, 1898, Mr. Seth S. Beckner, my brother, went dove hunting in a hemp field south of Winchester, Kentucky, about three miles and, while watching the limbs of a dead tree in which the doves were wont to perch, shot what he at first thought was a dove but which, when he picked it up and observed its size, he saw at once was a wild pigeon. Delighted with having shot a bird which he had not seen for many years he hastened home and had it plucked and cooked as a surprise for his sister-in-law, my wife, who was lying at home sick in bed.

After it was all done the realization of the mistake made came over every one acquainted with the facts, and time and again the feathers have been wished back on the bird that was accidentally killed and thoughtlessly served as a lunch, which might have graced the case of the richest museum in the land. I have been induced to read this short paper for the sole reason that I deem it proper that this bit of pigeon history be preserved as it is possibly the last wild pigeon to be killed in Kentucky and one, at least, of the last to be seen alive anywhere.

The Mosses of Kentucky: G. D. Smith.

The author exhibited and explained about 50 excellent colored lantern slides of mosses and liverworts which he had made from specimens collected and photographed by himself. Most of the specimens were in fruit. The localities include Natural Bridge, Kentucky River region, Berea, Rockcastle County, and other mountain districts. The species identified are:

Mosses

Bartramia pomiformis, Hedw.
Leucobryum commune.
Mnium cuspidatum, Hedw.
Catharinea angustata, Brid.
Catharinea crispa, James.
Catharinea undulata, Web. & Mohr.
Dicranum flagellare, Hedw.
Climacium Americanum, Brid.
Climacium Kinbergi.
Hypnum imponens, Hedw.
Hypnum crista-castrensis, Linn.

Hypnum Boscii, Schwaegr
Hypnum scoparium
Bryum roseum, Schreb.
Bryum caespiticium, Linn.
Webera sessilis, Lindb.
Pottia truncata, Fuern., l. c.
Anomodon apiculatus, Bruch. & Schimp.
Ulota crispa, Brid.
Pogonia brevicaulum
Thuidium delicatulum, Lindb.
Thuidium abietinum, Sch.
Polytrichum commune, Linn.
Polytrichum Ohiense, Ren. & Card.
Thelia hirtella, Sulliv.
Funaria hygrometrica, Sibth.

Liverworts

Marchantia polymorpha, Linn.
Riccia natans, Linn.
Conocephalus conicus, Dumort.
Kantia trichomanis, S. F. Gray.

Farmer's Earnings and Standard of Living in an Agricultural Area in Northern Kentucky. ..By W. D. Nicholls.

The investigation was carried on during the summer of 1923 by the Department of Farm Economics of the College of Agriculture of the University of Kentucky. The study involves two phases. First, a farm business analysis and second, an analysis of the cost of living of farm families. Complete analyses were made of the business of 241 farms. Complete data were secured on the cost of living on 360 farms. The office of Farm Life Studies of the U. S. Department of Agriculture cooperated with the College of Agriculture in the second phase of the study. The period covered was the farm year 1922. The figures were obtained by personal visits to the farms. The so-called survey method was used. The business analysis data were secured from the farm operators, the cost of living data in nearly all cases from the housewives. The area included was principally that part of Mason County within a radius of five miles from Mayslick and in Fleming County mainly the territory on the side of the county between Flemingsburg and the Mason County line. Farms were taken as the investigators came to them, the effort being made to have them representative of the general average of farming and living conditions. The area studied is a typical agricultural region and is one of the oldest settled regions of the state. Productivity, prosperity and standards of living are considerably above the average for the state. The region is one of diversified farming, the most important enterprises being the production of burley tobacco, corn, wheat, hay, beef and dairy cattle and dairy products, hogs and sheep.

The purpose of the business analysis study was to bring out the factors for profitable farm operation under post-war conditions. A complete list of receipts and expenses, inventories and net profits for each farm was obtained. The value of the perquisites furnished by the farm, including meat, dairy and garden products and poultry, was also secured in each case. The figures obtained brought out the relative profitableness of the farms studied. The records were digested and classified for the profitable and unprofitable farms for such factors as size, crop yields, production of livestock, price per pound of tobacco. The comparison gives a good idea as to the most important factors for farming success in the region.

The cost of living schedule shows the kind and quantities of food and other materials used by each family and the cost of the various items.

The question of the cost of living on farms and the value of the perquisites furnished by farms has a bearing on a number of farm problems. One of these is the rate of exodus of the farm population to the cities. Another is that of programs and methods of extension work among farming people. The question has been raised from time to time whether farmers get a fair share of the social dividend. Any attempt to form a judgment on this question must take into account the returns which farmers receive from the farm other than cash. The cost of living figures are also suggestive to home makers of a more effective allotment of the budget of expenditures.

This gives a summary of the outstanding points brought out in this study. A more detailed discussion will be given in publications now in preparation (Ky. Agr. Exper. Station Bul. 253).

Table one shows a comparison of the factors on successful farms with the average of 241 farms in the Mason and Fleming area. A significant point is that these farmers made an average return of $1029 as pay for their labor and management. That figure represents their pay above 6 per cent on their investment. An equally significant point is that the best 15 farmers were able to make over three times as much for their year's work and management as the average farmer. A study of the table indicates why these 15 farms were more profitable than the average. The principal factors of superiority are: better crop yields (lines 11, 12, 13, 15); better returns per head of livestock (lines 16 and 17); better use of labor, as measured by productive day's work per man (line 18) and per horse (line 19); greater volume of business, as measured by receipts per 100 acres in the farm (line 8); and better control of expenses. Out of each dollar taken in they spent 42c as against an average of 52c for all the farms. They produced a higher quality of tobacco as indicated by the price per pound.

Many classifications were made on various factors which might exert a casual influence on profits.*

*Presented in detail in Bulletin 253, Ky. Agricultural Experiment Station.

Table 1. Comparison of Factors on Successful Farms with Average Farms in Mason-Fleming Farming Area.

		Average of 241 Farms	Average Best 15 Farms
1.	Net earnings for year's work and management	$1029	$3205
2.	Labor income	$478	$2494
3.	Total acres in farm	152	185
4.	Total capital	$17927	$21753
5.	Acres in pasture	78.6	88
6.	Total farm receipts	$3714	$7124
7.	Total farm expenses	$1941	$3038
8.	Receipts per 100 acres in farm	$2443	$3851
9.	Expenses per 100 acres in farm	$1277	$1642
10.	Expenses per $100 income	$52	$42
11.	Yield of corn per acre, bushels	25.2	41.3
12.	Yield of tobacco per acre, pounds	1094.1	1192.3
13.	Yield of wheat per acre, bushels	12.4	15.4
14.	Yield of hay per acre, tons	1.4	1.3
15.	Yield of all crops (Community average, 100 per cent)	100%	105%
16.	Returns per productive livestock unit	$52.86	$76.03
17.	Returns per $100 feed fed	$95.12	$151.19
18.	Productive day's work per man	203.26	258.01
19.	Productive day's work per horse	47.02	56.21
20.	Price per lb. for tobacco	23.3c	28c
	*Includes value of products farm furnished the family	$332	$422

Table 2. Average Expenditures for Various Items as Shown by Value of Materials Furnished by the Farm and Material Purchased.

360 Farm Families.

	Owner families (229)			Tenant families (131)			All families (360)		
	Fur-nish'd	Pur-chas'd	Total	Fur-nish'd	Pur-chas'd	Total	Fur-nish'd	Pur-chas'd	Total
Food	$ 444.5	$ 177.0	$621.5	$390.5	$165.8	$556.3	$424.8	$172.9	$597.7
Clothing	....	263.0	263.0	....	192.1	192.1	......	237.2	237.2
Rent	260.6	....	260.6	140.4	....	140.4	216.8	....	216.6
Furniture and furnishings	....	34.0	34.0	....	26.8	26.8	......	31.4	31.4
Operating expense	14.9	251.8	266.7	17.8	137.1	154.9	16.0	210.1	226.1
Maintenance of health	....	54.2	54.2	......	44.8	44.8	......	50.8	50.8
Advancement	....	120.4	120.4	......	37.9	37.9	......	90.4	90.4
Personal	....	38.7	38.7	......	22.6	22.6	......	32.8	32.8
Savings	....	136.8	136.8	...	102.3	102.3	......	124.2	124.2
Unclassified	....	7.6	7.6	......	5.0	5.0	....	6.7	6.7
Total	720.0	1083.5	1803.5	548.7	734.4	1283.1	657.6	956.5	1613.9

Table 3. Distribution of Average Expenditures Among Different Groups of Items. 360 Farm Families

	Owner Families (229)	Tenant Families (131)	All Families (360)
	Per cent	Per cent	Per cent
Food	34.5	43.3	37.0
Clothing	14.6	15.0	14.7
Rent	14.4	10.9	13.4
Furnishings	1.9	2.1	2.0
Operating expense	14.8	12.1	14.0
Maintenance of health	3.0	3.5	3.2
Advancement	6.7	2.9	5.6
Personal	2.1	1.8	2.0
Savings	7.6	8.0	7.7
Unclassified	.4	.4	.4

Table 2 for the cost of living phase of the study shows the average expenditures covering a period of one year for the various items, both those furnished by the farm and those purchased. The families were sorted on the basis of owner families and tenant families. Table 3 shows the percentage which each class of expenditure is of the total expenditures. These figures are given more in detail in a preliminary report which has been prepared in mimeographed form, copies of which are available upon request.

The study showed that the largest single item of expenditure was that for food, this amounting to nearly 2-5 of the total expenditures. Of this the farm furnished about 70%. The average cost of clothing per family was $237.20.

The figure used for the item of rental was 10 % of the estimated value of the dwelling house. This figure was intended to cover interest, taxes, insurance, repairs and depreciation. The average value of owner's dwellings was $2505; of tenant's $1404.

Eleven and three-tenths per cent of the houses had running water, 15 1-2 per cent gas or electric lights, 9.4 per cent had furnaces or other central heating plants. Seven and two-tenths per cent had bathrooms.

One and one-tenth per cent of the homes had power washer or power vacuum cleaners, 14 per cent had hand vacuum cleaners. Windows and doors of 69.2 per cent of the homes were fully screened; 25.8 per cent partially screened. Only 5 per cent were entirely without screening. Pianos were in 25.3 per cent of the homes, and phonographs in 38.3 per cent.

Summary

There is a marked difference in the economic efficiency of farms and their operators. The reasons for these differences are to a considerable extent determinable by an economic analysis. The factors which are most influential in determining profits in the farming area studied are:

Better crop yield per acre.
Better returns per head of livestock.
A larger volume of sales per 100 acres operated.
Greater efficiency in performing the farm work.
A more adequate control of expenses in relation to receipts.
A higher quality of tobacco.

In general the farms which were strong in all or a majority of these factors were profitable. The significance of this analysis is that it serves as a diagnosis and points out the phases of the farm business which must be improved in order to make the business profitable. The cost of living data indicate the distribution and proportioning of the various cost items, and can be made useful by farm families in improving the effectiveness of the expenditure of the yearly budget and in suggesting ways of reducing the cost of living without loss to the standard of comfort and well-being of the family. One point suggested is raising more and purchasing less of the foods used by the family.

Laboratory Apparatus for the Dehydration of Alcohol Vapors by Means of the Mariller System. C. S. Yueh and C. C. Kiplinger, Mt. Union College, Alliance, O.*

Apparatus is described wherewith alcholic vapors can be almost completely dehydrated with a single distillation, using glycerol as the dehydrating agent. This is an adaptation to laboratory use of an industrial method described in Chemical Abstracts, Vol. 18, p 375, February, 1924. A 3-liter pyrex boiling flask is used, from which the vapor passes into the lower end of a fractionating column (size not stated) made of the jacket of a Liebig condenser, filled with fragments of porcelain, with a 2-inch layer of glass beads on top. During the distillation glycerol is allowed to drop into the top of the column and flow away thru a U-shaped trap at the bottom. In several experiments, a 75 % alcohol yielded 98% by one distillation. Addition of anhydrous $Cu SO_4$ or Na_2CO_3 to the glycerol had no appreciable effect. See also Chemical Abstracts, Vol. 18, p 769, March, 1924, in which a similar process is described, using quicklime.

The Harvard Summer School of Geology at Cumberland Gap, 1875. By Malcolm H. Crump.

The writer, after leaving the V. M. I., Lexington, Va., July 4th, 1873, began work with the engineer corps of the Lexington Branch of the B. & O. R. R. and there remained until the panic of December of that year when 150 engineers were thrown out of employment at one fell swoop. Work was immediately begun in the chemical and engineering department of the V. M. I. and continued till St. Patrick's day, 1874, when Hopkinsville, Ky., was first sighted by him as the commandant of a military school where his first sergeant is charged later with being the leader and organizer of the night-riders who did so much for the greatly improved price of tobacco. The 2nd July, 1875, found him at Morris-

*The complete paper, with drawing, is to be published in the Chemical Age.

town, Tenn., with some twenty or more of the most helpless members of the genus homo that it had ever been his misfortune to meet. They haled chiefly from Harvard, Boston, Cape Cod, etc. They had reached this point via steamer to Norfolk, then by rail to Morristown with The Harvard Summer School at Cumberland Gap, 50 miles away, reached only by foot and a weekly mail.

At the suggestion of a gentleman from Virginia, Capt. Kable, the only man from the South save the writer, a move was made about 2 P. M. toward the Gap, with an ambulance for the baggage and the extra aged men of whom there were several. A distance of some ten miles was made by wading the Holston and Clinch rivers, and we camped for the night in the very commodious quarters of Bean Station, which was occupied by a small family with absolutely no facilities for taking care of such a crowd. No supper could be had at the hour of our arrival, nearly nine o'clock, but soon there was a great disturbance and the owner appealed to Kable and myself to know what sort of a crowd we had brought upon him. They had cleaned up his pantry and apparently attempted, as he thought, to invade the sanctity of the bedroom of his family. We soon pacified him and had them in bed or possibly on the floor, for there was not sufficient bedding.

The next morning, after our ambulance had deserted us, we succeeded in securing a light two-horse covered wagon for the light baggage and the aged and struck out for another day's march. The second night we landed at Mr. Patterson's in sight of the Pinnacle but some five miles or more from our destination. Here the same trouble occurred as on the previous night—utterly impossible to have these people understand the difference between the home of a private gentleman and a hotel, for they thought that since they paid they should demand what they wanted, especially at the table; whereupon Mr. Patterson became enraged at supposed indignities to his daughters who acted as waitresses at the table. His wrath was finally appeased, breakfast was eaten and we reached the Camp in Bell County, Ky., at the Harlan C. H. road some mile or more from Cumberland Gap and at the foot of the Pinnacle about 10 A. M. The first person the writer met was a gentleman of most charming personality, Mr. Lucien Carr, Archeologist of the party. It was next to impossible for such a personage to have descended from the Mayflower gang, and so he was told, but in reply stated that he lived in Cambridge, Mass., tho later admitted he was born in Kentucky and raised in Missouri where he died within the last few years. I saw much of him and was more and more pleased as time went on.

The officers of the Camp were Nathaniel Southgate Shaler, of Harvard, b. in Newport, Ky. (with his charming wife, nee Page of Virginia). A. R. Crandall, of New York, P. N. Moore, St. Louis, C. J. Norwood, Missouri, J. H. Talbutt, Chemist, Lexington, Ky., John R. Procter, Maysville, Ky., Chief of the Camp, and Mr. Lucien Carr, Archeologist.

The Camp followers were:

Col. Gordon McKay, the millionaire shoe-maker of the McKay stitch notoriety, James Mullen, Lexington, Ky., the photographer, Col. W. C. P. Breckinridge and family, consisting of his wife, her sister, Miss Desha, and Mrs. Desha, Mrs. Pickett and daughter, Miss Annie Kinkead and Miss Ella Breckinridge, together with Shaler's very attractive ten year old daughter whom I first noticed with a beautiful little harmless grass green snake about her neck. The first named men were all members of the Kentucky Geological Survey which was reorganized in 1873.

The roll of students follows:

1. Col. W. H. Adney, aged 40, grad. Ohio Univ., teaching Wash-Jeff. College, Washington, Pa. Married.
2. W. F. Barclay—22, Bethel College, Ky., of W. & L. Univ., teaching in Russellville, Ky. Unmarried.
3. Jno. Bryan—23, Mo. State Normal. Unmar. Carthage, Mo.

4. E. R. Benton—23, Harvard Col. Unmar. Brookline, Mass.

5. M. H. Crump—25, V. M. I., Lex. Va. Unmar. Mil. School, Hopkinsville, Ky.

6. J. A. Cooper—40, Yale. Prin. Nor. School, Edinboro, Pa.

7. Wm. M. Davis—25, Harvard, Bookkeeper. Unmar. Philadelphia, Pa.

8. J. S. Diller—25, Westfield Normal. Unmar. In Normal School, Westfield, Mass.

9. Geo. H. Eldridge—20, Harvard. Studying surgery. mar. Cambridge, Mass.

10. J. W. Fewkes—23, Harvard. Studying zoology. Unmar. Cambridge, Mass.

11. S. S. Green—28, Univ. Mich. Teaching Swarthmore. Unmar. Swarthmore, Pa.

12. A. E. Gibbs—40, Grad. Westfield Nor. Mar. Prin. high school, Westfield, Mass.

13. Eben Hunt—29, Dartmouth. Unmar. Teacher Pa. Mil. Academy, Chester, Pa.

14. J. B. Harper—20, Purdue. Unmar. Student. Indianapolis.

15. E. H. Hartwell—25, Harvard. Boston, Mass.

16. B. F. Jackson—25, Harvard. Student. Unmar. Boston, Mass.

17. Wm. H. Kable—35, Univ. Va. Teacher. Charlestown, W. Va.

18. W. M. Linney—40, Grad. of no school. Shoemaker. Mar. Perryville, Ky.

19. W. LaMonte—41, Union Col. Teacher. Central Nor. Mar. N. Y. State.

20. Jno. Alva Myers—22, Bethany. Teacher. Unmar. West Liberty, W. Va.

21. H. A. Mertz—28, Bethany. T. Public school. Mar. Wheeling, W. Va.

22. Jno. Murdock—23, Harvard. Student Nat. Hist. Unmar. Cambridge, Mass.

23. G. H. Phelps—28, Cornell. O. Wesley Univ. Teacher. Unmar. Waukesha, Wis.

24. Richard Parsons—28, Ill. Univ. Teacher. Mar. Plymouth, Ohio.

25. H. S. Reynolds—25, Ill. Univ. Mar. Urbana, Ill.

26. H. H. Straight—29, Oberlin. Teacher. Mar. Oswego, N. Y.

27. A. J. Steele—27, Wis. Nor. Mar. Memphis, Tenn.

28. S. F. Stratton—35, Wheaton Coll. Ill. Teacher. Mar. Wheaton, Ill.

29. J. E. Todd—29, Oberlin. Teacher. Tabor Col. Unmar. Tabor, Iowa.

30. W. L. Titus—22, Unmar. So. Amesbury, Mass.

31. R. H. Wildherber—23, Ky. Mil. Inst. Commandant K. M. I. Unmar. Farmdale, Ky.

Of this number only Barclay, Kable, Linney, Wildberger and Crump were from the Sunny South, this side of Mason & Dixon's line and South of the Ohio. We made a close corporation—were a band of real brothers, so unlike in almost every way, in manners, customs, habit of thought, mode of dress—few if any of this set wore such essential undergarments as necessary drawers (B. V. D.'s and union suits unknown) for sanitary purposes, if nothing else, were unknown—never saw a pair among them.

Within a week after our arrival it was noised around that a rather noted fisherman would be with us soon, so one morning as we were about to take our seats for breakfast under the dining tent, there appeared on the horizon about the queerest looking duck seen to that time, among the many rather unusual members of our gang. He was bare-footed, with a foot as flat as a flounder and big as a barn door. His excuse for a shirt was decidedly decollete, a ten-cent straw hat, gone to seed, trowsers much abbreviated and of no describable color. He had walked from Lancaster, Ky., some 75 miles, there being no near railroad point on the Kentucky side of the Cumberland range. He was about the most dilapidated looking individual possible, rivaling the mountaineers in general appearance. This was the personage destined to become that rather noted David Starr Jordan, long time President of Stanford University, who has recently blown his own horn to the extent of some two voluminous volumes concerning deeds and doings, for which he expects the fabulous sum of $10 or $15 each. He is now the supreme authority on American Fish if not of the world. I have seen him but once since and think it quite improbable that he was convinced that we met at Cumberland Gap in 1875.

There were three large tents, one for sleeping, occupied by many cots, earth floor; dining tent capable of seating the entire crowd; then on an elevated point the lecture tent, with paper black-boards, etc., where Shaler held forth in his incomparable manner, probably the most learned and lucid speaker I have ever heard. The day after our arrival we were taken down the mountainside, thru the Gap from the upper coal measures to the Lower Silurian, now the Ordovician, each armed with a notebook (from which this information comes) and pencil, with instructions to note everything of interest seen. I was among the first called on but my notes were very limited and so were they all. Shaler, sitting on a pile of black Devonian shale, where the natives had dug a deep shaft for coal, told what he had seen on his way to that point. My eyes were opened wide and when the scales fell therefrom, I was thoroly convinced that absolutely nothing was known of geology by me. His daily method was to send parties of four or five, under the control, usually, of some member of the Kentucky Geological Survey, to some distant point, to come back with a section of the territory which was later drawn on the boards of the lecture tent where he explained and discoursed upon them. The writer, with a pack mule, Myers, Mertz and Wildberger, made the section from the Gap to Morristown, paced the distance and put in the geology. Many other trips were made, such as up Shillalah Creek, over on Straight Creek where the coal was seen, over which the fighting is now going on; Yellow Creek, Pineville, etc. Later all the mountains and peaks were climbed, in that vicinity.

When the school dispersed, Barclay, Wildberger, Straight and myself joined Mr. Kerr, State Geologist of North Carolina, at the North Carolina line and spent the first night at Warm Springs, where we met Mrs. Stonewall Jackson and her 14 year old daughter, Julia. The next night we stopped with Gen. Vance, brother of Governor Zeb Vance. Here we had a little experience with Straight, who had the unfortunate habit of removing his shoes and socks very soon after entering a house at night. On this occasion we had rather pleaded with him to keep them on as it was not the custom among gentlemen with homes of refinement and culture, but within half an hour Straight was seen to he stealthily removing both his shoes and socks. The attention of Gen. Vance, to whom it was very conspicuous, was called to the fact that Straight was a specimen from the wilds of New York State where probably this custom prevailed, and not of us.

The General lived only five miles from Asheville, which we reached in the early morning and where we remained sufficiently long to meet some of the very interesting citizens, among them Gen. Clingman after whom the peak of that name was called, which he claimed was a few feet higher than Mt. Mitchell. In settling the matter against Clingman, Dr. Mitchell lost his life by falling over a cliff at night. About 11 A. M. we started up the beautiful Swannanoah and spent the night in a small cabin which contained the Post Office known as Grey Eagle. We were up before daybreak next morning and in less than half an hour had a beautiful string of a dozen or more speckled trout—I have never seen the like since—which were in the frying pan before they ceased to kick and made us a breakfast equal if not superior to anything of the kind I have had before or since. It was 11 miles to the top of Mt. Mitchell, 6711 feet above the sea—the highest point east of the Rockies. This we reached about dark in a heavy rain, but fortunately a dozen or more cattle herders were there with a fire which was kept burning during the night. The next morning the sun came up over and above the clouds producing a scene which cannot be adequately described. Here our guide left us with instructions not to fail to keep to the almost worn-out blazes on the trees. Only two of us were left—Straight and Wildberger returned with the guide—leaving Barclay and myself alone. Wildberger was sick with what turned out to be a very long and dangerous attack of typhoid fever, while Straight was compelled to return for some cause personal to himself. Within an hour after the departure of the guide Barclay and I found ourselves lost—no trace of a blaze. More than an hour was spent in a most bewildered manner but when a marked tree was again found it was never left until another was sighted. Thus we were all day descending without seeing any sign of a human being till near the foot of the mountain when a 6 foot mountaineer suddenly appeared, who proved to be Big Tom Wilson, whose skill and mountain lore discovered the body of Dr. Mitchell in a ten foot pool of water at the foot of a very steep bluff over which the doctor had fallen. We had a late dinner with him and after passing Bakersville, Burnsville, and crossing Roan Mountain, we found ourselves at nightfall near a small cottage with a dirt floor occupied by a widow and sons. Here Barclay and I had supper, lodging and breakfast for 25 cents. On counting our cash we found ten cents to make the trip of 40 miles to Johnson City, on the railroad, at which point our valises and money to take us home were expected to be found. The cause of financial depletion was occasioned by the fact that our money was used to secure transportation for our sick friend Wildberger to the nearest railroad. We moved on toward Johnson City via Elizabethton, where Andrew Johnson was born, till about 2 P. M. when hunger began to gnaw. Passing a very nice farm house I went in to find the lady proprietor on the front porch. When she was made to understand that there was only a dime between us to be expended in as much buttermilk and corn bread as that sum would buy, she smiled, asked me to be seated and call in my friend who was in the road some 100 yards away. She soon returned and ushered us in to a dinner second to none I have had, which she said was prepared for a couple of visiting fishermen who had failed to appear. This we greatly enjoyed and we kept our last dime which she declined to relieve us of. We reached Johnson City in time for the train and to find that Barclay's money had come and been returned. I happened to have enough to land us in Nashville where we broke our fast at the Maxwell, and still owe five cents on that meal. We were yet 75 miles from home without a cent. We went out to find someone with whom we could negotiate a loan. As we neared the door of the Maxwell House I ran into an old V. M. I. friend from Little Rock but soon discovered he had been there a week without a dollar and was trying to locate his mother—no chance there. Hence on I went after my old friend S. Shelby Barrow whom I knew was connected with a bank. He was readily found and my conversation was gradually leading up to the momentous affair of securing this very important loan when, looking down the street I saw in the distance Barclay driving up in a buggy. He had found Overton Lee, a Washington & Lee University man, from whom he had secured $20. and his buggy in which he had driven to the city, living as he did a few miles beyond the limits. With the buggy we drove over the city, called on Dr. Safford, the State Geologist of Tennessee, who had visited us at the Gap, met his beautiful young daughter who was on the point of fleeing when she beheld two tramps at the front door, but the doctor recognized our voices, came to our rescue with a formal introduction, which gave us the pleasure of meeting her for an hour or more. Later re caught our train—I went to Hopkinsville and Barclay to Russellville, and thus ended a summer of some 400 miles of travel on foot. The summer of 1876 was spent at the Philadelphia Centennial and later I took the summer course in law at the University of Virginia under that most charming of lecturers, John B. Minor. The summer of 1878 I was again with Shaler from Columbus on the Mississippi to Pound Gap. In 1875 or 76 I became a member of the American Association for the Advancement of Science at its Nashville meeting, whence, after a buffet lunch with Mrs. Jas. K. Polk, I came to Bowling Green and here I am still.

Glacial Pebbles in Eastern Kentucky,* W. R. Jillson.

Within the last year (1923-24) the discovery of erratic pebbles of apparent glacial origin widely distributed thruout northeastern Kentucky has provided the first concrete evidence in support of an hypothesis of Pleistocene glacial ponding in a part of Kentucky heretofore thought to be without glacial characteristic. The occurrence of old elevated stream channels along the Ohio, notably at Huntington, West Virginia; Ashland, Kentucky; Ironton, Wheelersburg, and Portsmouth, Ohio, has been known for some time, having been described by Leverett (1) and Tight (2). These abandoned channels occur at elevations ranging from 680 feet to 690 feet above sea level. While they contain gravels chiefly composed of quartzite and chert of stream origin, possibly more remotely glacial, these are not to be confused with the pebbles which are now being found in remote parts of Eastern Kentucky at much higher elevations.

In the course of non-glacial field work geologists on the Kentucky Geological Survey, including the writer, have found 18 pebbles varying in size from a few ounces to 13 pounds, consisting principally of quartzites, but with an occasional granite, gneiss or other crystalline or metamorphic rock. These pebbles range in elevation from 720 feet on the Big Sandy River to 850 feet on the North Fork of the Licking River, and have been found in Lawrence, Elliott, Lewis, Morgan, Carter and Boyd Counties. Field evidence indicates that similar pebbles may also be found at similar ele-

---

(1) Monograph XLI., U. S. G. S., p. 106. 1902.
(2) Prof. Paper No. 13, U. S. G. S., Plate XV2. 1903.
*Science, Aug. 1, 1924 (Vol. LX. No. 1544) p. 101-2.

vations in parts of Menifee, Greenup, and Rowan Counties, tho the last is not a certainty. The drainage systems involved in these discoveries include the Big Sandy River, Little Sandy River and Tygarts Creek, and the North and Elk Forks of the Licking River.

Based on evidence now in hand which will be supplemented this year by further investigations, the following hypothesis is advanced:

The general accordance of elevations of these pebbles, coupled with their certain extraneous origin and decidedly glacial characteristic suggests their invasion into Kentucky by means of floating ice. It is held that they probably represent a complex assortment derived from both river and glacial front sources during the period of readjustment of the northward flowing drainage of this portion of the Cumberland plateau, while cols were being degraded to form the present course of the Ohio River at points just above (1) Ironton, (2) Portsmouth, and (3) Manchester, Ohio, and possibly just above Cincinnati. It is thought that the higher and more remote pebbles (800 to 850 feet) represent invasions by floating ice at the time of the first cutting of the Manchester col which may have been originally about 850 or 900 feet. Ridges in the vicinity of Manchester now show elevations ranging up to 1000 feet above sea level. Pebbles occurring in Kentucky at points near to the major drainage at elevations ranging from 720 to 750 feet are taken to represent subsequent ponding during the latter cutting of the Manchester col, and possibly those at Ironton, Portsmouth, and Cincinnati. Ridge elevations at Ironton now range between 800 and 850 feet; at Portsmouth between 900 and 950 feet; and at Cincinnati (Dayton, Ky.—Walnut Hills, Ohio) between 850 and 860 feet.

The section involved in this ponding in Eastern Kentucky has not been topographically mapped except in part. Barometric elevations run thruout this section indicate that the highest ridges range from 1000 to 1200 feet. At the highest level of ponding, ridge topography in this section would have appeared insular, the region resembling somewhat the Thousand Island region of the St. Lawrence. A study of the elevations of these pebbles, their position and the gradient of some high-level fluviatile gravels and terraces may possibly bring out the fact of uplift in the southwestern part of the section, subsequent to the Pleistocene. The period of ponding at an elevation of 850 feet appears to have been short as terraces apparently were not widely developed. There is no evidence now in hand to prove the extension of glacial ice lobes into this part of the State. Stratified drift is absent and ridge topography does not show a general beveling. Ponding in northeastern Kentucky at this time very possibly covered an area of about 2000 square miles.

The occurrence of pebbles at high levels on that part of the drainage of the Licking River which adjoins the Little Sandy River may mean (1) that these ponded glacial waters flowed over one or more low divides in this interior part of Kentucky, and (2) that these southern cols were in direct competition for a time at least with those which were removed at such northern points as Manchester and elsewhere. To accept this theory the assumption of regional uplift in Morgan County and vicinity during and subsequent to the Pleistocene becomes a necessity. Yet this assumption would seem to be far more plausible than (1) a high damming of the Licking River, and (2) glacial ice floating southeastward along the serpentine course of the Licking over 100 miles to the Elliott County line.

If the Morgan-Elliott County passes thus brought into prominence were indeed temporary debouchures for impounded glacial waters, to the superior hardness of the lower Pottsville clastics of this region and some coincident regional uplift may be ascribed the present course of the Ohio River bordering northeastern Kentucky. Had the Coal Measure sediments of Morgan and Elliott Counties less competently met the erosive action of surging glacial waters the course of the then formative Ohio River would undoubtedly have been directed up the valley of the Little Sandy River and down the Licking River. Such a hypothetical change in the pattern of the Ohio River would have (1) reduced the area of Kentucky by 2,500 square miles, (2) placed Lexington the heart of the Bluegrass Region within 35 miles of the Ohio, and (3) profoundly altered the history and economics of the entire lower Ohio valley.

Unit Characters in Poultry. W. S. Anderson and J. Holmes Martin.

Reciprocal crosses of White Silkies and Black Cochin Bantams were made. The strawberry comb, crest and black skin color of the silky are dominant to the single comb, absence of crest and yellow skin of the Cochin. The black feather color and normal form of feather of the Cochin are dominant to the white feather color and silky form of feather of the Silky. Out of 22 hybrids 16 had the fifth toe of the Silky indicating that the Silky is heterozygous in respect to the presence of the fifth (extra) toe.

Reciprocal crosses of Buff Orpingtons and White Leghorns were made. The white color of skin, beak and shanks of the Orpington is dominant to the yellow color of skin, beak and shanks of the Leghorn. The white color of egg shell of the Leghorn is recessive to the brown tint of egg shell in the Orpington. The mode of inheritance in plumage and ear lobe color is more like blending or particulate inheritance. Black was present in the shanks of 19 out of the 22 female hybrids. Of the 26 male hybrids only one showed a slight tint of black in the shanks. This is an example of sex limited inheritance in which the black is limited to the females. It also holds true in the F^2 generation.

Reciprocal crosses of White Plymouth Rocks and Black Minorcas were made. The rose comb, white skin and black plumage color of the Minorca are dominant to the single comb, yellow skin color and white plumage of the Plymouth Rock. The mode of inheritance of ear lobe color is in the nature of blending or particulate inheritance.

Davenport, after crossing Silkies with Frizzles, found that the black skin color of the Silky was dominant to the white skin color of the Frizzle. The authors find that the white skin color of the Minorca is dominant to the yellow skin color of the Plymouth Rock. This presents an example of white skin color within one family of fowls being dominant to yellow and recessive to black. Davenport, in crossing Black Minorcas with White Leghorns, secured only white feathered hybrids. The authors, in crossing Black Minorcas with White Plymonth Rocks, secured no white feathered hybrids. Here we have the interesting case of black feather color in the Minorca proving recessive to Leghorn white and dominant to Plymouth Rock white. In the Leghorn we have a dominant white feather color and in the Plymouth Rock a recessive white. That the Plymouth Rock white should be recessive is perhaps explained by its origin, since the original fowls of this breed were white sports from the Barred Plymouth Rock variety.

Geology of the Carter Caves. W. R. Jillson.

These caves, situated in a forested, hilly plateau region on Cave Branch of Tygarts Creek, 10 miles N. E. of Grayson, are the most important in Eastern Kentucky. They are in the Gasper and St. Genevieve (Mammoth Cave) limestones of the lower part of the subcarboniferous limestones. Much of the limestone is very porous and the usual fracture, joint and bedding planes have favored the entrance of meteoric water, thus bringing about the excavation of these caves. The thick, nonsoluble Logan formation beneath the limestone beds forms a flow bed for the subterranean water. The paper is published in full as Chapter III, p. 23, in the volume "Kentucky State Parks", Ky. Geological Survey, Frankfort, 1924.

Influence of Season of Calving on Milk and Butter Production of Cows. J. J. Hooper.

Records of official tests of eighty-eight cows were used in this study, 22 calving during each season of the year. The relative yields of milk and butterfat from these cows, over the course of a year, were as follows, taking the yields of the winter-fresh cows as 100 per cent:

	Yield of	
Fresh	**Milk**	**Fat**
Winter	100%	100%
Fall	94	99
Spring	92	88
Summer	81	85

The winter-fresh cows yielded 23 per cent more milk and 18 per cent more fat than those calving in summer. The production of the cows freshening in spring and fall was intermediate between these extremes.

A review of the test reports shows that 30 per cent of the cows freshened in spring, 29 per cent in summer, 20 per cent in fall and 21 per cent in winter. Considering the fact that the fall and winter-fresh cows produce more milk and butterfat, and produce it at a time when milk and fat are more valuable, it is unfortunate that more cows are not bred so as to freshen in the fall and winter. See Ky. Experiment Station Bulletin 248, pp 79-85.

MINUTES OF THE TWELFTH ANNUAL MEETING

The meeting was called to order by President McAllister, at 9:25 A. M., in room 108, Science Building, University of Kentucky, May 15, 1925. About 30 members present.

The Secretary's report was read in outline by Dr. Peter. Upon motion, it was adopted unanimously.

The Treasurer's report was read by Prof. Anderson showing total receipts of $410.84, including balance from last year, and expenditures of $296.87, leaving a balance of $113.95 in the treasury. Two instalments on the printing of the Transactions are included in the expenditures. Upon motion of Dr. Middleton the report was referred to the auditing committee.

President McAllister called upon Dr. Jillson to explain the matter of the Academy medal. Dr. Jillson stated that it was the sense of the Council that it would be a good thing if this Academy could award frequently an Academy medal for first excellence in scientific investigation, based on some paper presented before our annual meeting, and that he had been appointed a committee of one to see what could be done towards securing funds for the endowment of such a medal. The assistance has been secured of a citizen of this State who will give the money necessary to endow such a medal but who wishes to remain anonymous. The medal will be known as the Kentucky Academy of Science Medal and can be awarded every other year following presentation of papers before our Academy by members of the Academy and of a subject relative to Kentucky. Rules should be established governing the award. If an arrangement agreeable to both parties is reached this gentleman will set the money aside to the credit of our treasurer, during the course of this year, and the funds will be deposited in some Lexington Bank to the credit of the Kentucky Academy of Science and unavailable for any other use. The awarding of such a medal by our Academy probably would do much to improve the character of our programs, increase the attendance at our annual meetings and advance the development of scientific investigation in Kentucky. This is a matter which should be decided by the Academy itself. It is not the desire of the council or of its committee of one to foist this presentation upon the Academy without its approval. If the Academy accept, it will result in an unusual distinction being given to some member every two years.

Dr. Buckner moved that the Academy accept this gift, that it be written into the minutes of this meeting and that a letter be written to the donor expressing the thanks and gratitude of the Academy. Also that the Academy thanks Dr. Jillson for his efforts in bringing about the establishment of this award of merit which will add much to the interest in the work of this Academy.

The motion was seconded and adopted unanimously.

Dr. Jillson explained that the medal will be of gold and bear a suitable inscription and emblem. It is not the intention of the donor that the award be in the nature of a money prize.

Dr. Boyd moved that the matter be placed in the hands of the Council, in cooperation with Dr. Jillson, to work out the details of the award.

Dr. Boyd's motion was seconded by Dr. McHargue and adopted unanimously.

The report of the Committee on Membership was read by Prof. Burroughs. Upon motion of Dr. Jillson the report was adopted by unanimous vote and the Secretary was directed to cast one ballot for the election of all the nominees. Accordingly, the following persons were unanimously elected to active membership:

Mr. Roth Janes, Louisville Testing Laboratory, Louisville.
Mr. Henry Clay Barbour, 101 W. Chestnut St., Louisville.
Mr. W. F. Hamilton, 101 W. Chestnut St., Louisville.
Dr. H. O. Calvery, Dept. Chemistry, Univ. of Louisville, Louisville.
Dr. H. Jensen, Dept. Chemistry, Univ. of Louisville, Louisville.
Prof. F. M. Shipman, Dept. Chemistry, Univ. of Louisville, Louis

Mr. Chas. Wilson Logan, Levelman for Survey, Frankfort.
Mr. Silas T. Wilson, Civil Eng. on Survey, Frankfort.
Miss C. B. McNamara, Secy. to Dr. Jillson, Frankfort.
Miss H. M. Scott, Chief Clerk, Survey Office, Frankfort.
Dr. Homer E. Cooper, Richmond, Ky.
Dr. Clara Chassell Cooper (Mrs. H. E. Cooper), Richmond, Ky.
Mr. E. M. Johnson, Experiment Station, Lexington.
Mr. Lewis C. Robinson, Dept. of Geology, Univ. of Ky., Lexington.
Mr. Hugh Tanner, Dept. of Geology, Univ. of Ky., Lexington.
Dr. E. M. Wilcox, Ph. D. Dept. Biology, Transylvania College, Lexington.
Prof. J. M. Saunders, Dept. Chemistry, Transylvania College, Lexington.
Dr. George F. Weida, Centre College, Danville.
Dr. William J. Hutchins, Pres. Berea College, Berea.
Prof. Waldemar Noll, Prof. of Physics, Berea College, Berea.
Prof. John Milton Guilliams, Prof. in Mathematics, Berea College, Berea.
Prof. Luther M. Ambrose, Assoc. Prof. Science, Berea College, Berea.
Prof. Chas. C. Graham, Instr. General Science, Berea College, Berea.
Dean Charles D. Lewis, Normal School, Morehead.
Miss Effie King, State Normal School, Morehead.
Prof. Clarence Nickell, State Normal School, Morehead.
Prof. Henry Haggan, State Normal School, Morehead.
Prof. Wm. Jesse Baird, Jr. High School, Berea College, Berea.
Prof. D. V. Terrell, Dept. Road Engineering, Univ. of Ky., Lexington.
Mr. E. N. Todd, State Highway Engineer, Frankfort.
Mr. E. N. Posey, State Highway Engineer, Frankfort.
Mr. W. A. Shelton, Engineer, Geological Survey, Frankfort.
Mr. Leo Gilligan, Principal High School, Bellevue, Ky.
Dr. O. T. Koppius, University of Kentucky, Lexington.
Mr. Herluf Strandskov, University of Louisville, Louisville.

Dr. George R. Bancroft, University of West Virginia, Morgantown, West Virginia, was transferred from active to corresponding membership.

Reporting for the Publications Committee, Dr. Peter stated that Volume 1 of the Transactions had been prepared and distributed to the membership, each member in good standing being entitled to one without charge. The Publications Committee proposes to publish two meetings in Vol. 2 of the Transactions.

Dr. Middleton of the Ecological Committee reported that the publication of the Ecological Society of America is practically completed in regard to setting aside special areas for preservation.

President McAllister appointed as Nominating Committee W. S. Anderson, Chairman, Prof. Mayfield and Prof. V. F. Payne.

For Resolutions Committee: Jillson, Meier and Crouse.

The business session adjourned until 2 P. M., in the Physics lecture room.

Professor McAllister then gave his Presidential address on "What are the results of science teaching in the schools?" After which the meeting divided into two sections, biological and physical.

The Biological Section organized by electing Dr. J. S. McHargue Chairman and Dr. A. R. Middleton Secretary, after which papers 1 to 9 were read and discust. The Section appreciated the presence of Dr. E. N. Transeau, of the Ohio State University, as a visitor.

The Physical Section elected Dr. W. R. Jillson, Chairman, and Prof. W. G. Burroughs, Secretary. Papers 10 to 12 and 14 to 17 were read and discust. Dr. J. W. Pryor exhibited a photographic negative taken by the light of fireflies.

The afternoon session was called to order by President McAllister, at 2:10 P. M., in the Physics lecture room.

The Auditing Committee reported the accounts correct and tendered the thanks of the Academy to Prof. Anderson for his efficient services. Adopted unanimously.

Papers 18, 19, 20 and 21 were read and discust.

Mr. Howson, engineer of the Dix River dam, was introduced by Dr. Meier. Mr. Howson said the dam is 270 ft. high, backing the water up 34 miles. It was started in

August, 1923, and work continued day and night since then in an endeavor to keep ahead of the high water of the spring. The gates were closed March 17th and water rose 90 feet in the next two or three days. Today the depth is 151 1-2 feet in the reservoir. The dam has a capacity for about 40 feet more. This is by far the largest dam of its kind. They endeavor to let the water in before the dam is completed, as it is better to work it up by degrees just ahead of the water; that the pressure of the water against the dam helps to consolidate it. The dam is curved towards up-stream. It will be sixty days before the work will be entirely completed. Everything is working along smoothly. The rock blasted out for the spillway was used to build the dam. Dr. Jillson asked if it would be practical to build such a dam at Cumberland Falls. Mr. Howson could not tell as he had not seen the place.

The following amendment to Article III. of the constitution was read and adopted by unanimous vote:

Active members shall be residents of Kentucky who are interested in science, or other persons actively engaged in scientific investigation within the state. Active members are of two classes, national and local. National members are members of the Academy and of the American Association for the Advancement of Science; local members are members of the Academy but not of the Association. Each active member shall pay to the Academy an initiation fee, upon election, and annual dues beginning October 1 next after election, the amounts to be fixed in the by-laws. The amount of annual dues to be paid by a national member shall equal the difference between the amount to be paid by a local member and the amount allowed per member by the A. A. A. S. Any member in good standing may become a life member by payment at one time of a suitable sum, prescribed in the by-laws, and is thereafter relieved from payment of dues.

Also the following was added to the by-laws:

V. The initiation fee for active members shall be one dollar. Annual dues shall be two dollars and fifty cents, for local members, and two dollars for national members. A life membership shall be fifty dollars.

Mr. Mayfield presented the report of the nominating committee nominating the officers as follows:

For President: Dr. Austin R. Middleton.

For Vice-President: Prof. W. G. Burroughs.

For Secretary: Dr. A. M. Peter.

For Treasurer: Prof. W. S. Anderson.

Upon motion of Dr. Jillson, duly seconded, the report was adopted unanimously and these officers were elected by unanimous vote.

Prof. Anderson nominated Dr. Jillson for member of Publications Committee, seconded by Dr. Meier. Upon motion, the Secretary was directed to cast the ballot for Dr. Jillson, which he did.

The Resolutions Committee presented the following report which was unanimously adopted:

WHEREAS, the need for the preservation and restoration of forests has been recognized by Congress in the passage of the Clarke-McNary Act which provides for the purchase of lands by the Federal Government, for timber production and protection of watersheds, and

WHEREAS, such purchases should be made according to a definite plan which provides for the necessary expenditures within a reasonable time, and

WHEREAS, a program has been suggested by the American Forestry Association calling for the purchase of 8,000,000 acres over a period of ten years, involving the expenditure of \$3,000,000 per year for the first five years, and \$5,000,000 per year for the second five years; therefore

BE IT RESOLVED, that the Kentucky Academy of Science urges the adoption by the Congress of the United

States of an adequate program covering the acquisition of forest lands by the Federal Government, with the necessary appropriations, either in accordance with the program of the American Forestry Association or such modification as will fulfill the same purpose, and

BE IT FURTHER RESOLVED, that copies of this resolution be sent to Congress, all of the Kentucky Representatives and Senators, and that copies be printed in the daily press of the State, and spread upon the minutes of the Kentucky Academy of Science.

WHEREAS, the Cook Forest in northwestern Pennsylvania, a tract of 8200 acres, includes one of the largest remaining bodies of primeval white pine, besides having hemlock, oak, maple, hickory and other broad-leaf trees native to that region, and is easily accessible, and

WHEREAS, it is good public policy to preserve some such tracts for their high scientific, educational and inspirational value, therefore

BE IT RESOLVED, that the Kentucky Academy of Science approves the efforts being made by the Ecological Society of America and the Cook Forest Association looking to the acquisition of the Cook Forest tract by the State of Pennsylvania for protection and preservation.

There being no further business, the afternoon session then adjourned.

The evening session was called to order at 7:30 in the Physics lecture room. Dr. Jillson introduced the speaker of the evening, Dr. Rollin T. Chamberlin, of the University of Chicago, who delivered a very interesting lecture on "Earthquakes", illustrated by stereopticon views, some of which showed the slipping which had caused the California earthquake, as it appears in the landscape.

The Academy then adjourned **sine die.**

About 100 persons were present.

MINUTES OF THE COUNCIL

The Council met on call of President McAllister, March 27, 1925, in Prof. Anderson's office: Present, Messrs. Cloyd McAllister, W. R. Jillson, W. S. Anderson and A. M. Peter; absent, Dr. Sam Trelease.

1. The report of the committee on procedure at the annual meeting was adopted without change and the Secretary was instructed to arrange the program accordingly.

2. Friday, May 15, was selected as the date of the meeting, in the physics lecture room, University of Kentucky.

3. After some discussion as to a suitable person to deliver the annual address, Drs. Jillson and Peter were made a committee to find someone, with power to act.

4. The account of the State Journal Company for $94.23, being the balance due on Volume 1 of Transactions was approved and ordered paid out of any money in the treasury.

5. Dr. Jillson suggested that the Academy award a medal annually or at stated times for the most meritorious piece of work done in Kentucky, and expressed the opinion that a small endowment fund could be raised for this purpose. He was requested to investigate the matter of raising the fund, and report as soon as convenient.

6. The Secretary was instructed to prepare an amendment to the Constitution and make the proper announcement of the same in the call for the annual meeting. The amendment will cover:

(a) Payment of $2.00 by national members, instead of $1.50, to correspond with the change in the A. A. A. S. allowance, from $1.00 to 50 cents.

(b) Define active members as "Residents of Kentucky, who are interested in science, or any one actively engaged in scientific investigation in Kentucky, whether a legal resident of the state or not."

(c) Transfer the provision as to the amount of dues from the constitution to the by-laws.

7. The Secretary was directed to have application blanks for membership printed and distributed with the announcement of the annual meeting.

8. It was determined to include two meetings in Vol. 2 of the Transactions and publish this volume as soon after the coming meeting as practicable.

9. The Council adjourned to meet at 8 A. M., Friday, May 15, 1925.

The committee on procedure at annual meetings met at the Phoenix Hotel, Lexington, November 1st, 1924. Present: Messrs. Peter, Meier, Hinton and Boyd. Absent, Mr. Best.

The following resolutions were passed and recommended to the Council for adoption:

1. That the meetings begin promptly at 9:15 A. M.—first for transaction of business and then the President's address to be given.

2. That at 10 o'clock the members present divide into two groups, viz: that of the Physical Sciences (mathematics, astronomy, physics, chemistry, etc.) and that of Biological Sciences (botany, physiology, zoology, bacteriology, agriculture, animal husbandry, genetics, etc.). These two groups to meet separately until 12:30 o'clock for the reading and discussion of papers that belong to the respective groups. Each group is to elect a temporary chairman and a secretary, one of them to present a digest of the papers read and of the discussion of each at the afternoon meeting.

3. The afternoon meeting is to begin at 2 o'clock, and the first order of business shall be the reports, mentioned above, from each of the two groups. Then shall follow the reading and discussion of papers of general interest. This meeting is to close with the transaction of the unfinished business and the election of officers.

4. The public address is to be given at the evening meeting which is to begin at 7:30 o'clock.

5. The author of each paper is to select the group before which he wishes to read his paper.

6. It is also recommended that the Department of Journalism of the University of Kentucky, or the publicity man of the Experiment Station, prepare a digest of each paper read, as well as of the public address and to have these printed in the Sunday papers. Likewise a digest of each paper shall be sent to the home papers of the respective authors.

REPORT OF THE COUNCILOR OF THE A. A. A. S.

The Academy was represented in the Council meeting by Dr. Sam F. Trelease, who had been given credentials as substitute. Much business was transacted by the Council at this meeting. The action which concerns this Academy most directly is the adoption of the following resolutions concerning arrangements with affiliated academies of science and local branches:

(a) In view of the rapid increase in the number of members concerned, it has become impossible to continue the annual grants to affiliated academies and local branches as in the past, and the association consequently finds it necessary to reduce the allowances for these organizations, for 1926 and until further notice, to one-half of the present amount per member. This reduction is to go into effect October 1, 1925.

(b) All members of any affiliated academy are to be at all times, until further notice, eligible to admission to the association on certification by the proper academy officer and without payment of the usual entrance fee.

(c) The permanent secretary is instructed to take up the application for academy affiliations according to the modified arrangements for academy affiliation now authorized.

For a full account of the doings of the council, see "Science", Vol. LXI, No. 1571, (February 6, 1925) pp. 131-136.

(Signed) A. M. PETER, Councilor.

SECRETARY'S REPORT

Of the 17 persons elected to active membership at the last meeting, twelve have paid the initiation fee and have been added to the roll of the Academy.

We have lost two members by death since the last meeting: Col. M. H. Crump, of Bowling Green, and Dr. O. C. Dilly, of the College of Pharmacy, Louisville. Three members will be dropt on account of removal from the state (Van Becelaere, Coolidge and Sweeney), and 4 have resigned (Allen, Best, Vance and Freeman).

The total membership is now 172, including 76 national and 59 local, making 135 active members, 23 corresponding members and 14 honorary members.

The membership may be classified as follows:

Active members in good standing	89
Active members in arrears 1 year	27
Active members in arrears 2 years	19
Corresponding members	23
Honorary members	14
Total	172

Classed geographically and as to educational institutions our active membership includes:

54 from the University of Kentucky, Lexington.
9 from the University of Louisville, Louisville.
7 from Centre College, Danville.
3 from Berea College, Berea.
3 from Eastern State Normal School, Richmond.
3 from Western State Normal School, Bowling Green.
3 from Transylvania College, Lexington.
2 from Georgetown College, Georgetown.
1 from the College for Women, Danville.

Not connected with educational institutions in the state are: Nine from Louisville, 7 from Frankfort, 4 from Lexington, 2 from Ashland, and 1 each from Shively, Wallins

Creek, Danville, Mayfield, McAfee, Stearns, Versailles, Kyrock, Winchester, Harlan, Jenkins and Middlesboro. Besides these there are 7 active members outside the state.

The Council of the A. A. A. S. at their annual meeting in Washington voted to decrease the refund allowed to affiliated Academies to 50 cents for each national member, instead of $1.00, beginning October 1st, next. In view of this change the Council of the Academy proposes an amendment to our constitution whereby the dues of our national members will be increased 50 cents, making national members pay $2.00 a year to the local Academy instead of $1.50. The proposed amendment was sent to the membership with the announcement of the present meeting, in order that it might be acted upon at this meeting.

The President appointed the following Membership Committee: W. G. Burroughs, Chairman, S. I. Kornhauser, and V. F. Payne. Also a committee on arrangement of program for this meeting composed of A. M. Peter, Chairman, Henry Meier, Robert T. Hinton, Harry Best and P. P. Boyd. This committee met at the Phoenix Hotel on November 1st, 1924, and prepared a report to the Council. This report was adopted at a meeting of the Council on March 27th, 1925. (See copy attached). It has been followed in arranging the program.

The Council held two meetings during the year, on March 27, and May 15, 1925, the minutes of which are attached to this report.

The program of our last meeting, with a short account of the meeting, was published in "Science" under date of June 13, 1924.

Volume 1, of Transactions, covering the first 10 meetings of the Academy, was mailed to the membership shortly after the last meeting, each member receiving one copy free. Extra copies will be sold to members at actual cost, $1.25 per volume. We have about 50 of these volumes left. The printing has been paid for, Dr. Jillson having assumed $242. of the amount, the Academy paying the balance of $174.23.

The Secretary received the following letter from William S. Cooper, Chairman of Glacier Bay Committee, of the Ecological Society of America, in regard to Glacier Bay, which he promptly acknowledged.

> "You will be glad to learn that on February twenty-sixth President Coolidge issued a proclamation establishing the Glacier Bay National Monument in Alaska. On behalf of the Ecological Society of America, which has had the movement in charge, I wish to express sincere appreciation of your valued assistance in the campaign."

Our Academy endorsed this movement at the last meeting.

The American Forestry Association, thru its executive secretary, Mr. Ovid M. Butler, Lenox Building, Washington, has asked the endorsement of the Academy for the acquisition of forest land by the Federal government, under the Clarke-McNary act. The movement has been endorsed by Section O (agriculture) of the A. A. A. S., and seems worthy of our support. Your endorsement has been asked, also, by the Committee on Preservation of Natural Conditions of the Ecological Society of America for the project to preserve the Cook Forest in northern Pennsylvania.

A cordial invitation has been extended to this Academy by the Indiana Academy of Science, to join their field meeting at Madison, on May 14, 15, and 16. Your Secretary acknowledged the invitation with thanks and the explanation that we could not change the plans already made for our annual meeting, but that individual members are free to attend.

On request of the management, your Secretary named Dr. G. Davis Buckner to represent the Academy on the general committee of arrangement for the sesqui-centennial celebration of Lexington. Dr. Buckner has attended all meetings.

Respectfully submitted,

A. M. PETER, Secretary.

May 15, 1925.

The following papers were presented at the Twelfth Annual Meeting of the Academy:

(1) **Calcium Metabolism in the Laying Hen.** G. Davis Buckner, J. Holmes Martin and A. M. Peter.

We have shown experimentally that a calcium deficiency in a diet abounding in protein was not the primary cause of the production of shell-less eggs but that it caused a general depletion of the body material of laying hens, especially the bones, and a general lowering of the vitality of the hens. We have further shown that unless the ordinary food stuffs fed to laying hens are properly supplemented by some material which is high in calcium carbonate, such as cracked oystershell or limestone, there will be a gradual cessation of egg production, accompanied by a thinning of the egg shell.

Again we have shown that calcium carbonate greatly increased the efficiency of buttermilk for egg production by increasing the number of eggs laid and causing the production of eggs that had heavier shells and a larger edible part. The experiment described in this paper was undertaken to determine how such increase in weight of the edible part of the egg was distributed between the yolks and whites and whether the protein and calcium content of the whites and yolks were changed.

With this idea in view, three lots, each containing 10 white Leghorn hens were selected having egg records for the pullet years ranging from 153 to 170 eggs. These hens were the same age, 19 months, and were grouped so as to make the lots as nearly equal as possible in weight, vigor and egg production. Lot No. 1 was allowed a fair sized grass range and lots 2 and 3 were confined to their houses during the experiment with ample direct sunlight available. A trapnest record was kept thruout the experiment and the eggs were weighed. The yolks and whites of the eggs were separated, weighed separately, and nitrogen and calcium were determined in each portion.

All three lots were given buttermilk ad libitum with a grain mixture of wheat and yellow corn and all received some green food such as lettuce, cabbage and kale twice a week. An oat straw litter was used and sufficient grit that was free from available calcium was supplied. Crushed oystershell was supplied ad libitum from Nov. 1st to May 1st to lots 1 and 2 and withheld from lot 3. Beginning May 1st and continuing 3 months the oystershell was withheld from lots 1 and 2 and given ad libitum to lot 3.

To summarize briefly the results obtained we can say that the total edible part, yolks and whites, of eggs produced by the hens that received oystershell during the first 6 months weighed distinctly more than those produced by the corresponding hens that had not received calcium carbonate.

When oystershell was added to the diet of the hens that had not received it for 6 months, the weight of the contents, whites and yolks, was not increased, but the number of eggs per hen was trebled.

When oystershell was withheld from the diet of the hens that had received it for 6 months, the total content, yolk and white, weighed distinctly less than before.

When oystershell was withheld from the diet of the hens that had received it for 6 months, the number of eggs produced per hen was halved in the pen confined to the house but was not effected in the pen that had daily range.

The presence or absence of oystershell in the diet had no appreciable effect upon the percentages of protein and of calcium in the whites and yolks.

From a practical standpoint it will be seen that the addition of a calcium supplement such as oystershell to a grain, buttermilk diet, causes an egg to be produced whose edible portion is approximately 10 per cent larger, besides increasing the number of eggs laid three-fold.

(2) **Lactobacillus Acidophilus vs Lactobacillus Bulgaricus.** M. Scherago, Head of Department of Bacteriology, University of Kentucky.

The reports of recent investigations, that the alleged beneficial effects on the intestinal tract which Metchnikoff attributed to *Lactobacillus bulgaricus* are in reality due to an implantation and proliferation of *Lactobacillus acidophilus*, have stimulated renewed interest in the comparative study of these two aciduric organisms. Any one working with Lactobacillus acidophilus and Lactobacillus bulgaricus is soon impressed with their marked similarity in morphology and in cultural characteristics and wonders at the differences displayed by these two strikingly similar organisms in their ability to implant themselves in the intestinal tract.

When Bouchard announced his theory of intestinal intoxication in 1884, many diseases and conditions were treated with the idea of overcoming intestinal putrefaction by means of various so-called antiseptics. In 1907 Metchnikoff published his book "Prolongation of Life" in which he claimed that auto-intoxication and premature senescence were brought about by the absorption of the products of putrefactive bacteria from the intestinal tract. Metchnikoff proposed to combat these harmful toxin-producing micro-organisms by crowding them out by the ingestion of large numbers of harmless bacteria and used for that purpose milk soured with Lactobacillus bulgaricus. He decided to use this organism because he believed it to be the predomnant one in the milk and milk products used by the famously long-lived natives of Bulgaria. It is interesting to note that since the first appearance of Metchnikoff's book the greatest interest has been shown in the prevention of the onset of old age by changing the intestinal flora, as manifested by the appearance on the market of all kinds of preparations of Lactobacillus bulgaricus in the form of tablets, capsules, liquid cultures and even in the form of Bulgarian Milk, and these preparations were used with more or less enthusiasm by practically all physicians.

Altho several observers, including Leva, Cohendy and Belonowsky, at first reported the presence of Lactobacillus bulgaricus in the feces of persons who had ingested Lactobacillus bulgaricus milk, later work failed to substantiate Metchnikoff's claims. Among the first to demonstrate that Lactobacillus bulgaricus cannot grow and be colonized in the intestinal tract were Herter and Kendall. By killing a monkey three and a half hours after it had been fed 500cc of milk soured with Lactobacillus bulgaricus, they found that the organism did not survive below the ileocecal valve. In an earlier experiment with the same animal they failed to detect Lactobacillus bulgaricus in the feces after feeding the sour milk for three days. Distaso and Schiller, and Rettger and his associates have also shown independently that the implantation of Lactobacillus bulgaricus cannot be brought about in the intestines of the white rat by the ingestion of this organism even when taken in enormous numbers. In a more recent extensive investigation Rettger and Cheplin have definitely proved that Lactobacillus bulgaricus cannot be implanted in the intestinal tract of either white rats or man. After feeding large quantities of this organism to several rats for a week or more, in no instance could the organism be found in the feces; and on autopsy none were found in cultures made from various portions of the intestine 24 hours after the last feeding. They also failed to isolate the organism in a single instance from the feces of human beings who had previously ingested large quantities of milk soured with Lactobacillus bulgaricus and had taken the milk over long periods of time.

Metchnikoff, in his search for a harmless organism, attempted to acclimate a lactic acid organism to such an unnatural environment as the alimentary canal. Furthermore, he evidently overlooked the important influence of diet on the predominating type of bacteria in the intestines. It is now well known that there is a definite relation between the character of the food and the type of intestinal flora. Herter and Kendall first noted this in 1909 when, by substituting a diet of milk and sugar for meat and eggs, they were able to convert a proteolytic putrefactive bacterial flora in the intestinal canal into an aciduric non-proteolytic type. In other words, the intestinal canal acts as an ideal culture tube in which certain organisms thrive best in media consisting of large amounts of carbohydrates, while others thrive best in media containing large amounts of animal protein. As a result of the proteolytic action of the putrefactive bacteria, toxic substances are formed, which are assumed to be the cause of the various forms of intestinal toxemia; and in addition, considerable amounts of gas are produced. Combe, Herter and others have shown that the fecal flora of the adult consists almost always of putrefactive bacteria which are therefore potential disease producers. Proteus, Cl. putrificus, Cl. welchii and E. coli, all of which are normal inhabitants of the human intestinal tract, have been shown by various investigators to have at times been the cause of various types of diarrhea, cystitis, cholecystitis and intestinal poisoning. This predominance of putrefactive bacteria in the adult is however dependent upon the continued ingestion of a proteinaceous diet. For, as Rettger and Cheplin, and others have pointed out, if we change from a proteinaceous to a carbohydrate diet the intestinal flora changes from a proteolytic type to an aciduric type.

Tissier, in 1900, demonstrated that the meconium of the new born baby is sterile, but if it is breast fed exclusively there is established in a few days an intestinal flora consisting almost exclusively of B. bifidus. This organism remains predominant in the intestinal tract as long as the infant is breast fed and can be obtained in almost pure culture from the feces. In 1900 Moro described another acid-producing organism which is also found in the intestinal flora of nursing infants. He named this organism *Bacillus acidophilus* and claimed that it was the predominating form; but after closer study accepted the claim of Tissier that B. bifidus is the predominating organism in the intestines of nursing infants. As the infant is given other food the number of B. bifidus organisms gradually decreases and there is a corresponding increase in the number of Lactobacillus acidophilus organisms so that by the time that breast feeding is discontinued the intestinal flora consists almost entirely of Lactobacillus acidophilus. This organism remains predominant for about a year or two after breast feeding is discontinued and then the flora gradually becomes more complex as the diet becomes more complex so that even before adult age is reached the simple aciduric flora is replaced by a great variety of other types that become established. In adults only a few, if any, acidophilus organisms can be found in the intestinal flora. It is evident, then, that diet has a marked influence upon the bacterial flora of the intestines and, therefore, the simple aciduric type of bacteria as represented by the B. bifidus and Lactobacillus acidophilus in the baby gradually gives way to the more complex proteolytic and putrefactive type as the diet of the baby gradually approaches that of the adult.

If diet plays such an important part in influencing the type of intestinal flora, is it possible, by proper feeding to change the intestinal flora? Attention has already been called to the work of Herter and Kendall and that of Rettger and Cheplin. The latter found that they could transform the intestinal flora of white rats from the gas forming putrefactive type to the Lactobacillus acidophilus type by feeding them in addition to their daily diet two grams of either lactose or dextrin. They began to notice an increase of Lactobacillus acidophilus within two days and the maximum implantation took place within four to eight days. They also fed these sugars to men and found that whenever they fed 300 grams or more per day they produced a change in the intestinal flora within four to eight days, the putrefactive bacteria having practically disappeared and the Lactobacillus acidophilus constituting the most predominant organism present. Smaller quantities of sugar would bring about an increase in the number of Lactobacillus organisms but there was not an appreciable decrease in the number of the other bacteria present, especially the gas formers. Bass' experiments substantiate these results and indicate that the amount of sugar necessary to bring about a transformation in man is 300 to 450 grams per day, a quantity that can hardly be continued over long periods of time and therefore a limiting factor in its general usefulness for therapeutic purposes.

Rettger and Cheplin in 1919 resorted to the use of cultures of an aciduric organism, Lactobacillus acidophilus, with the expectation that these organisms would remain in the intestinal tract and colonize there as they do normally in the intestines of babies. They fed broth cultures of Lactobacillus acidophilus to white rats, in addition to their daily diet, and found that when they fed a sufficient quantity the fecal flora changed rapidly to the Lactobacillus acidophilus type. They obtained similar results in man when they fed sufficiently large quantities of the broth culture. Early in 1920 Rettger and Cheplin substituted for the whey broth cultures, milk cultures of Lactobacillus acidophilus because, as they put it, "acidophilus milk is much to be preferred to the lactose broth or whey broth cultures of the organism for the following reasons: the milk is tolerated by those who are unable to retain the simplest and most wholesome foods for convalescents; when properly prepared and preserved the acidophilus milk remains practically unchanged and free from bacterial contamination and deterioration; it contains at least four per cent lactose which in itself serves to stimulate Lactobacillus acidophilus proliferation in the intestines; it is nutritious, and for those who cannot take or do not tolerate other foods it does much toward the maintenance of nitrogen balance and the prevention of tissue waste, when taken in the usual amounts, from one pint to one quart daily, and finally, as a young culture of viable bacteria it is particularly potent in bringing about the desired transformation of bacterial types in the intestine." Their first experiments were performed upon animals and apparently normal human beings and their conclusions suggested that the simplification of the fecal flora might possibly be of benefit in certain pathologic cases in which there is associated a predominance of the putrefactive forms of bacteria in the intestinal tract. They applied their Lactobacillus acidophilus milk therapy to more than 60 cases and reported that the ingestion of Lactobacillus acidophilus milk resulted in relief from chronic constipation, chronic diarrhea, mucous colitis and sprue. They also reported beneficial results in the treatment of eczema referable directly to the bacteriology of the intestinal tract. Kopeloff and Cheney also reported good results from the use of acidophilus milk in seven cases of marked constipation occurring in patients with various psychoses, in four normal patients with mild constipation and in two patients with intermittent diarrhea. Kopeloff has also shown that relief from constipation has persisted for six months after the ingestion of Bacillus acidophilus has been discontinued. A more recent communication from Kopeloff reports good results with Bacillus acidophilus milk in thirty constipated cases and two cases of diarrhea. The constipated cases were observed from a week to about a year after treatment, and almost without exception all had more normal defecations than before treatment. Gompertz and Vorhaus in their experiments with 200 cases of chronic constipation and 100 cases of diarrhea and mucous colitis were very favorably impressed with the results, 70 per cent of all the cases of either group showing complete relief from symptoms and toxemia and 15 per cent showing some relief and improvement. Mizell, experimenting with 20 patients, reports that "Relief from chronic intestinal toxemia, putrefactive type, and stasis, even in the presence of intestinal adhesions, has been secured while feeding acidophilus milk in conjunction with a general diet; and that chronic ileo-colon and colon stasis of undetermined origin as well as secondary to intestinal adhesions may be relieved by feeding acidophilus milk." Bass and Norman and Eggston have also given the acidophilus therapy widespread application and strongly advocate the acidophilization of the intestinal tract by means of milk cultures.

Experiments to determine the therapeutic value of Lactobacillus acidophilus milk cultures were carried out at the University of Kentucky on 40 individuals who had the following conditions as diagosed by their respective physicians: Chronic constipation, 20 cases; Chronic colitis, 2 cases; Debility and anemia, 4 cases; Chronic diarrhea, 2 cases; Rheumatism, 1 case; Dermatitis and acne, 5 cases; Intestinal toxemia in children, 6 cases. The amount of acidophilus milk taken per day and the duration of the treatment varied with the age and the condition of the patient. In every case the patient and his physician reported marked improvement. One of the patients with chronic constipation, who was an epileptic, reported fewer attacks during his period of treatment than ever before within a similar period. It is intended to carry out experiments on a larger number of epileptics to see if a transformation of the intestinal flora has any effect on the number of attacks.

The therapeutic value of Lactobacillus acidophilus, because of its ability to colonize in the intestinal tract and displace the putrefactive bacteria, is definitely established. The instances of presumably successful implanations with Lactobacillus bulgaricus all show long periods of feeding of large quantities of milk soured with this organism. Such soured milks contain as much as four per cent lactose which in itself would bring about a proliferation of Lactobacillus acidophilus in the intestine if fed over a long period of time. It is not surprising then, because of the close resemblance of the two organisms, that Metchnikoff and his followers thought they were getting an implanation of Lactobacillus bulgaricus when in reality the organism that they observed in the feces after the feeding of milk soured with Lactobacillus bulgaricus was not this organism, but Lactobacillus acidophilus.

The close resemblance of Lactobacillus acidophilus and Lactobacillus bulgaricus, both morphologically and culturally, makes differentiation between these two organisms exceedingly difficult. As a matter of fact this similarity has caused some investigators to conclude that the two are identical. A separation of the two species is based largely on their action upon maltose, sucrose and levulose. Most strains of Lactobacillus acidophilus ferment these three sugars while most strains of Lactobacillus bulgaricus do not attack them. Lactobacillus bulgaricus being more variable in this respect than Lactobacillus acidophilus. Recently Albus and Holm have been able to differentiate the two species on the basis of surface tension using sodium ricinoleate and sodium taurocholate as surface tension depressants. They found that all of their fifteen strains of Lactobacillus acidophilus grew very well in a medium having a surface tension as low as 36 dynes, while a similar number of strains of Lactobacillus bulgaricus in the same medium depressed to a surface tension of 40 dynes, failed to show growth after seven days incubation at 37°C. They conclude that a surface tension of 40 dynes represents the extreme lower limit for Lactobacillus bulgaricus. Kopeloff and Beerman state that they have good reason to believe that the enzymes of Lactobacillus acidophilus differ from those of Lactobacillus bulgaricus.

Just why two organisms so strikingly alike in all other aspects should manifest such marked diversity in their behavior in the alimentary canal has been puzzling. It may be that the enzymes of the digestive tract have a differential action upon the two species. Albus and Holm suggest that surface tension may be a factor in the implantation of these organisms. However, this does not explain the failure to recover any Lactobacillus bulgaricus organisms in feces after feeding milk soured with this organism. It is possible that a specific bacteriophage, lytic for Lactobacillus bulgaricus and not for Lactobacillus acidophilus may be the important factor. This problem is at present under consideration.

(3) The Association of Copper with Substances Containing the Fat-Soluble A Vitamin. J. S. McHargue.

(Abstract) Small amounts of copper are widely distributed in rocks, soils, waters, plants and animals. A method for its estimation in tissues of plants and animals is described. Copper occurs in the largest amounts in the young and tender leaves and in the germs of the seed of plants. It is a normal constituent of the blood and tissues of mammals and occurs in greatest concentration in the offspring previous to and at the time of their birth. Colostrum is relatively rich in copper and normal milk contains appreciable amounts. It occurs in the fat, and most of that carried in normal milk is separated with the cream. Upon churning, the copper remains in the butter. On heating the butter, curd is precipitated and carries with it considerable copper. The occurrence of copper in greatest concentration in some of the most vital organs of plants and animals leads the author to infer important biological functions for this element in the normal metabolism of plants and animals. (For the complete paper, see American Journal of Physiology, Vol. LXXII May, 1925, pp 583-594).

(4) Anaphylaxis and Hydrogen Ion Concentration. Daniel J. Healy, Howell Spears and Louise B. Healy, From the Laboratory of the Ky. Agricultural Experiment Station.

Of the many theories regarding the cause of anaphylaxis, that offered by Besredka and Steinhardt, (1) that the phenomena of anaphylaxis and of anti-anaphylaxis result from conditions similar to the precipiting and absorbing actions which govern the relations of colloids among themselves, is of interest. Von Behring's (2) claim, that anaphylaxis results from thrombosis of the cerebellar vessels caused by agglutination of the blood platelets, is of further interest.

(1) Ann. de l'Inst. Past., 1907, 21, p. 384
(2) Deutsche. Med. Wchnschr. Leipz. u. Berl., 1914, 40, p. 1857

Kopaczeoski and Vahram (3) maintain that anaphylactic shock is a physical phenomenon. They demonstrated that the introduction of suspensions or of colloidal gels into the serum disrupted the colloidal equilibrium, producing flocculation of colloids, obstruction of the capillaries, and death from asphyxia. Among recent investigators there is a distinct tendency to consider colloidal precipitation the cause of anaphylaxis and also, of specific agglutinations.

Of the many conditions associated with the colloidal state none is more important than the hydrogen ion concentration. As Beatty (4) points out, colloids are distinctly influenced by hydrogen and hydroxyl ions, tending to precipitation under their influence, the rule being that ions possessing an electric charge of opposite sign to that of the colloidal particles precipitate such particles. The ions are precipitated with the colloidal particles and, in certain cases, may be removed by washing, which indicates a physical and not a chemical action.

Bayless (5) has shown that the intravenous injection of half normal hydrochloric acid, in quantity sufficient—10.4 cc per kilogram of body weight—to reduce to one-third of its normal value the bicarbonate present, does not alter the H-ion concentration of the blood.

Crile (6) has shown that in certain conditions, as narcosis, anaesthesia, and shock, the H-ion concentration of the blood may increase with the increased CO_2 tension. The greatest concentration which Crile observed was pH 6.98. Crile states the normal value as pH 7.67 and Bayless states it as pH 7.4.

It occurred to us that it would be of interest to know the H-ion concentration of the blood during or immediately after anaphylactic shock. This we determined in the following manner:

---

(3) Compt. rend. d'l Acad. des Sciences, 169, 1919, p. 250
(4) The Method of Enzymic Action, James Beatty, 1917, p. 16
(5) Jour. Physiol., 53, 1919, Nos. 3-4, p. 162
(6) Amer. Jour. Physiol., 38, 1915, P. 225.

Five guinea-pigs, Nos. 29, 31, 33, 34 and 35, average weight of 397 grams, were each given intraperitoneally, 2 cc of a 1 to 1 solution of fresh egg-white in distilled water. Two guinea-pigs, Nos. 32 and 36, average weight of 569 grams, were placed under similar conditions but received no egg-white; they were controls.

Four months later, the control pigs, Nos. 32 and 36, together with another normal pig, were anaesthetized with ether, the hair clipped over the cardiac area and this area washed with 93% alcohol. Using a sterile, oiled (paraffin oil), and chilled hypodermic syringe, 4.5 cc of blood was withdrawn from the heart, and immediately transferred to an oiled and chilled centrifuge tube and centrifuged for 10 minutes. The cells were thrown down but the plasma coagulated. The coagulum was separated from the cells, cut into small pieces and each piece tested with a drop of either phenol red or cresol red in .02% solution. The resulting colors were compared with those obtained with the standards recommended by Clark and Lubs ([7]). The H-ion concentration of the coagulum was pH 7.8 in each case. These guinea-pigs recovered.

We were unable to obtain blood from the heart during anaphylactic shock; therefore, immediately after death, we exposed and opened the heart, obtaining such blood as it contained. The quantity of blood thus obtained was insufficient for centrifuging. It was, therefore, diluted with 4 volumes of distilled water. Clark and Lubs ([8]) have shown that colored or cloudy liquids may be diluted in the proportion of 2 cc of the liquid to 10 cc of distilled water with but slight change of the H-ion concentration. They determined electrometrically the H-ion concentration of various colored and cloudy liquids: such liquids were then diluted in the above proportions, and the H-ion concentration determined colorimetrically. Of two hundred such determinations the

---

([7]) Jour. Bact., Vol. 2, Nos. 1, 2, 3, pp. 1, 109, 191.
([8]) Ibid.

average variation between the two methods was .11 of one pH value, the maximum being .75 and the minimum being .01 of one pH value.

Four months after the initial injection the test pigs each received, intraperitoneally, 5 cc of a 1 to 1 solution of fresh egg-white in distilled water. With pigs Nos. 29 and 31, marked convulsions occurred in twenty minutes. They were anaesthetized, an attempt to draw blood from the heart failed, the pigs dying within five minutes from the onset of convulsions. After death the heart was quickly exposed and 2.5 cc of liquid blood obtained from it. This blood was quickly diluted 1 in 4 with distilled water and the H-ion concentration of the dilution determined, using cresol red, .02% solution. The H-ion concentration in each case was pH 6.5. Pigs Nos. 33, 34 and 35 were anaesthetized immediately following the second dose of egg-white and blood removed from the heart before the onset of convulsions. The H-ion concentration of such blood was in each case pH 7.8. Death from anaphylactic shock occurred in each case within twenty minutes after the second dose of egg-white. Immediately after death, blood was obtained from the heart, diluted 1 in 4 with distilled water, and the H-ion concentraton determined as with pigs 29 and 31. The H-ion concentration was, in each case, pH 6.5.

Summary. Among recent investigators there is a tendency to consider colloidal precipitation the cause of anaphylaxis. No condition of colloids is more important than the H-ion concentration. The H-ion concentration of the blood of anaesthetized normal guinea-pigs and of guinea-pigs before the onset of anaphylactic convulsions was pH 7.8. The H-ion concentration of the blood of guinea-pigs immediately after death from anaphylactic shock was pH 6.5 which is a marked increase compared with the maximum increase under CO_2 tension of pH 6.98 as determined by Crile.

(5) **The Vegetation of the Barrens.** Harrison Garman.

What is here presented is merely a suggestion of a point of view, but is based upon a careful study of the flowering plants of Western Kentucky, these brought into comparison with the prairie flora of Illinois with which the writer has been familiar from childhood.

It may be thought too late to determine what the vegetation of the region called the barrens was when the country was settled, but enough may be gathered from early writings to show its general character, and a study of the plants now found growing wild in these parts of the State and their comparison with those of other parts of Kentucky gives, it is believed, a fair conception of the plant life of the great treeless areas as they were when the white man appeared in Kentucky. It has often been asserted, and need hardly be repeated, that the barrens were not regions of sterile soils. The soils were and are in fact of good quality in many places, but ranged widely from poor to rich. The feature of the barrens that most impressed the pioneers was the lack of forest growth. They were not used to it. It was prairie, in fact, and like the settlers of prairie states north of us they were afraid at first to take up farms in this open country and chose land along the watercourses. Coming thru the densely wooded sections of Eastern Kentucky the vast open plains must be accounted for as something unnatural. The most obvious explanation of the general absence of trees was accepted by them, namely, the destruction wrought by forest fires started by the Indians. This explanation has been passed on to our time, and has done service from pioneer days as an explanation of the prairies of the North.

But the important fact seems to have been overlooked that forest fires do not result in a typical prairie vegetation such as was present in the barrens and in the prairie region of Illinois. Forest fires in Michigan and other northern states have been of frequent occurrence, but in a short time the burnt-over land is occupied again by woody growth similar to that destroyed. Among some of this young growth can now be found charred stumps and logs of the primitive forests. Nothing of this sort was observed in the prairies or in the barrens. They had evidently been prairies and nothing else for hundreds of years. When our barrens were first visited by botanists they were described as covered with waving grasses "so tall as to conceal a man on horseback." In wet places were rushes and sedges, on drier ground a great variety of flowers, goldenrods, asters, shootingstars, adder's tongues and the rest, low-growing plants in the greatest profusion, with only a few woody species, dwarf willows, blackjack oak and the like, pushing in along the streams from surrounding forests. Many of the woody plants came from the East, from the South and Southeast.

These great meadows have now largely disappeared and the places of the tall grasses and other plants have been taken in part by weeds from foreign countries, but the native species are still to be found by the botanist in bits of waste land along railroads and highways and probably few have been completely exterminated. The tall grasses of the early writers were undoubtedly the same as those of the prairie regions north of the Ohio River. The species are still here, but could not stand the close grazing to which they were subjected by the settlers, and have retreated to such sheltered places as they can find. The tall bluestem (*Andropogon furcatus*) was one of the dominant grasses and probably constituted much of the tall growth among which cattle grazed, as it did in Illinois. Both bluestem and Indian grass (*Sorghastrum nutans*) actually grew tall enough to conceal a man on horseback in both the prairies of Illinois and the barrens of Kentucky.

The original prairie grasses were certainly not Kentucky bluegrass. In the barrens this grass does not now thrive very well in most sections after all its tall native competitors have been scattered and greatly reduced in numbers. As late as 1868 whole sections of land in Central Illinois had been untouched by the plow and were covered by their original prairie flora, the tall bluestem often dominating and affording both pasturage and hay. A little later a fringe of bluegrass mixed with ragweed and other introduced plants began to creep in from surrounding cultivated land. Bluegrass seems to have invaded our barrens in similar fashion and tracts of land never tilled can be found, or could within a few years, with the original prairie grasses still dominating. The expression "taller than a man on horseback" never applies to our bluegrass, as any one familiar with it knows.

The barrens seem to have been merely outlying tracts of prairie of the same nature, the same origin and plants, as the prairies of Illinois. It seems certain that this flora was prepared for by a removal of vegetation over large tracts during glacial and post glacial times and the prairie flora that first appeared was assembled by conditions of moisture and temperature unfavorable at first to the establishment of forests.

Attention was first drawn to these considerations by noting the strong resemblance of the present native flora of the barrens to that familiar to the writer in childhood on the prairies of Central Illinois. Many of the dominant prairie plants of the regions north of the Ohio River are still to be found in the barrens. Tall bluestem, a dominant prairie grass, is there. The small bluestem *(Andropogon scoparius)*, its associate, is present. Indian grass *(Sorghastrum nutans)*, one of the very tall species, has not entirely disappeared. It may be said that a large proportion of the typical prairie plants of Illinois still exist in the barren regions of Kentucky. With the grasses named, occur the purple and white prairie clovers *(Petalostemum)*, the button snakeroot *(Eryngium yuccifolium)*, Indian hemp, two blazing-stars *(Liatris)*, the cup plant, compass plant *(Silphium laciniatum)*, and the purple coneflowers.

Such assemblages of species do not appear after fires in other regions of the State. They did not appear in either the Eastern or Western Coal Fields. The plants did not assemble here in a year or two. It required hundreds of years to establish a turf that resisted the penetration of forests except where the soil was disturbed along streams. It seems probable that if the white man had not appeared, these open tracts of meadow would exist today.

The pioneers were witnessing, not, as they supposed, the results of recent disturbances of plant conditions due to the Indians, but the much more profound effects of glacial conditions* during which plants were destroyed over large areas, leaving swamps and boggy tracts at first, these as the temperature rose and the waters subsided affording an opportunity for growths of rushes, in turn to give place, as the land became drier, to sedges, the climax vegetation of tall grasses and Compositae appearing finally and covering much of the affected territory when the pioneers arrived.

Characteristic Plants of the Barrens, also Characteristic of the Illinois Prairies:

Scouring-rush (Equisetum hyemale)
Cattail (Typha latifolia)
Little bluestem (Andropogon scoparius)
Tall bluestem (Andropogon furcatus)
Indian grass (Sorghastrum nutans)
Switchgrass (Panicum virgatum)
Panicum scribnerianum
Mesquite grass (Bouteloua curtipendula)
Turk's cap lily (Lilium superbum)
Partridge pea (Cassia chamaecrista)
Wild sensitive plant (C. nictitans)
Purple prairie-clover (Petalostemum purpureum)
White prairie-clover (Petalostemum candidum)
Button snakeroot (Eryngium yuccifolium)
Indian hemp (Apocynum androsaemifolium)

---

*The writer must not be assumed to hold that the ice cap extended into Western Kentucky. It is well known that it reached but little south of the Ohio River and only in Eastern Kentucky. The influences referred to are those of low temperature and of great quantities of cold water coming from melting ice at the North.

Indian hemp (Apocynum cannabinum)
Butterfly-weed (Asclepias tuberosa)
Green milkweed (Acerates viridiflora)
Green milkweed (Acerates floridana)
Puccoon (Lithospermum canescens)
Wild bergamot (Monarda fistulosa)
Venus's looking-glass (Specularia perfoliata)
Cardinal flower (Lobelia cardinalis)
Blazing-star (Liatris squarrosa)
Blazing-star (Liatris spicata)
Goldenrod (Solidago canadensis)
Goldenrod (Solidago altissima)
Rosin-plant (Silphium terebinthinaceum)
Rosin-plant (S. trifoliatum)
Cup-plant (S. perfoliatum)
Compass-plant (S. laciniatum)
Silphium integrifolium
Purple coneflower (Brauneria purpurea)
Coneflower (Brauneria angustifolia)
Pale Indian plantain (Cacalia atriplicifolia)

(6) **Preliminary Inoculation Experiments with Fusarium Species on Seedlings Growing in Nutrient Agar.** W. D. Valleau and E. M. Johnson.

The impression appears to be quite prevalent that the Fusaria as a group are somewhat specific in their host preferences. This is especially true of the wilt-producing species which it would seem from a review of the literature are only capable of attacking a single species or at best only species within a genus. Wollenweber ([1]) in describing *F. tracheiphilum* Smith and *F. vasinfectum* Atk., states that they cause the wilt disease of Vigna, and Gossypium herbaceum and *G. barbadenese*, respectively, and are "Saprophytic on various hosts". He states also that "the parasite from one host, as a rule, has not been found on the living organs of another host."

Taubenhaus, in his "Diseases of Truck Crops (p. 47) expresses the same idea when he states that "The Fusarium

(1) Phytopath. 3; 24-50, 1913

of the sweet-potato wilt cannot, as far as we know, attack potatoes, tomatoes, or any other host. This is similarly true for the Fusarium which produces a wilt on tomatoes, etc."

Bolly ([2]) states that; "Though living normally as a decay form (saprophyte) this low type of fungus *(F. lini)* can also invade the living tissues of its host. As it can live and increase upon decaying matter found in soils, especially upon old roots and stems of flax, it can readily thrive there for a long period." And further; "It can live from year to year upon the humus of the soil, hence the soil is soon ruined for flax." This implies that the organism is quite specific for the flax crop and does not live on other living plants.

Tisdale ([3]) in studying the nature of wilt-resistance in flax found "that *Fusarium conglutinans* would penetrate the root hairs of flax seedlings. Likewise, *F. lini* was evidently able to penetrate cabbage seedlings as they were killed by it in tube cultures." He also found "that *F. lini* can penetrate the young seedlings of the resistant strain of flax as readily as it can penetrate the seedlings of the susceptible strain under those conditions".

Pratt ([4]) has stated that *F. trichothecidides, F. radicicola* and *Rhizoctonia solani*, organisms which are commonly considered as potato pathogens, are found in the virgin soils of southern Idaho.

Bisby ([5]) made cross inoculations with several species of Fusaria and as a result of these studies and other observations states that "Rots of carrots and other vegetables due to various Fusaria are quite common, particularly in storage and following wounds." But "despite their semi-parasitic nature many Fusaria, such as *F. oxysporum*, exhibit

---

([2]) North Dakota Agr. Expt. Sta. Bul. 50: 27-58, 1901

([3]) Jour. Agr. Res. 11: 573-606, 1917

([4]) Jour. Agr. Res. 13: 73-100, 1918

([5]) Minnesota Agr. Expt. Sta. Bul. 181, 1919.

what amounts to a considerable specificity of parasitism to certain crops".

The impression to be gained from these statements and others of a like nature which can be found in the extensive Fusarium literature is that the wilt-producing Fusaria are quite specific in their host preferences and live from one crop of the host to the next, even tho the interval be one of many years, as saprophytes in the soil. That this is probably not the only method of survival in the soil is indicated by the inoculation experiments to be reported in this paper.

Miller (6) working in this laboratory, made numerous isolations from tobacco roots affected with the so-called brown root-rot both from fields in which the root-rot was severe enough to cause extensive injury to the plants, and from fields in which the injury was comparatively slight as judged by the development of the plant.

The Fusaria obtained have not yet been completely identified, but a comparative study of them indicates that quite an extensive list of species are concerned.

Miller made inoculation tests, with 7 of the cultures which he isolated, on young tobacco seedlings growing in tubes on nutrient agar and found that all of them killed the plants in a period of from 3 to 10 days. Since then we have carried on extensive inoculation experiments in test tubes both with seedlings just producing the first true leaf and with older plants having several true leaves. The results of these tests may be summed up by saying that nearly all of the Fusaria isolated from tobacco roots cause injury to tobacco seedlings under the conditions of the experiment.

The results of these tests indicated so clearly that tobacco was susceptible to many species of the unidentified root Fusaria that a number of the better known species were obtained thru the courtesy of Dr. E. C. Stakman, University

---

(6) Miller, Paul W., Brown root-rot of tobacco. University of Kentucky thesis, 1924.

Farm, St. Paul. These have been tested, in comparison with some of the identified Fusaria isolated from tobacco, on seedlings of various kinds. The identification of our cultures of tobacco and other Fusaria used in these tests have been made, in some cases tentatively, by Dr. C. D. Sherbakoff. They are as follows: *F. acuminatum* Ell. et Ev.? from alsike seed; *F. succisae* (Schroet.) Sacc. from tobacco seed; *F. solani* (Mart.) App. et Wr. and *F. oxysporum* like, but differing in certain characters, from red clover roots; *F. argillaceum* (Fr.) Sarc.; *F. angustum* Sherb.; *F. aurantiacum* (Lk.) Sacco.; *F. bulbigenum* Cooke et Massie; *F. falcatum* App. et Wr., *F. lycopersici* (Sacc.) Wr.?, *F. orthoceras* App. et Wr.?, *F. solani cyanum* Sherb.?, and *Gibberella saubinetii?* from tobacco roots.

The following were identified by one of the writers, *G. saubinetii* from a wheat seed, *F. moniliforme* from a corn seed and *F. moniliforme* from clover roots.

The named species of Fusaria obtained from Dr. Stakman are as follows: *F. conglutinans*, *F. conglutinans calistaphani* (Michigan Agricultural College No. 58), *F. discolor sulphureum* (North Dakota 2007), *F. lycopersici* (C. D. Sherbakoff), *F. lycopersici* (M. A. C. 153), *F. lycopersici* (S. H. Essary), *F. lycopersici* (Edgerton), *F. martii?* (F. R. Jones), *F. lini* (No. 54), *F. lini* (H. O. B.), *Gibberella saubinetii* (E. C. S.), and *G. saubinetii* (MacInnes thesis), *F. batatatis* (M. A. C. 60), *F. batatatis* (Massachusetts), *F. oxysporum* (M. A. C. 52), *F. oxysporum* (G. R. B.), *F. oxysporum resupinatum* (M. A. C. 52), *F. oxysporum asclerotium* (M. A. C. 56), *F. hyperoxysporum* (M. A. C. 57), *F. orthoceras triseptatum* and *F. radicicola* (M. A. C. 84). *Gibberella saubinetii* (Wis. 259) was received thru the courtesy of Dr. James Dixon, University of Wisconsin.

The inoculations reported in this paper were all conducted on seedlings growing in test tubes of nutrient agar. The tubes containing the young plants were kept in the light near a window in a room kept uncomfortably warm (75+°F). Inoculations were made by transferring a small bit of mycelium from a vigorously growing culture to the surface of the agar and usually near the plant. It was then necessary for the fungus to spread over the agar and penetrate the uninjured seedling. This development usually required at least 2 days so that this time might be subtracted from the time required to kill the plant. The seed were treated in various ways to rid them of seed-borne organisms or at least to prevent the development of these organisms in the tubes.

The details of the various inoculation tests are too extensive to be given at this time but a summary of the results obtained and their possible significance will be given.

In all, 25 distinct named species or varieties of Fusaria have been used in these tests, together with a large number of isolations from the roots of various crops as tobacco, corn, clover, etc., including isolations from several weeds. These root organisms have not been completely identified but the majority fall into the section Elegans of the genus Fusarium, a section which contains the most important wilt-producing Fusaria. The remainder belong, with a few exceptions, to the section, Martiella, which is supposed to contain but very few pathogenic forms.

The named species were tested on seedling plants of corn, soybeans, wheat, radish, onion, tobacco, clover, alfalfa and cabbage. In all more than 1000 inoculations were found to be capable of killing at least some of the species of plants inoculated in a period of five to ten days from the date of inoculation. The majority of them were capable of partially or completely destroying the roots of all of the plants, with the exception of corn, within a period of about 12 days. Corn was found to be the most resistant, of the plants tried, to injury by these organisms. Fifteen of the cultures used had caused no injury to corn seedlings after 14 days, while 22 cultures had rotted a portion of the roots, in some cases killing the seedling.

Tests with organisms other than Fusaria, some of which are generally considered to be somewhat pathogenic, as

Alternaria sp., and others generally not so considered, as the common penicillia, have shown that these organisms usually cause less injury than the least pathogenic of the Fusaria tested.

Certain of the Fusaria as *Gibberella saubinettii*, *F. succisae*, a wilt-producing strain of *F. lycopersici* (S. H. Essary) and others proved to be very injurious to all of the plants tested. A few cultures, as *F. hyperoxysporum*, *F. lini* (H. O. B.), *F. falcatum* and *F. acuminatum* caused very little injury to nearly all of the plants against which they were used.

Extensive tests of the unidentified fusaria from roots of various crop plants show that nearly without exception they are capable of causing the death of seedlings of clover, alfalfa and tobacco and of penetrating either slightly or extensively the roots of corn. An interesting feature of this part of the work has been the results obtained with cultures belonging to the section Martiella, usually considered non-pathogenic. The cultures of the Martiella section, most of which were probably *F. solani*, appeared to be just as injurious to clover, alfalfa and tobacco seedlings as most of the cultures of the Elegans section. They were, on an average, only slightly less injurious to corn seedlings than the most injurious of the cultures of the Elegans section, and decidedly more injurious than many others of this section, particularly those tentatively identified as *F. angustum*.

It appears from these inoculation experiments that the species of Fusaria commonly isolated from the rotting roots of plants, the common wheat scab organism, and several of the wilt-producing species of Fusaria are capable, to a greater or less degree, of injuring and penetrating the tender roots of seedlings of several common crop plants. The wilt producing species appear to be particularly injurious as evidenced by these tests. When we consider the severe competition going on between micro-organisms in the soil, and the fact that under certain conditions these fusaria are capable of penetrating the injured roots of several crop plants, the possibility is suggested that they are not soil saprophytes in the true sense of the word, but rather weak parasites on a large number of plants, maintaining themselves from year to year partly by rotting rootlets and partly by remaining in these decayed tissues the remainder of the year. In the case of the wilt-producing Fusaria, which remain in cultivated soils for many years in the absence of their specific host, the conclusive determination of this point is of economic as well as scientific interest.

(7) **A Kentucky Thorobred.** G. D. Smith.

The paper described a fine thorobred racehorse that was, when young, a little difficult to start in a race and grew more so each year until finally he became useless as a racer.

(8) **Relation of Some Constituents of Tobacco to Grade.** O. M. Shedd, Kentucky Experiment Station. (Synopsis)

This investigation is a comparative study of the total content of nitrogen, nicotine, nitrate nitrogen, crude ash, silicon, phosphorus, potassium, calcium and magnesium found by chemical analysis in the different grades of tobacco represented by 145 samples of burley and 109 samples of dark tobacco grown in Kentucky in 1920 and 1921. The mineral constituents were determined in composite samples but the other determinations were made in the individual samples.

The burley crop of 1920 was abnormal, being infected to an unusual degree with leaf-spot diseases. The dark tobacco of that year employed in this investigation, was less diseased than the burley. Both burley and dark tobacco samples taken from the 1921 crops were more nearly normal, as they were freer of disease. This affords a comparison of abnormal versus normal leaf, as well as variations in different years.

The "good" division of any grade usually contained a larger percentage of nicotine than the "common". The nitrogen and nitrate were more variable but in the majority of instances, the "good" carried larger percentages of these constituents than the "common".

Of the burley grades, the fillers usually contained the largest percentages of nitrogen and nicotine and the smokers, the smallest. In the dark tobacco the leaf usually had the largest percentage of nitrogen, nicotine and nitrate, and the trash the smallest.

The burley tobacco of 1921 contained larger percentages of all constituents determined, except calcium, than that of 1920. The dark tobacco of 1921 also carried larger percentages of all except calcium and phosphorus, than that of 1920. The proportions of phosphorus and magnesium, altho different in the two kinds of tobacco, showed the least variation in the same crop, in the two years.

The burley tobacco of each year contained larger percentages of nitrogen and nitrate but a smaller percentage of nicotine than the dark tobacco. The combined burley samples showed 4.5 per cent more total nitrogen and 78.8 per cent more nitrate nitrogen, but 40.9 per cent less nicotine than the dark.

The ranges for the nitrogen constituents determined in the dry burley were 1.96 to 6.05 per cent total nitrogen, 0.29 to 6.18 per cent nicotine, and 0.009 to 1.37 per cent nitrate nitrogen. For the dry dark tobacco they were 2.07 to 5.75 per cent total nitrogen, 2.12 to 7.83 per cent nicotine, and 0.002 to .73 per cent nitrate nitrogen.

The proportions of the ash constituents, other than phosphorus and magnesium, differed considerably in the "good" and "common" grades. The "good", apparently, had the most potassium.

The averages obtained for burley tobacco apparently show that the wrappers had the smallest percentages of silicon and calcium but the largest potassium; the fillers, the smallest percentages of ash and potassium, and the smokers the largest percentages of ash, silicon and calcium. The averages for dark tobacco show that the leaf had the smallest percentages of ash and silicon but the largest of potassium and calcium, while the trash had the largest percentages of ash and silicon but the smallest of potassium and calcium.

The burley tobacco of each year contained smaller percentages of ash, silicon and magnesium, but larger percentages of phosphorus, potassium and calcium than the dark tobacco of the corresponding year. The averages of the analyses of burley tobacco representing the two years show 1.7 per cent less ash, 67.7 per cent less silicon and 36.9 per cent less magnesium, but 81.0 per cent more phosphorus, 51.7 per cent more potassium and 37.8 per cent more calcium than the corresponding averages for the dark tobacco.

Burley leaf badly infected with leaf-spot disease contained a considerably smaller percentage of nicotine but a larger percentage of nitrogen than that which was less diseased. This indicates that such tobacco either had part of its nitrogen in combinations which were detrimental or the deficiency of nicotine vitiated its quality. (For the detailed report see Ky. Experiment Station Bulletin No. 258.)

(9) A Mineral Mixture as a Supplement in Hogging Down Corn. E. J. Wilford, Ky. Exp. Station.

The Kentucky Station, in 1915, commenced a series of investigations to determine the best crops and the best combination of crops and supplements for hogging down. The first year's work eliminated cowpeas. It was shown that even tho the peas were supplemented with 2 per cent of the live weight of the hogs in corn meal, only 100 pounds of pork was produced per acre, resulting in a heavy financial loss. Hogging down soybeans, supplemented with 2 per cent of the live weight of the hogs in corn meal, proved to be very profitable. One acre produced 825 pounds of pork at a cost of $4.54 per hundred. We have not been able to equal or even approach these figures since, and apparently only one station has gotten as many pounds of pork per acre on soybeans.

The good results obtained from this experiment led to other combinations with soybeans; First, soybeans hogged down with corn self-fed, which proved to be unsatisfactory for four years; second, soybeans and corn grown together, which showed an average net profit for five years of $34.68 per acre. To get a comparative basis, corn alone was tried three years, which gave an average net profit of $25.39, or an average of $9.29 less than the corn and soybeans grown together. During this series of experiments tankage was given a trial. Corn hogged down with tankage self-fed gave an average net profit per acre for two years of $47.82, or $13.14 more than the corn and soybeans grown together. The criticism may be advanced that there were only two years' results, while the other combinations had three or more years, but in comparing these crops for the same two years we find tankage and corn have a larger margin of net profit than that just stated.

Thus we have corn hogged down with tankage self-fed ranking first, corn and soybeans grown together, second; corn alone, third; soybeans plus 2 to 3 per cent of the live weight of the hogs hand-fed in corn, fourth, and soybeans hogged down plus corn self-fed, last.

The good results obtained by the use of mineral supplements and the high price of tankage caused us to compare them in this year's test (1925). Poland China, Duroc Jersey, Hampshire, Berkshire and Poland China and Duroc Jersey crossbred hogs were used. Their average weight was a trifle over 100 pounds, which is the most desirable weight for hogging down corn, as they have the size and weight to break the corn down. With all conditions equal, they make more rapid gains than pigs of lighter weight and more economical gains than those of heavier weight.

The usual precautions were taken to have the lots as uniform as possible in representative pigs. The variety of corn used was Iowa Silver Mine and the soybean varieties were Ito San, Haberlandt and an early maturing bean raised on the Kentucky Experiment Station farm. This unnamed variety gave us just as good returns as the other two mentioned.

The corn and bean yield was very good, the weather conditions having been ideal to produce these crops. The corn was just denting and the beans were in the dough stage when the hogs were turned into the lots, August 29. This is an ideal condition for hogging down these two crops. Previous work with soybeans had shown that it is advisable to turn in as early as possible, as the beans become less palatable with age. The hogs in all lots remained healthy during the hogging down period which was favored with almost ideal weather, there being only a few extremely hot days and only one cold, drizzling rain. A comparison of the trials is shown in the table.

Results of hogging down corn with and without tankage and mineral mixture

	Lot 7 Corn with soybeans in row	Lot 8 Corn with soybeans in row plus mineral	Lot 4 Corn plus tankage self-fed	Lot 3 Corn plus mineral self-fed
Pigs in lot ....No.	10	10	19	19
Days on feed ....Days	58	46	26	25
No. of pig days..........	580	460	494	475
Initial weight ....lbs.	1025	1025	2010	2010
Final weight ....lbs.	1550	1810	2840	2765
Pork produced ....lbs.	525	785	830	755
Average daily gain ....lbs.	.90	1.70	1.68	1.59
Value of pork produced at $7.50 cwt.	$ 39.38	$ 58.88	$ 62.25	$ 56.63
Weight of tankage ....lbs.	....	....	125	....
Weight of mineral mixture lbs.	....	25	....	30
Cost of producing crop, per acre*	$ 22.23	$ 22.23	$ 19.40	$ 19.40
Cost of supplement	....	.41	3.75	.50
Total cost per acre	22.23	22.64	23.15	19.90
Net gain per acre	17.15	36.24	39.10	36.73
Estimated yields ....bu.	50	55	60	60
Price received per bu. corn	$ .787	$ 1.07	$ 1.03	$ .944
Pork produced per bu. corn ....lbs.	10.5	14.2	13.8	12.6

*Includes plowing and cultivation, seed and rent of land for five months. Cost of tankage was $60 per ton; mineral mixture, 1.6c per pound. The mineral mixture was composed of 2 parts, by weight, steamed bone meal, 2 parts ground limestone, and 1 part salt.

Lot 8, with corn and soybeans together supplemented with a mineral mixture, excels all other lots in the rapidity of gains and the number of pounds of pork produced per bushel of corn, based on estimated yields which checked very closely with actual yields on the agronomy plots. Lot 7, which is like Lot 8, but received no mineral mixture, was the least productive of the four.

Lot 4, with corn hogged down and tankage self-fed, produced 830 pounds of pork, which was 45 pounds better than any other lot, but the average daily gain was a trifle less than that of Lot 8.

Lot 3, corn hogged down and supplemented with a mineral mixture, ranks third in average daily gain and in the amount of pork produced, but in net profit it ranks second. It is unfortunate we did not have a check plot of corn alone this year, but as compared with results obtained from corn alone in previous years, Lot 3 is by far the better.

Lot 4, corn and tankage, led in net profits per acre, with a return of $39.10. Lots 8 and 3 ranked close to it with net profits $36.24 and $36.73, respectively.

Conclusion

It is seen that tankage has not been dethroned yet, but that it has very close contenders in corn and soybeans grown together, plus a mineral mixture, and in corn alone hogged down, plus a mineral mixture.

There are indications that a mineral mixture is a material aid to corn alone hogged down and that it is probably the missing link which will aid the farmer to get better results from his corn and soybeans grown together, when hogs are used as harvesters.

A Universal Resistance Box. M. N. States, U. of Ky. (Abstract)

For the experimental verification of Kirchhoff's Laws of electrical circuits and for various other purposes, as, for example, the determination of the figure of merit of a galvanometer, a network circuit is extremely useful in the average physical laboratory. Such circuits usually are constructed of several so-called resistance boxes of the dial or plug type. With the ever increasing cost of electrical equipment even the simplest of such circuits involves the use of equipment amounting to several hundred dollars. The purpose of this paper is to explain the design of a new resistance box which functions in the normal way and in addition is capable of forming network circuits of three branches without additional equipment. Practical application is made show-

ing the use of this divided circuit in obtaining the figure of merit of galvanometers as well as its use in demonstrating Kirchhoff's laws.

Geography of the Western Kentucky Coal Field.* Wilbur Greeley Burroughs, Professor of Geology and Geography, Berea College, Asst. Geologist, Kentucky Geological Survey.

The Western Coal Field includes the area underlain by the Pennsylvanian strata in Western Kentucky. It is bounded on the east and south by the Mississippian formations and on the north and west by the Ohio River. The Coal Measures strata have been preserved from erosion by being in a geosyncline on the west side of the Cincinnati Arch.

The principal streams flowing thru the Coal Field are the Green and Tradewater Rivers which empty into the Ohio River, and their larger tributaries.

The rougher surfaced areas are along the southern, and portions of the eastern borders. Northward and westward the Coal Field becomes more gently rolling as the Ohio is approached, except for a strip of hills that are formed where the streams leave the uplands for the Ohio River bottoms. The bottom lands along the Ohio are level and in places very wide. The stream valleys thruout the Coal Field, except along the rough margin areas, are often broad, flat and poorly drained. They are being aggraded by wash from the surrounding uplands.

The climate is humid, temperate and of the continental type. The Coal Field lies within the path of the moisture bearing storms which move from the Gulf northeastward to the Great Lake region and the North Atlantic coast.

Residual and transported soils occur. Transplanted soils are found chiefly in the stream bottom lands. Loess

---

*The material given in this paper was secured by the writer during his investigations of the geography of the Western Coal Field for the Kentucky Geological Survey. Field work was carried on in the summer of 1923. The condensed account here given is read by permission of Dr. W. R. Jillson, Director.

covers large areas in the uplands of Union, Henderson and other counties, along the Ohio River. There are many large swamps in the more gently rolling portions of the Coal Field and along the Ohio River bottoms. These swamps are being drained in Daviess and other counties. The land thus reclaimed is valuable for agricultural purposes.

Coal is the greatest mineral resource. Seams Nos. 9 and 11 are the most important coal beds mined. Large quantities of shale occur which are suitable for brick, tile and the like. Sandstone and limestone suitable for building stone are quarried. The limestone is also used for road metal and agricultural lime. Certain limestones might be used in Portland cement. Gravel is dredged along the Ohio River and used for surfacing the roads and other purposes. Glass sands occur. Oil and gas have been found in commercial quantities, but much territory remains to be prospected. Oil shale of the Pennsylvanian System has been found, but is too low grade to compete with the Ohio shale of the Kentucky Knobs. Rock asphalt is being quarried along the southern margin of the Coal Field and beds of rock asphalt still await development along the southern and eastern margins. Iron ore occurs but is too low grade to be of economic importance at present.

Drinking water can be obtained at shallow depths in the river bottomlands, but deep wells are safer from the standpoint of purity. Mineral springs occur, as at Dawson Springs. Many of the towns and cities have their water supplies filtered and thoroly purified. Thus Henderson and Owensboro have excellent systems of water supply.

Forests cover wide areas of river bottomlands and the steeper slopes of the uplands. The large trees, however, have been mostly cut away, but some virgin timber still remains and is now being cut. Many of the smaller trees are used for mine props, ties and the like. Some of the coal mining companies have large acreages of forest land for this purpose.

The wild animal life consists of the common birds, snakes, rabbits, squirrels, skunks, occasional foxes and other animals found elsewhere in the State. The rivers contain fish.

The rougher surfaced counties and those containing large swamps have in general a lower percentage of improved land than the more gently rolling counties with cultivable land. Farms have increased in number and decreased in size chiefly by subdivision, especially in the tobacco-producing counties. The percent of increase in land values in general, bears a relation to the increase in the number of farms. Also, rugged counties with poorer soils and greater difficulties in farming and in reaching a market, have lower land values, other things being equal, than the more level counties. The percent of increase in valuation of farm land has been greatest in the counties which raise tobacco extensively or have large acreages of swampy land reclaimed by drainage projects. The increase in price of all farm products a few years ago caused farm land to increase in price. When the depression came after the War, farm land values declined the most where products were raised extensively which decreased in price to the greatest extent. Thus tobacco-and corn-producing counties had their land values decline more than did the rough surfaced counties where these products are not raised in such quantities.

The assessed valuation of all farm property and incomes from gross crop returns were greater in the more level counties than in those having a rougher topography.

The principal crops grown are corn, tobacco and wheat, which are raised in greatest amounts in counties having level or gently rolling topography. Oats, rye, barley, potatoes and sorghum are produced in smaller amounts. Sorghum is raised in greater quantities in districts remote from railroads where all the necessities of life are produced, as far as possible, on the farm. Truck gardening is carried on chiefly near the large cities. Small and orchard fruits are raised. Apples are of especial importance in Henderson County. Hay and forage crops are raised most in the more level counties.

Horses are decreasing and mules are increasing in numbers. Dairy and beef cattle are found in greater numbers in the more level counties which have a greater abundance of forage crops than in the rougher surfaced areas. Cattle are increasing in numbers. Whole milk is produced in greatest quantities near the cities. Cream, butter and cheese can be produced at a distance from markets if there are railroad transportation facilities. These dairy products offer the farmer in many localities an opportunity to increase his income. The sheep industry has declined due, in part, to the difficulty in protecting the sheep from dogs. The topography, however, is suitable for the raising of sheep. Swine are fattened in greater numbers in the more level counties which produce heavy acreage yields of corn per square mile. Many of the hogs are killed in packing houses at Owensboro and Henderson. The poultry industry is increasing. Bees are kept successfully in a rough as well as level topography. Poultry products and honey can be produced in the more remote districts and shipped to market.

In prehistoric times the Western Coal Field was inhabited by an unknown race called the Mound Builders. Relics of peaceful and warlike pursuits can still be found. At present, the level and rolling areas are dotted with well-kept farms and farm buildings. Near the large towns and cities the roads are piked. In the rugged areas log cabins and boxhouses are found, as well as larger houses. The roads are often narrow and rough. Many of the mining towns and camps are composed of regularly spaced, neatly painted houses. On the outskirts of some of the camps may be seen the shacks where the "floating" population live. Everywhere in the rural districts, better roads will benefit the citizens. Even as it is, the rural mail service has brought the most remote areas into contact with the outside world.

Illiteracy exists in all the counties, but the more hilly regions have a higher percent of illiteracy than the more level counties with their better roads. The condition of the dirt roads influences the dates of beginning and closing the school year. High schools, academies, business colleges, and institutions of higher learning are located at many of the towns.

Health conditions are influenced by the geographic location. Counties having large towns and cities have higher tuberculosis and pneumonia death rates than the more entirely rural counties. The typhoid rate is higher than in the Knobs and Bluegrass. Ordinary precautions will greatly lower the number of deaths due to typhoid. Malaria is becoming less common as the swamps are drained. Hookworm and trachoma occur in some districts, but can be eradicated.

Tenancy is more customary in the more level, tobacco-growing areas than in the rougher districts. Native white farmers are increasing in numbers. Foreign-born and negro farmers are decreasing. Nearly all the farmers in the more mountainous areas are native white. More foreign-born whites are found along the Ohio River where the land is more accessible to the outside world than in the more isolated, hilly counties. In the agricultural districts negroes are found in greatest numbers where tobacco is raised, and on the larger farms as hired labor or tenants. They also flock to the cities. In the Western Coal Field as a whole the negro population is steadily decreasing.

The Western Coal Field is well served by railroads thruout the important agricultural and coal mining districts, altho Butler, Edmonson and certain areas in other counties are badly in need of railroad transportation. The railroads generally follow the valleys and tunnel thru the hills which they encounter. The Coal Field is in touch by rail with Louisville, Evansville and other large city and rural markets. The Ohio and Green Rivers with their dams and locks are navigable to steamboats of quite large size. The majority of the wagon roads are dirt. The Dixie "B" Line auto trail passes from Indiana into Kentucky by ferry across the Ohio River at Henderson. Other auto roads pass thru the Coal Field.

In the country, small stores are found at the intersections of the more frequented roads. Small towns have grown up at the intersections of main highways. Mineral springs have aided the growth of a few towns. Many villages and towns owe their existance to nearby coal mines. Nortonville is a railroad junction as well as being a coal mining town. Livermore is located at the union of Rough and Green Rivers, and logs floated down these rivers are used at the two chair manufactures in this town. It is also on a railroad. Several towns which formerly were important Ohio River ports before the development of railroads, have ceased to grow or have decreased in population. Improvements in the Ohio River may stimulate navigation and thereby aid these towns. County seats are often located near the center of the county; but a few are in the most important cities irrespective of geographic location.

Favorable locations for towns relative to the topography are on the edge of an upland where the drainage is good, access to both upland and lowland easy, and a railroad following the lowland is nearby. Providence is an example.

Cities of the Western Coal Field are Owensboro, Henderson, Madisonville, Providence, Earlington, Central City and Morganfield. Owensboro is situated on the most southerly portion of the Ohio's meandering course along the northern boundary of Kentucky, before the river finally turns southward on its last comparatively short stretch to the Mississippi. Thus Owensboro with its river traffic is brought nearer to all portions of Kentucky directly south of that town, than any other point along the Ohio east of Mt. Vernon. Railroads have since aided in developing the city. Henderson also is strategically situated on the most southerly curve of the Ohio since the strean passed Owensboro. Madisonville is located in the heart of the Western Coal

Field. Providence, Earlington and Central City owe their importance to coal mining. Morganfield, located in the central part of Union County, is a county seat, has a trade from the surrounding rich agricultural areas, and has several coal mines.

The density of population in the Western Coal Field in 1920 was 54.9 per square mile. The rural population has moved away to a small extent from the farms to the cities during the last decade. In 1920, Daviess County ranked first among the Western Coal Field counties in total taxable wealth. Counties having large areas of level or rolling rich farm land, or coal seams have a higher taxable wealth per square mile than do the hilly areas along the southern and eastern margins of the Coal Field.

In conclusion it should be remembered that great areas of coal land, rock asphalt, oil and gas pools, and many other mineral resources remain undeveloped. The forest lands under scientific management will prove a source of enormous wealth. Live stock can be kept profitably on the farms in increased numbers. Poultry and bees will add to the farm income. Correct rotation of crops and care of the soils will increase the returns from the land. Fruit culture is really in its infancy as compared to the development that can take place. Near the towns and cities truck gardening can be increased. Better roads will prove of benefit to everyone in many ways. The cities, due to their natural resources and strategic positions, will continue to grow as industrial centers. The future of the Western Coal Field both socially and economically is very bright.

Subcrustal Expansion as a Possible Factor in Earth Diastrophism. Walter H. Bucher. (Abstract)

Three times within the last twenty-five years the suggestion that subcrustal expansion may have played a role in the major diastrophism of the earth, has arisen in the minds of geologists. Each time the suggestion arose inde-

pendently, in the course of reasoning from entirely different premises. The author sketches the three lines of reasoning, dwelling especially on the last, as contained in a paper by J. Joly, published in the Philosophical Magazine, vol. XIV, 1923. Joly has based on the suggestion an elaborate theory which, in its implications is at least most interesting and may well represent a step in the direction toward a satisfactory explanation of the mechanism of earth diastrophism.

The Present Status of the Oil Shale Industry. C. S. Crouse, University of Kentucky.

The oil shale industry has been slow of growth. Since 1922, there has been very little development, apparent to the layman at least, of the eastern shales and those of Kentucky in particular. Nevertheless a great amount of work has been done in the past few years looking toward the industrial development of shale not only in this country but in the world at large. It is the purpose of this paper to briefly sketch these developments.

The outstanding features of the past year in England were two; the demonstration of the Crozier retort before the Empire Mining and Metallurgical Congress in London combined with the intense interest in shale shown by leaders in Mining and Metallurgical work in the United Kingdom and the contribution by subscription of approximately $600,000 to the University of Birmingham for the purpose of research work on English oil shales.

In Sweden a commercial plant has been erected which can produce annually 250,000 tons of crude oil at a cost which will enable it to be sold at less than the imported oil.

In Esthonia a Swedish syndicate proposes to expend 60,000,000 Swedish kronen in erecting retorts, building a harbor and constructing a railroad. Two English companies are also interested here, Cunningham-Craig of London estimating a net profit of $5 per ton for these companies. In addition half the locomotives in Esthonia use raw shale as a fuel and an ever increasing amount is being used for general heating.

France has oil shale to the amount of about 50,000,000 tons in seven distinct regions and the first unit of a 200-ton plant is now in successful operation.

The Italian shale is being worked in Sicily, the bitumen product being used for asphalt paving and the lubricating oils being of excellent quality.

Ichthyol, a skin specific, is being produced from the Swiss oil shales.

In Spain, about 110 miles south of Madrid, a commercial shale plant has been in successful commercial operation for some time.

The oil shale situation in Japan is very interesting. The navy requires 500,000 tons of oil annually and industry 300,000 tons. The great Fushan coal deposits are overlain with shale which it is estimated will yield 1,900,000,000 bbls. of oil. The financial plans for the exploitation of this shale involve the expenditure, over a period of years, of $25,000,000, part of which is to be contributed by the South Manchurian Railroad and part by the Japanese Government. The initial plant to be erected will have a daily capacity of 2,000 tons and the profit is estimated at 13% on a capital investment of $3,000,000.

In Burma-Siam, 13,500,000 tons of shale of an average yield of 33 gal. of crude oil to the ton have been proved by core drilling.

In New South Wales it is estimated that 40,000,000 tons of crude oil can be expected from known deposits. These deposits are in the experimental stage only, however.

The geological survey in Tasmania estimates the available amount of shale at 43,000,000 tons of an average yield of 40 imperial gallons to the ton with the cost of mining and retorting estimated at $2 per ton. Both governmental and private interests are concentrating on the development of these shales.

Considerable development work has been done on the torbanite deposits in the Transvaal the area to be exploited covering 40 square miles and containing at least 25,000,000 tons. This torbanite is richer than the ordinary oil shale.

Rather extensive preliminary work has been done in New Brunswick, Canada, by a subsidiary of the Anglo-Persian Oil Company. It is tempororily at a standstill but will undoubtedly proceed in the near future not only on these shales but also on those found in Nova Scotia and Newfoundland as well.

In the United States the four outstanding events of the year have been the pioneer distillation work of M. J. Trumble in making water-white gasoline from shale in one operation; the completion and continuous operation of a commercial oil shale plant, the first in the United States, by Mr. Catlin at Elko, Nevada; the oil shale conference last fall at Sacramento; and the very active interest of the government in oil shale due primarily to the needs of the navy for a dependable supply of oil.

The oil shale conference at Sacramento, held in connection with the annual meeting of the American Mining Congress, was attended by Rear Admiral Rousseau as the representative of the navy. In an address before that body, Admiral Rousseau, after making the statement that there are two naval shale reserves, one in Colorado and one in Utah, the two together containing about 160,000 acres, said, "The President's commission on oil reserves considers that the production of shale oil is so essential to the future of our United States that it recently made a recommendation to the effect that the Government should undertake, at once, experimental work that would lead to an adequate output of shale oil thru the construction of a plant of commercial size".

As a result of this recommendation an appropriation of $90,000 to be used by the Bureau of Mines, was requested of Congress. This appropriation was passed and on March 12th last an invitation was extended by Mr. H. Foster Bain, Director of the Bureau of Mines, to those of us vitally interested in shale, to attend a conference at the University of Colorado. The purpose of this conference was to assemble a group of shale men to advise with the engineers and chemists of the Interior and Navy Departments on the construction of the oil shale plant above mentioned.

On April 22nd the Federal Oil Conservation Board which consists of Secretaries Work, Weeks, Wilbur and Hoover and of which Secretary Work is Chairman, sent out, over Secretary Work's signature, a letter which began as follows: "Under the instructions of the President, this Board is undertaking a comprehensive, cooperative study of the problems which the United States is facing as the largest producer and the largest consumer of petroleum, with rapidly diminishing reserves". A large part of this letter was then devoted to oil shale and its possibilities.

Thus it will be seen that the United States Government is awake to the necessity of the immediate development of the oil shales of the nation. Whether this interest will take the form of a subsidy or some other form is not apparent at the present time. However, with the active interest of the government and the concentrated effort of the many private interests involved it can not but follow that the next few years will see a real oil shale industry started; and the factors that make for the establishment of an oil shale industry in the western portion of the United States make equally well for the establishment of such an industry in Kentucky, for Kentucky, more than any other portion of this country, combines, in her oil shales, all the conditions most favorable for commercial exploitation.

Therefore, tho the only thing of moment that has been done in Kentucky in the past year is the publication, by the

Kentucky Geological Survey, of a symposium by various authors, on Kentucky oil shale, nevertheless world development and development in the United States at large, will inevitably force the commercial development of Kentucky's shales in the not far distant future.

The Characteristic X-rays of Molybdenum. T. M. Hahn, University of Kentucky.

The famous researches of the Braggs[1] on X-rays which won for them the Nobel prize, the subsequent work of Hull[2], Debye and Scherrer[3], and others which extended the use of X-rays to the analysis of the atomic structure of all substances are well known. The problem of the arrangement and spacing of the atoms in most of the simple and a few of the more complicated crystals has been solved. In the study of the very complex organic and inorganic salts, the need for a powerful source of monochromatic X-rays has been quite apparent. Hence it is very important that the characteristic X-radiations of the elements be accurately known. It is the purpose of this paper to describe the determination of the characteristic X-radiations of molybdenum.

The tube used was a special type Coolidge tube, with a water-cooled anode. This anode consists of a large hollow copper rod, in the end of which is set, perpendicular to the electron stream, a molybdenum button. A water flow of a quart a minute at a pressure of from 25 to 80 pounds per square inch was maintained by means of a specially constructed closed U-tube manometer. For a source of high potential a Kny-Scheerer apparatus of the rotating cross arm type was used. This was found to be quite satisfactory. At a difference of potential of 35,000 volts, the tube current was about 35 milliamperes.

(1) X-Rays and Crystal Structure, W. H. and W. L. Bragg
(2) Hull, Phys. Rev., 10, 661, 1917
(3) Debye and Scherrer, Phys. Zeit. 17, 277, 1916 also 18, 291, 1917

Both NaCl and calcite crystals were used, surfaces being selected which gave undistorted reflections of the scene thru an open window when the crystal was held a millimeter or so from the eye.

The X-ray spectograph used was designed by Dr. Mueller, and built by Hilger, London. It is adapted for use by either Braggs' crystal method, Hull's transmission method or Debye and Scherrer's reflection method. The crystal or crystals are mounted upon a graduated crystal table which may be made to oscillate thru a small angle about any setting. For the Bragg method, the crystal face, as well as the central plane of the X-ray stream, must pass thru the axis of rotation. This adjustment was accomplished by a series of photographs.

Sixteen exposures were taken, the Bragg method being used thruout. The time of exposure was varied from fifteen minutes up to seven hours. The effect of a filter of zirconium, which is especially suited for use as a filter with molybdenum since its upper K series limit lies just below the K^a lines of the latter, was investigated. A thickness of the nitrate equivalent to 0.35 mm. of the oxide was used. This filter was prepared by impregnating a strip of blotter paper of known area with a water solution of the salt. This gave a uniform thickness of the filter. Only the lower half of the plate was covered by this filter, giving a direct comparison between the filtered and unfiltered radiation. One of the photographs and a table of results follow.

Line	Order	Displacement	Theta	Lambda	Lambda (Bragg)
a_2	1	1.2746	7° 15′ 40″	0.7113	0.7121
a_2	2	2.7801	14° 38′ 00″	0.7109	0.7121
a_1	1	1.2683	7° 13′ 30″	0.7078	0.7078
a_1	2	2.7683	14° 35′ 00″	0.7085	0.7078
b	1	1.1238	6° 26′ 00″	0.6306	0.6311

(All wave lengths given in Angstrom units)

A comparison of the results with those obtained by many others as given by Bragg is also shown. The filter very nearly eliminated the beta and gamma lines and the general radiation, but passed the alpha doublet with but slight diminution.

Early Glaciation in Kentucky. W. R. Jillson, State Geologist. (Abstract)

The paper reports the finding of glacial pebbles and boulders of igneous and metamorphic rock, apparently of Canadian origin, in Lawrence, Elliott, Morgan, Carter, Rowan, Lewis, Montgomery, Clark, Robertson, Harrison, Scott, Owen and Franklin Counties, Kentucky. This indicates that a very thin but widespread mantle of glacial material, in size both large and small, covers Northern Kentucky from the Big Sandy River as far south as 38° 10′ and as far west, at least, as the northwestward drainage of the Kentucky River. The widely disseminated characteristic coupled with the absence of glacial shaping of topography, glacial sands and gravels tends to substantiate the author's early hypothesis that these erratics belong to the first continental glaciation of the Pleistocene period and are equivalent to the Nebraskan or Jerseyan epochs. (For the complete paper see the Pan-American Geologist, Vol. XLIV, August, 1925, pp. 17-20, with map).

Major Drainage Modifications of the Big Sandy River. W. R. Jillson, State Geologist. (Abstract)

The Big Sandy River of Southwestern Virginia, West Virginia, and Eastern Kentucky is only the upper middle portion of a former much larger stream. Recent discoveries of many erratic stream-worn quartzite boulders, some of which carry pronounced scolithus (worm) borings have been made on the upper waters of the Licking River and the middle waters of the Big Sandy River. These boulders, ranging in weight from two to one hundred pounds, indicate that the ancient Big Sandy River had its headwaters in the Roan Mountain region of Western North Carolina. It is in this section of the Southern Appalachians that the parent ledges of Cambrian quartzite occur from which these old stream boulders were derived. This inference is further substantiated by many specimens of erratic vein and milky quartz found at the same levels and in the same region as the quartite boulders. Both are apparently identified with the old Cretaceous peneplain—the present summit levels of this part of Eastern Kentucky.

Headwater piracy of the Clinch and the Blue Stone Rivers operating advantageously along Northeast and Southwest lines of favorable structure, beheaded, probably during the middle Tertiary, the upper one-fifth of Big Sandy River. The occurrence of so many of these quartzite boulders close to levels of the old Cretaceous peneplain on the upper waters of the Licking River as well as adjacent drainage courses, indicates that the Big Sandy River was flowing thru the Licking to the northwest as late as the Cretaceous. The probability is that it had occupied this course since the uplift which marked the close of the Paleozoic. Subsequent structural elevation along the nearly North-South axis of the Paint Creek Uplift in Johnson County has operated to bisect the waters of the original Big Sandy, and shunted the upper waters to the northeast to join the Tug Fork—the course occupied today.

At the time the Big Sandy flowed in the course of the Licking River it did not, however, join the Ohio River in the vicinity of the present townsite of Cincinnati, for during the Cretaceous there was no Ohio River—this stream being one of the direct products of the Pleistocene glaciation. The original Big Sandy, therefore, probably flowed on to the Northwest in the region of Southwestern Ohio and Southeastern Indiana until it met major drainage and was turned to the southwest to the Gulf of Mexico, then heading at Cairo, Illinois, or what is more likely to have been the case, to the Great Lakes basin via Lake Erie.

The old Big Sandy basin has thus been cut transversely three times: first, about seventy-five miles below its headwaters, by the Clinch and Blue Stone Rivers; second, one hundred and fifty miles below its headwaters, by the Paint Creek Uplift; and third, three hundred miles below its headwaters, by the newly formed glacial Ohio River. That all these modifications occurred at the same time is highly improbable, but that they are all post Cretaceous is quite certain. Various indications point to the early and middle Tertiary, and the early Quaternary.

Exploration for Oil and Gas in Boyd County, Kentucky. W. R. Jillson, State Geologist. (Abstract)

Altho Boyd County is the smallest subdivision of Eastern Kentucky, it occupies a very strategic geographical position at the juncture of the Big Sandy and Ohio Rivers. Ashland, its principal city, with an estimated population of about 26,000 (1926) is a rapidly growing iron, fire-brick, and manufacturing center using large amounts of industrial natural gas.

The surface rocks of this region consist of shales, sandstones, coals and limestones, given in the order of their importance in the geological section. Stratigraphically these sediments belong to the Pottsville and Allegheny divisions of the Coal Measures (Pennsylvanian). Structurally, Boyd County exhibits a sweeping monocline dipping to the Southeast, as measured on a surface bed, the Fire-Clay coal, at the rate of about thirty-five feet to the mile. This general structure is interrupted by but a few pronounced irregularities. These structures are : (1) Midland Trail Dome, (2) Laurel Dome, (3) Four Mile Creek Dome, (4) Ashland Anticline, (5) Laurel Anticline, and (6) East Fork Anticline. The domes are small. The anticlines are of the finger type plunging to the southeast. The subsurface structure has recently been detailed on the Sunbury black shale (Mississippian). It erases the surface domes and smaller features entirely, and increases the dip to the southeast because of the thickening of many beds in this direction.

Nine oil and gas "sands" are recognized, these being, in descending order, 1st Salt sand, 2nd Salt sand, and 3rd Salt sand (Pennsylvanian), Big Injun gas sand, Berea Oil and Gas sands (Mississippian), Gordan and Ashland gas sands (3 in number) and the Corniferous limestones (Devonian). The Ohio shales contain the three separate Gordon and Ashland gas sands, all of which are of commercial importance. Beneath the Corniferous, a long sequence of limestones and calcareous shales extends, the entire sequence of the Silurian and Ordovician, to depths of at least 4000 feet. Included in these lower rocks are the "Clinton sand" and Trenton sand" which here are thought to be unproductive. The Gordon and Ashland gas sands are lenticular and very irregular.

Drilling was first undertaken in Boyd County during the decade 1880-1890 and was carried forward sporadically until 1919, when a considerable body of gas was developed in the vicinity of Ashland for industrial purposes. Successful natural gas drilling is in progress at the present time. A total of about 80 wells have been drilled in Boyd County. This prospecting indicates that oil from the Berea and Corniferous may be developed in small commercial quantities, particularly in the vicinity of Bolts Fork and Laurel Creek, but that the particular commercial production of this county will be natural gas varying in volume from 200,000 cubic feet to 3,000,000 cubic feet in individual wells.

Regional metamorphism in the interior of Boyd County is relatively high being indexed by the 60% isocarb which circles Cannonsburg as a center. The anomalous cause of this island of high regional metamorphism in northeastern Kentucky is unexplained. A volume of several million cubic feet open flow of natural gas is now at the casing head in Boyd County. Rock pressures vary from 350 pounds in the Salt sand (Pennsylvanian) to 800 pounds in the Gordon and the Ashland gas sand (Devonian). The gas is used locally for both industrial and domestic purposes. This gas production is derived chiefly from the three separate and somewhat irregular Ashland "sands" encountered in the black Ohio shales (Devonian) at depths ranging from 1800 to 2200 feet.

Some Problems in Pauperism. W. S. Anderson, Professor of Genetics, U. of Ky. (Synopsis).

The infertile soils in many sections of the country are divided into small farms. The mountain regions of the eastern section of the United States are thus divided. It is remarkable how many people live on these super-rural farms —more than 3,000.000. The farms will not support the families in comfort. Often the children are raised in poverty, in ignorance and frequently without any church advantages. The long distances without roads cut off many of these communities from contact with industries and there is no hope of ever bringing such neighborhoods in touch with the outside world thru good roads. There are thousands of streams with from three to twenty families whose land and entire natural resources, if sold, would not bring money enough to build a hard surfaced road for the convenience of the families. These isolated sections may become centers of crime in some form or another. In the past this has taken the form of the manufacture and sale of whisky.

Another sociological problem of very great importance is the tenant family in the richer sections where tobacco is raised. Many of these families do not make enough to properly clothe and educate the children. The price of tobacco varies so much that one year they may have a fair income, while perhaps the next they have almost nothing. They live in mere shacks for houses, stay as a rule but one year in the same place and take no care of the property they live in. The land owners are unwilling to constantly spend money on their tenant houses to keep them in livable condition. Surveys in some of the bluegrass counties have shown that one-third of the children in the rural schools are improperly clothed, poorly nourished and receive no medical attention or dental corrective work except that which is furnished by public charity.

The mountain and infertile soils and tenant shacks have not brought about the poverty-stricken condition of the people described as much as the people themselves selecting these out-of-the-way places for their families because they are unwilling to meet the competition in more prosperous sections. They can live on an isolated farm without much labor and as their neighbors are in the same condition they seem not to object to their poverty.

The greatest problem in rural sociology either is to better the condition of these people or to prevent their continued rapid multiplication.

An Experiment in Cooperation. O. B. Jesness, Kentucky Agricultural Experiment Station.

The subject of my discussion, "An Experiment in Cooperation", has been selected not entirely because of the appeal it may have to those of you who are accustomed to work with and think in terms of experiments, but because the undertakings to which I shall refer are not entirely beyond the experimental stage. Tobacco is a leading industry of our State. We are all interested in it. I am therefore going to speak briefly of the tobacco marketing associations in Kentucky.

Please do not conclude from the title that cooperative marketing is merely an experiment. Cooperative marketing has been developed successfully for a considerable period of time and is a permanent part of our agricultural industry. However, the establishment and successful conduct of an enterprise such as the Burley Tobacco Growers' Cooperative Association, involving a hundred thousand individuals and business totalled in millions of dollars, is not a matter of overnight mushroom growth but one of gradual development with some experimentation, as in any pioneering field, in finding the best methods.

I must not trespass on your time to the extent needed to give a detailed review of the development and progress of the Burley and the Dark Tobacco Growers' Cooperative Associations. It will be my endeavor to supply merely some of the more important features of the picture. The Burley Association received its impetus in the war period. Prices rose to high points, the peak being reached in the sale of the 1919 crop. The growers were encouraged by the profitable returns to increase acreage and the crop of 1920 turned out to be a record breaker. Conditions changed very materially, however, between planting time and marketing time the following winter. Deflation set in. Business conditions became unsettled and prices of many commodities, especially raw materials, took decided drops. The combination of an unusually large crop of disease-damaged tobacco and unsettled business conditions resulted in a severe price drop. The Lexington market averaged 46 cents for the 1919 crop (a record average, being higher than the district), while the 1920 crop brought only about 13 cents a pound. This crop had been produced at high costs and many growers saw disaster staring them in the face.

It was under circumstances such as these that cooperative marketing was proposed in the spring of 1921. Tobacco growers in the Carolinas and Virginia already had started an organization campaign and the Burley district adopted practically the same plan. A spectacular organization campaign was staged during the summer and by November 15, 1921, over 50 thousand individuals had signed marketing contracts, binding themselves to sell their tobacco to the association up to and including the crop of 1926.

Briefly, the plan of organization adopted was what students of cooperative enterprises speak of as the "centralized plan". It is centralized in that it has no formal locals. The members are all members of the central association and authority is centralized in the overhead management. Thus, it differs from the "federated" plan in which there are definite local bodies that have control over local questions. The association is of the nonstock, nonprofit type. Each member pays an initial membership fee of five dollars. Binding contracts are signed, these being agreements of purchase and sale whereby the title of the tobacco passes to the association upon delivery. Separate warehousing corporations have been organized to acquire the necessary receiving and storing facilities.

The characteristics of a crop and its market are important factors to consider in connection with cooperative developments because they determine what can be done and the method of doing it. Tobacco is a nonperishable commodity. It not only can be carried over from one season to the next but is carried over in unusually large amounts. This is part of the aging and blending processes. The result is that much of the tobacco is over a year old before being used. There is, therefore, the problem of carrying over the crop until consumed. Another important feature is the high degree of concentration of the outlets. In the case of burley tobacco, four manufacturers supply the market for the major portion of the crop. Unlike wheat and cotton, tobacco has no highly organized market where large numbers of buyers and sellers meet and where opportunity is given to the factors of supply and demand to register their influence upon price.

Let us take a moment to note the effect of this upon the marketing association plan. The concentrated outlet made it seem advisable for the organization to have control over a large proportion of the burley production. The contract, therefore, called for a seventy-five percent sign-up in order to make it effective. The organization, instead of following an established market, under the circumstances is an important factor in price determination. One of its principal services is in the use of bargaining power in selling to the buyers. Effective bargaining can not well be obtained without adhering to a policy of gradual selling. Hence, the association adopted the plan of pooling the tobacco from each crop year according to grade. An advance is made to the member upon delivery of his tobacco and further payments are made from time to time as tobacco is sold. Final payment is not made until all the tobacco of a crop year has been sold. The tobacco that is not sold in loose leaf form soon after delivery is redried and placed in hogsheads. In that form it may be warehoused and the warehouse receipts which are issued furnish collateral which may be employed as security in borrowing money for the making of additional distributions to members.

The low prices for the 1920 crop of burley curtailed acreage in 1921. The association received about 120 million pounds of the 1921 crop. Approximately half of this was sold during the winter of 1921. The balance was carried over until the fall of 1922. Final payment was made to the growers in February, 1923. Almost 200 million pounds of the 1922 crop was received by the Association. The sales of this crop were not completed until late in 1924, the final payment being made in March, 1925. The association's receipts of the 1923 crop amounted to about 245 million pounds. Part of that crop as well as part of the 1924 crop remains unsold at this time, consequently final payments for these two years have not been made.

No extended mention of the Dark Tobacco Growers' Cooperative Association is necessary for our purpose. The plan of organization employed by the association is essentially the same as that for burley. The formation of a separate association for the dark types of tobacco of Western Kentucky and Tennessee is explained by the fact that those types, for the most part, have different outlets from those of the burley. While the burley is used almost entirely by domestic manufacturers for chewing and smoking tobacco and cigarettes, much of the dark tobacco is exported to foreign countries. Some slight change in the details of the plan was made for the dark district because several types of tobacco are involved, namely the dark fired, the Henderson, the Green River and the one sucker types. The Dark Association was organized in 1922.

I referred at the outset to the fact that these enterprises are somewhat experimental in that there are many problems for which the solutions need to be obtained before enterprises of this kind can be said to be on a permanent basis. Some persons heralded the achievement of signing up the thousands of members as assuring success. Without in anyway discounting the importance of that accomplishment, it must be appreciated that the sign-up was only the initial step.

It would be too much to expect that these enterprises could operate without bringing upon them criticism of various kinds. The source of the most frequent criticism is to be found in the delays occurring in paying the members for their tobacco. Under the loose-leaf method of selling the growers have been accustomed to receiving all the returns for their tobacco immediately after delivery. Naturally it is not an easy matter for every grower to adjust his finances so that it will not be inconvenient for him to wait a considerable time for part of his returns. Sight must not be lost of the fact that a long time intervenes between the time the expenses for producing begin to pile up and the time of final payment. Another point which causes some difficulty is that the nonmember growers appear to fare about as well as the members without having to share in the expenses and delays in payment of the organization.

Since these are encountered so frequently, a brief consideration of the problems involved may be in order. Mention has already been made of the custom of carrying large quantities of tobacco over from one season to the next in order to age the leaf and permit of blending to maintain uniformity of brands. Previous to the organization of the associations, this service was performed by the manufacturers and dealers. After the establishment of the associations to render marketing services, it is only natural that part of this work has been delegated to them. Furthermore, the effective exercise of bargaining power would be impossible without gradual marketing. But gradual marketing means delayed payments. The solution to this difficulty would seem to be one of adjustment by the growers of their finances so that the hardships and inconveniences of delayed returns will be reduced to a minimum.

As to the objection that nonmembers obtain benefits without sharing the burdens, it must be remembered that the tobacco associations necessarily are important factors in establishing the price level in the market. It is likely that the outside price will continue to be as attractive as that obtained thru the association. Naturally, this is not pleasant for the member who sees his neighbor reap advantages without sharing the load. However, the basic consideration of the member should be how the association has helped him rather than how it has helped the outsider, and he must realize that if everyone were outside there would be no benefits.

These by no means represent all the difficulties experienced by the tobacco associations. The Burley Association has over 100,000 members and the Dark Association about 70,000. Cooperative marketing on the present basis is a new thing to most of them. It is new to business interests. It also is new to many of those connected with the management. The members are no different from the rank and file of folks in that many have but little grasp of the economic principles involved in organization and marketing. As every economist knows, problems of price are little understood and it is on the question of price and price control that much of the difficulty hinges. It is frequently suggested that the purpose of organization of farmers is to enable them to command prices for their products which will represent cost of production plus a fair profit. Other industries are held up as shining lights of the application of this principle.

An economist friend of mine has found a quotation from Shakespeare's Henry the IV which is apropos of the limits of price control. It is the dialog between Glendower and Hotspur where Glendower boasts "I can call spirits from the vasty deep" and Hotspur retorts "Why so can I and so can any man; But will they come when you call for them." In other words, any one can fix a price on his product but that does him no good unless some one is willing to pay that price. There is no magic power in cooperative organization which enables it constantly to obtain more than the market conditions warrant. It is unquestionably true that the mistaken notion has been somewhat prevalent that organization furnishes the tobacco grower with the means of price control. The purpose of cooperative marketing is to get all that the market justifies. This is by no means the same as arbitrary price control.

May I also invite your attention to the fact that a farmers' marketing association is not an exact counterpart of a manufacturing corcern? The factory has direct control over the amount of its output; the marketing association leaves acreage control in the hands of the growers, merely selling the products turned over to it. A favorable price stimulates production and that is exactly what has occurred in burley tobacco. The low price for the 1920 crop reduced the 1921 crop of burley to about 220 million pounds. Favorable prices for the 1921 crop, the first handled by the Association, brought a crop of 275 million pounds in 1922. In 1923, the largest crop on record, estimated at 326 million pounds, was produced. Last year's crop was almost as large, being estimated at 310 million pounds. This production is an evident response to price. Overproduction has taken place as shown by the increasing stocks on hand. Dealers and manufacturers reported 562,769,273 pounds of burley on hand, April 1, 1925. The supply on hand has been increasing during the last three years, being over 40% larger this year than on April 1, 1922. The oversupply, no doubt, has delayed sales by the association and payments to growers have been delayed thereby. It is a logical conclusion that the burley prices will have to go to lower levels in order that supply and demand may be brought back into line.

If the purpose of these associations is not to fix prices, what is it? Their real functions lie in the field of performance of services. Among these services may be mentioned the sale of tobacco on the basis of grade, giving uniform treatment to the members and placing the growers more nearly on the same level as the buyers in bargaining. Year in and year out, these associations should be able to sell tobacco in line with market conditions.

There is evident need at present for a more general understanding of the problems as well as the real possibilities of organized marketing. A closer contact between management and member is important. An understanding of the relations between production and price and price and production needs to be obtained. The associations have problems of great magnitude resulting from the human element involved and considerable experimentation probably will be needed before the most satisfactory solutions are determined.

The Application of Science Thru the Agronomy Extension Service in Kentucky. Ralph Kenney.

The farmers of Kentucky are continually faced with a shortage of good legume hay and pastures. More and better livestock cannot be realized on a large scale until more of this quality of feed is produced. With a steady decline in the acreage sown to clovers there has been a steady decline in fertility, rendering clover growth still more difficult and livestock profits have rapidly decreased.

Most soils in the state are in a low state of productivity at the present time and their reclamation can only be accomplished with the aid of science. Crop yields may be increased thru the extensive use of lime and sweet clover as soil builders, or by the use of phosphate and lespedeza for the same purpose. A large development along either line would be the result of past years of scientific investigation followed by the current and past years of publicity to overcome popular prejudice against the growing of sweet clover and the prejudice against lespedeza, both of which are manifested even yet in parts of our state.

Scientific investigation has shown that one-fourth of the cultivated land must be kept in legumes if an adequate soil nitrogen content is to be maintained. The United States census of 1919 shows that one acre in thirty-three acres of cultivated crops in Kentucky was in a legume. These statistics show Kentucky with the rank of forty-fifth among all states in comparative legume production and indirectly in the maintenance of soil productivity in so far as related to the growth of legumes.

This situation calls for a large effort to be directed toward the stimulation of growing more legumes. Those best adapted appear to be red and alsike clovers, soybeans, alfalfa, sweet clover and lespedeza. Extensive experimental work conducted by the Agronomy Department of the Experiment Station on eight outlying soil fields during the past twelve years has shown (1) that two tons of ground limestone and eight hundred pounds of 16-per-cent acid phosphate per acre, applied once every four years, has raised the hay yield of red and alsike clover mixed from 912 pounds to 3070 pounds per acre: (2) that soybeans without soil treatment have produced an average hay crop of 2273 pounds per acre: (3) that the soil treatment mentioned has increased the soybean hay yield to 3602 pounds per acre: (4) that 5600 pounds of lespedeza hay per acre were grown the third year after six hundred pounds of 16 per cent acid phosphate per acre was applied to tobacco followed by a wheat crop in which lespedega was sown: (5) that the largest average yield of dark tobacco harvested at Mayfield followed lespedeza treated with phosphate alone, this exceeding the yields following red and alsike clover mixed and treated with a combination of two tons of limestone and six hundred pounds of 16-p-cent acid phosphate per acre every three years.

During the past two years extensive deposits of lime-rich marls have been found in all limestone formation counties in the State. This is the greatest development of many years tending to stimulate the use of lime in Kentucky. During 1924 approximately 60,000 tons of lime materials were used and should this practice continue without increase for five years it will result in at least 150,000 acres being made capable of growing good clover, alfalfa and succeeding grain crops.

The scientific facts above cited show the feasibility of readily increasing the legume acreage. Kentucky farmers readily grasp the situation when shown the facts and are at present perhaps more receptive toward the ideas presented than ever before. It therefore behooves an extension organization to carefully guide and direct the ideas upon which a farmer may be expected to act. When lands are treated with lime and phosphate as indicated for red and alsike clover, they are prepared equally well for alfalfa and sweet clover. Since alfalfa produces an average of 50 per cent more hay per acre, as determined by various experiment stations, then treated soils should be used in a larger sowing of alfalfa for hay, in place of clovers which are lower yielding crops. Where pasture is desired on such treated soils, sweet clover is more productive of highly nutritious feed in Kentucky than any other plant at present known.

With two such excellent legumes to choose from, it is not at all surprising that a man of no experience should pick either one or the other, depending largely on the enthusiasm of the advocate for either crop who may appear before him while his mind is in the process of reaching a decision. Enthusiasm is a necessary part of any field agent's ability, but slow, conservative judgment must be used to the limit before enthusiasm is allowed to develop. All legumes will do some good to a farmer but an improper choice may result in his not satisfying an immediate need and a disappointed and prejudiced farmer may result from having encouraged such an improper choice.

For example, alfalfa makes a finer quality of hay that is easier handled than sweet clover hay; but alfalfa is seriously injured by continuous heavy grazing. It is true alfalfa can, with intelligence, be profitably handled entirely as a grazing plant but few Kentucky farmers have either the experience or sufficient livestock to utilize it in this manner. On the other hand, sweet clover grows vigorously, even while being grazed, and, being a biennial, can be grazed heavily during its second years growth without subsequent shortening of its natural life. Sweet clover is a difficult crop to handle for hay production. These crops require practically the same soil amendments in most parts of Kentucky and careful guidance must be given to the farmer whose enthusiasm has been aroused to the extent that he spends money and works hard to lime the land in order to grow one or the other.

That alfalfa is the logical choice in the long run is shown by the large alfalfa acreage now growing in Pendleton and Campbell counties where sweet clover once reigned supreme. Such long time farm demonstration of relative values or adaptability to farmers needs should guide our recommendations to a large degree. Having learned by thirty years experience that alfalfa more fully meets most farm needs and will replace sweet clover in the long run, it is inadvisable to continue starting new growers in a way to learn only by experience a fact so well demonstrated.

Most of the work in inducing farmers to apply the facts cited above is carried on by county agricultural agents. Field Agents of the Agronomy Department serve in a variety of ways among which may be listed: (1) assisting the agents to plan logical things to be done and ways and means of doing them; (2) directing the attention of the public to the county agent for information on the subjects planned to be worked upon. A specialist, by the use of proper publicity, can bring to the county agents' offices more new cooperators in a season than either he or the agents can secure thru many days of personal interviews. The agents also find profitable returns from local news service. Direction of public interest is done largely in two ways, (a) In the preparation and distribution of posters. For example, this year several thousand each of posters on alfalfa, soybeans, alsike clover, lespedeza, lime and marl have been used. When the agent displays fifty to one hundred and fifty such posters in public places over his county the result is that every farmer gets some idea in regard to the subject. The idea may be wrong but the farmer is made to think of it every time he passes one of the posters. (b) In the preparation of timely news stories distributed thru the extension editor to the papers of the state. An example of action from such a source was an item in the Louisville Courier Journal and other state papers about January 6th, 1923, stating that county agents had root rot resistant tobacco seed for free distribution. In ten days time 2000 lots of seed were given out for demonstrations and the agents had the requests directed to them by this publicity service.

Soil improvement is brought about by the growing of any of these legumes. The immediate need of the Kentucky farmer is for more feed and cash crops, hence we are approaching him from those angles rather than featuring the soil building powers of legumes.

During the past 5 years the soybean acreage has increased from less than 2,000 to approximately 125,000 acres in 1924. The normal increase seems to be approximately as follows: 75 to 100 acres in one county the first year, scattered among ten or fifteen men; 200 to 300 acres the second year, and 1000 acres the third year, followed by the crop becoming a regular part of the farm practice. It is not unreasonable to assume that half a million acres of soybean hay will be an annual crop in Kentucky and that three-fourths of the corn will be planted with soybeans in the same row. The states of Illinois and Missouri already grow three quarters of a million acres of soybeans annually and Fulton County, Kentucky, has for three years planted 75 to 90 per cent of its corn with beans in the row. 15,000 to 20,000 acres of new alfalfa were sown in 1924. It is expected that 50,000 acres will be sown in 1925 and 100,000 acres sown in 1926.

There are more than 1,000,000 acres of cultivated land in twenty-five counties in the outer Bluegrass Region with plenty of lime in the soil to grow good alfalfa. Three-fourths of all the alfalfa in the state is now in that region. There are over half a million acres of other cultivated lands rich in lime in various parts of Kentucky ready to grow alfalfa. With the universal change in the corn belt to alfalfa and sweet clover Kentucky must in a few years harvest annually a million acres of alfalfa hay where at present we have perhaps 100,000 acres.

In 1923, so far as known, only three men saved lespedeza seed in Kentucky. In 1924, 78 seed pans were purchased or made in Graves County alone and several thousand bushels of seed were saved in the Purchase Region. Seven years ago not over ten men were sowing lespedeza seed as a regular farm practice in the entire state. Now each of five counties uses from five hundred bushels to three thousand bushels of seed each spring and demonstrations of such seeding with good results were completed in over half the counties in the state last year. Prospects are good for the building of a 100,000 bushel annual lespedeza seed industry and an incalculable increase in carrying capacity of Kentucky pastures thru extensive seeding of lespedeza in all grass and clover mixtures.

Agricultural Marls in Kentucky. S. C. Jones, Kentucky Experiment Station. (Abstract)

The need for a cheap and easily accessible source of lime for improving the soils of the State caused the writer, on behalf of the College of Agriculture and Experiment Station, to investigate the extensive deposits of calcareous clays or marls found in the state. Kentucky marls are soft, calcareous or calcareo-magnesian materials which quickly disintegrate when exposed to atmospheric agencies. The most extensive deposits are found in the Silurian formation, but usable deposits are found, also, in the Chester, St. Louis or St. Genevieve, Upper Waverly and Cincinnatian horizons. Chemical analyses of many samples have been made and show a wide range of neutralizing value, some as high as 95 per cent, estimated as calcium carbonate. Most samples were highly magnesian, especially those from the Silurian. Mainly thru the activity of County Agricultural Agents, the marls are coming into extensive use in many counties to the great advantage of farmers. (The subject is treated more fully in Ky. Experiment Station Circular No. 32, Kentucky Marls, by S. C. Jones)

The President's address, What are the results of science teaching in the schools? was given at the open session by Dr. Cloyd N. McAllister, of Berea College. He scored slavery to textbooks which discourages independent thinking, and said that the teaching of science should be a fascinating and rewarding inquiry into the phenomena of the world. He declared that memorized content of textbooks does not answer natural inquiries, and urged field work, outside reading and definite attempts to make knowledge function in the lives of students. Science releases men from superstitions, but all science adds to the mysteries of life and leads to recognition of the principle that all things are in accord with law. Science adds to the joy of living, brings respect for nature, and gives all literature, including the Bible, a much stronger place in the lives of its students.

Earthquakes. Dr. Rollin T. Chamberlin, University of Chicago.

From the very earliest times the attention of man has been arrested by earthquake phenomena.

What is an Earthquake? Earthquakes are tremors or quakings of the earth's surface, due to causes not connected with human activities. If, as occasionally happens in certain of the limestone districts of this state, the roof of a cave collapses and falls in, a slight earthquake results. Great landslides in mountainous districts are the cause of some minor earthquakes and probably slumping on the slopes of deltas in the ocean and on the borders of the continental shelves also causes earth shakings of considerable magnitude. But the vast majority of quakes are not produced in these ways, and for most of them we must look to other causes.

As the horizon of man became wider thru geographical discovery, the intimate relation between the distribution of volcanoes and earthquakes became apparent, and it was natural that earthquake phenomena should be attributed to volcanic activity. This was the dominant view of the last century. But now the theory that volcanic action is the chief cause of earthquakes has been generally abandoned.

Most earthquakes are now known to be due to tectonic forces which produce faulting, or the slippage of rock along fracture planes. ([1]) In Japan, where volcanoes are numerous, the districts surrounding the volcanoes are less frequently shaken than other parts of the islands. In the same way many of the disastrous earthquakes of South America originate along the shores as well as beneath the Pacific Ocean, many miles from the volcanic vents of the Andean chain. The great earthquakes of India and Turkestan occur in regions from which volcanic action is now entirely absent, but which lie on the steep slopes of mountain ranges that are known to be of recent growth.

---

(1) The term "tectonic" is used for these forces because they are the forces concerned in the building and construction of the earth's major relief features, such as the uplift of continents, the upheaval of mountain ranges, or the downsinking of the Red Sea trough, or the great rift valleys of Africa. Earthquakes produced by tectonic forces are thus called tectonic earthquakes.

On the other hand, the intimate relations between lines of crustal weakness and the distribution of earthquakes have been abundantly demonstrated. The internal forces involved in the slipping of the rocks along these lines of weakness are very great, as we think of forces in ordinary human affairs. Each slip involves both a tremendous amount of friction and a tremendous amount of inertia before the rocks are again brought to a state of rest. If the slip is very sudden, the entire region may be given a violent shaking. Such earthquakes, resulting from faulting, are tectonic earthquakes. They are of first importance; volcanic quakes are of decidedly secondary importance. Let us, however, consider first the volcanic quakes.

Volcanic Earthquakes. A volcanic earthquake, according to Professor Omori, is one which is due to the direct action of the volcanic force, or one whose origin lies under, or in the immediate vicinity of a volcano, whether active, dormant or extinct. Some of the characteristics of volcanic earthquakes may be listed as follows:

1. The shock is usually felt over but a very small area.

2. The earthquake centers, or foci, are usually small and seldom more than four or five miles in length.

3. The foci are situated at a very slight depth below the surface.

4. Some, but not all volcanic earthquakes are preceded and followed by a rather large number of accessory shocks. In this they resemble tectonic earthquakes. But the after-shocks of volcanic earthquakes are distinguished by the short period of their action, and these after-shocks are practically confined to the epicentral area. They point to little extension of the original focus.

Origin of Volcanic Earthquakes. Professor Davison, the British authority, groups the possible causes of volcanic earthquakes under the following heads:

(1) The formation of new fractures or the extension of old fractures in a volcanic mountain mass, due to the pressure of the columns of lava or of gaseous materials, in their progress toward the surface.

(2) Explosions of any kind, such as those from the sudden generation of steam within the volcano by the access of water to the highly heated rocks below.

(3) The sudden injection of fluid rock into fractures or cavities formed in the mass of the volcano.

(4) The slipping of the rock surfaces adjoining a fracture due to subterranean movements of the magma.

All of these possible causes doubtless have produced earthquakes but they have been among the less important ones.

Within the last few years the view has been gradually gaining ground that many of the stronger earthquakes which have been called volcanic are in reality tectonic quakes precipitated by volcanic action; that they are due, not so much to the actual formation of fractures within the mass of the volcanic mountain, as to slipping along preexisting fractures.

Tectonic Earthquakes. Let us consider the earth as it is at the present time, essentially solid thruout, with only small reservoirs of liquid magma locally here and there. Under the force of gravity the pressures in the interior are enormous. Under this great compression the rock material is undergoing rearrangement in favor of greater density. Shrinking of the interior is thus taking place thruout the globe, both beneath the continents and also the ocean basin.

But the oceanic segments, larger in area and of heavier and stronger material, sink more than the continents. They thus crowd the borders of the continental masses. The greatest crowding on the globe tends to be along the borders of the continents. As the greatest crowding occurs there, there it should be that the rocks should give way first under the strain, unless they be stronger there than elsewhere. As a matter of fact, long strips of unusually weak sedimentary rocks occur near the borders of the continents in many places. And so it is that the belts of unusual disturbance on the globe are located very generally along the margins of the continents. Those are the belts in which earthquakes are most abundant.

In yielding under strain the rock strata may wrinkle and fold somewhat like the loose wrinkled skin of an apple which is drying up and shrinking. Or the rocks may actually break and slide over one another and become adjusted in that way. Folding ordinarily does not cause earthquakes, but each individual slip in the long continued process of faulting produces an earthquake, slight if the slip be slight, great and destructive if the slip be sudden and large in amount.

Such earthquakes, incidental to the construction of the earth's major relief features, have certain distinctive characteristics:

(1) As individual fault planes are in many instances traceable along the surface for several hundred miles, tectonic quakes may originate over a long strip.

(2) As fault planes may extend deep below the surface, the foci of many tectonic quakes have been at considerable depths. Professor Matsuyama tells me that the first fault slip in the Tokyo disaster of September 1, 1923, was at a depth of approximately twenty miles.

(3) Because of the depth and because of the length of the faulted strip in many cases, such earthquakes strongly affect large areas on the surface. And because of the intensity of many such shocks, seismographs in all parts of the globe are set in motion and record the tremors. Such earthquakes are of a very different order of magnitude from the much feebler and very local volcanic quakes which disturb only a small tract. All world-shaking quakes are believed to be of tectonic origin.

Earthquake Belts. Observation shows that while earthquakes occur in all parts of the world, they are most likely to happen in certain well-defined tracts which lie in what we may call the great seismic belts. The great belt of the western hemisphere follows the Pacific coasts of both North and South America from the Aleutian Islands nearly to Cape Horn.

The seismic belt in Columbia, instead of swinging thru the Isthmus of Panama, veers sharply to the east along the Caribbean coast of South America and follows the curving chain of the Antilles. This is a strip of much crustal unrest at the present time, as exemplified in the formation of volcanic islands and much trough faulting associated with the development of the islands and the development of several remarkable deep troughs in the floor of the Caribbean.

In the eastern hemisphere a continuation of the seismic belt from the Aleutian Islands extends southward thru Japan, the Philippines and the Celebes to Java where it meets the east and west belt. The great east and west belt starts in the Atlas Mountains and the adjacent coast of Spain, and includes Italy and the eastern Mediterranean. In Persia the belt divides, one branch following the Tian Shan Mountains toward northern China, while the other follows the Himalayas to Burma and thence thru Sumatra and Java into the East Indies.

It will be noted that these seismic belts are also the zones of newly-formed mountain ranges and of present active volcanoes as well as earthquakes. Clearly these three phenomena are all results of the same underlying cause. The mountains are growing by the repeated rending asunder of the earth's crust. With the growth of these ranges are countless quakes. Also, where fracturing of the earth shell is occurring, there the molten magmas come the more easily to the surface, bursting forth in volcanic eruptions. All three phenomena are related.

What we see, therefore, is that certain unstable tracts of the earth's surface are shaken by many earthquakes, while other stable tracts, which are much greater in area, suffer from very few earthquakes. These stable tracts, which are relatively free from quakes, are in general the interior portions of the continents. What quakes do occur there are mostly very slight. We should be thankful that we live in a comparatively stable region.

Earthquakes of the Interior. Let us consider next the interior of this continent and the region nearer home. In the central states, the only really severe earthquake of historic times, so far as I know, was the famous New Madrid earthquake of 1811. New Madrid is situated in the southeast corner of Missouri, across the Mississippi River from the extreme southwest corner of Kentucky. It is a well known region of quakes, for a year rarely passes without some slight shock being felt in the neighborhood.

The primary cause of the New Madrid earthquake, according to Dr. Stuart Weller, was probably a slip along one of the fault lines in the belt of very intricate faulting which extends from the New Madrid region northeastward on both sides of the Ohio River, in Kentucky and Illinois.

Earthquake Situation in Kentucky. Let us now consider the earthquake situation in Kentucky. In the western part of the state, particularly near the Ohio River and presumably extending southwest under later formations to the Mississippi River and beyond, is a remarkable belt of ancient faults. These have been carefully mapped in detail by my colleague, Dr. Weller. This belt presumably continues past New Madrid and far to the southwest across Arkansas to a faulted belt in Texas, familiar to the oil companies. These are old faults, along most of which movement ceased long ago. But along a few of these fracture lines slight movements are still going on from time to time. While the earth strains in this interior region are not great, still they do amount to something, and with the rocks so thoroly broken by these fractures, small adjustments are likely to take place. It was one of these on an exceptionally large scale which produced the New Madrid quake. Other much lesser movements cause the slight quakes which are felt in western Kentucky one or more times every year. The quake of April 26, 1925, may have been due to such a movement, or it may have been due to the cave-in of mine workings as claimed by Herrin in my own state. Either one is possible. I do not know which it actually was.

The western portion of Kentucky may therefore expect slight earthquakes on the average of one or more every year. But as earthquakes they are only slight, and rarely destructive and scarcely any attention need be paid to them, outside of the passing interest in their occurrence. One cannot, of course, dismiss the possibility of another severe shock in the New Madrid region, but it may not come in a lifetime and even if it should, it would not be nearly so bad as the Californian, Japanese, or other quakes in the well-defined earthquake belts. Nobody should worry about the uncertain possibility.

Central Kentucky is more stable. In the cave regions, to be sure, the collapse of a cave roof may cause a small quake, but such quakes are purely local and trivial affairs. Southeastern Kentucky, bordering on the Appalachian tract of Virginia, is close enough to the mountains to participate in some of the light quakes originating in the faulted mountain district. But compared with many other mountains these are now fairly stable, so that dangerous earthquakes are not to be expected here.

All in all, Kentucky, in my opinion, does not need to worry much about earthquakes, for the interior of the continent is comparatively safe. The most stable portion of the state, in my judgment, is the central portion, probably no portion safer than the Bluegrass Region. The New Madrid shock, to be sure, was felt over the entire state and beyond, but it was really destructive only near the place of origin. A city situated like Lexington seems to me nearly as safe from serious earthquakes as Chicago, where we regard the danger from earthquakes as practically nil.

Prediction of Earthquakes. No means have yet been found for predicting the time and place of earthquakes with any considerable degree of success. I believe that a prediction as to where is likely to be easier and safer than as to when. In regions of recently active faults, where earthquakes have been numerous in the past, earthquakes are to be expected in the future. But beyond this generalization that earthquakes tend to recur at intervals where they have occurred before, predictions must not be taken too seriously.

Professor Matsuyama has pointed out the fact that five destructive earthquakes have occurred in the Tokyo region between March 1, 1633, and September 1, 1923. The intervals between them have been as follows: 70.8 years, 78.3 years, 69.5 and 70.6 years. Here is a rather regular interval avaraging 72 years. On this basis one might predict the next destructive quake in the Tokyo region for 72 years from 1923, or the year 1995. But it is a slim basis for prediction.

Dr. Lawson, of the University of California, has recently presented a method of estimating the approximate date of the next bad earthquake in the San Francisco region. This is by an application of the doctrine of elastic rebound. Very accurate latitude and longitude determinations by the U. S. Coast and Geodetic Survey have showed that the San Francisco region had been moving slowly northward at an average rate of .05 meter per year for many years prior to the earthquake of 1906. This is interpreted as creep with increasing strain. At the time of the earthquake slip, sudden rebound brought the strained area back toward its former less-strained position. The amount of elastic rebound on the two sides of the fault at the moment of release was found to be approximately the same. Hence one-half of the total rebound is considered to be the measure of strain which the crust will stand before a slip occurs on the fault. The half rebound near Tomales Bay was approximately 3 meters. This divided by .05 meter, the strain creep per year, gives 58 years as the length of time necessary to accumulate strain to the point of slip. Estimates at other stations gave 35 and 46 years—an average of about 45 years. Forty-five years is thus the best estimate, now available, of the time which should elapse between 1906 and the next slip on the San Andreas fault. While this figure has been taken up by the public press, Dr. Lawson states explicitly that the average is far from satisfactory, and that he has little confidence in the exact figures.

In conclusion, earthquakes are not mysterious outbreaks due to inscrutable forces. They are regular and as orderly as any of the other processes of Nature. They are the natural growing pains in a changing earth. In certain well defined areas they are very numerous; in other portions of the globe they amount to little. In the regions where they are abundant the best protection against their danger is not the knowledge of the particular dates upon which they are expected to occur, but the realization that they may occur at any time, and that foundations and structures should be built sufficiently strong to withstand their shocks. In the regions where they are not important, such as Kentucky, people should not worry in the least about earthquakes.

MINUTES OF THE THIRTEENTH ANNUAL MEETING

The 13th annual meeting of the Kentucky Academy of Science was called to order by President A. R. Middleton at 9:30 A. M. on Saturday, May 1, 1926, in room 108, Science Hall, University of Kentucky. Present about 35 persons.

The Treasurer read his report which showed total receipts $505.45, including balance from last year; expenses, $153.51, leaving a balance of $351.94. From this, $50. is to be invested to cover a life membership, leaving $301.94 available for expenses. The report was referred to an auditing committee composed of Drs. Boyd and Koppius and Miss Didlake, who later reported the account correct, after which the Treasurer's report was adopted.

The Secretary's report was read in outline and adopted.

President Middleton presented the report of the Council, including the following recommendations:

(1) That the by-laws be amended to provide for a Program Committee composed of the President, the Secretary and the Secretaries of the Divisions. Upon motion, the following by-law was adopted: "XII The program committee shall consist of the Secretary of the Academy and the Secretaries of the Divisions, with the President of the Academy, *ex officio.*"

(2) That the Academy go on record as favoring the establishment of the metric system in the United States. Referred to the Resolutions Committee. The President appointed on this committee Messrs. Chalkley, Caldwell and Fergus.

(3) That the matter of a union of the Kentucky Academy of Social Science with the Kentucky Academy of Science be left in the hands of the Council. So ordered.

(4) That the matter of cooperating with the University and certain other organizations in the publication of a quarterly journal be left in the hands of the Council. So ordered.

The Council elected 9 persons to active membership in the Academy, 8 of whom have qualified.

The Council authorized by a majority vote (1 member dissenting) the sending of a circular letter to the membership asking contributions to the Scopes Scholarship fund.

President Middleton suggested the advisability of the Academy holding its annual meeting in Louisville, in connection with the meeting of the Kentucky Educational Association. After considerable discussion, the prevailing opinion seemed to be that the Academy meeting would be overwhelmed by the K. E. A. The matter was passed without formal action.

Dr. Payne presented the report of the Membership Committee, by which the following persons were recommended for election to active membership:

Alfred Brauer, Dept. of Zoology, University of Kentucky
John F. Bullard, Veterinary Dept., Experiment Station
Philip R. Edwards, Veterinary Dept., Experiment Station
Miss Statie Erikson, Home Economics Dept., University of Kentucky
P. A. Davis, Asst. Prof. Biology, Univ. of Louisville, Louisville
Leonard Giovannoli, Dept. of Zoology, University of Kentucky
W. F. Hamilton, 101 West Chestnut St., Louisville
Miss Mariel Hopkins, Home Economics Dept., University of Kentucky
F. E. Hull, Veterinary Dept., Experiment Station
Coleman Hunter, Dept. of Geology, University of Kentucky
W. L. Hyden, Dept. of Chemistry, Centre College, Danville
R. W. Jackson, University of Louisville
R. J. Kaufman, University of Louisville
R. C. Lane, Dept. of Geology, University of Kentucky
Raymond Miller, Dept. of Geology, University of Kentucky
Miss Thelma MacIntyre, Dept. of Zoology, University of Kentucky
J. S. Pierce, Dept. of Chemistry, Georgetown College, Georgetown
Henry M. Pyles, Dept. of Biology, Ky. Wesleyan College, Winchester
Walter T. Tucker, Dept. of Chemistry, Centre College, Danville
Edgar Van Slyke, Dept. of Biology, Centre College, Danville

Samuel M. Wilson, Lexington
Spencer Withers, Dept. of Geology, University of Kentucky
R. Tyson Wyckoff, Berea College, Berea.

Upon motion, the report was adopted and all the nominees were formally elected.

Dr. Buckner was authorized to represent the Academy in the Sesqui-Centennial Association of Lexington.

The Committee on Publications reported that the manuscript of volume 2 of the Transactions, to include three meetings, was in an advanced stage of preparation and that a very reasonable estimate for the printing had been obtained.

The President appointed as Committee on Nomination of Officers, Messrs. McHargue, Bangson and Buckner.

The President delivered his address on "The effect of teaching of evolution on the religious convictions of undergraduate students, as evidenced by theses upon this subject," after which the two divisions convened in separate session.

In the Biological Division, Dr. A. R. Middleton was elected Chairman and Dr. G. D. Buckner, Secretary. In the Physical Division, Dr. O. T. Koppius was elected Chairman-Secretary.

In the afternoon session, Dr. H. H. Laughlin, Head of the Eugenics Record Office of the Carnegie Institution, Cold Spring Harbor, N. Y., delivered a very interesting and instructive address on "The Principles of Eugenics".

Transaction of business was continued in the general session.

The establishment of a Mathematical Division of the Academy was authorized, details of the proposed organization to be worked out by a committee composed of Dr. P. P. Boyd and two others to be chosen by him.

The establishment of a Division of Philosophy and Psychology was authorized, the organization to be in the hands of Dr. Morley A. Caldwell.

The establishment of the class of Fellow in the membership of the Academy was authorized, the details to be worked out by the Council.

An invitation was voted to the ornithological societies of the state to become a section of the Academy. Mr. Beckner was appointed Chairman of a committee of three in charge of this matter, he to select the other two. The three last mentioned committees are to report to the Council.

The Committee on Nominations reported as follows:
For President, Prof. W. G. Burroughs, Berea College
For Vice-President. Prof. Henry Meier, Centre College
For Secretary, Dr. A. M. Peter, Experiment Station

For Treasurer, Prof. W. S. Anderson, University of Kentucky

For Councilor, to the A. A. A. S., Dr. A. R. Middleton, University of Louisville

For member of the Publications Committee, Dr. W. R. Jillson, Ky. Geological Survey, Frankfort.

The report was adopted and these officers were duly elected.

Report of the Committee on Resolutions

The Committee on Resolutions presented the following report which was adopted unanimously:

Resolved: That the following telegram be sent immediately by the Secretary to Hon. Randolph Perkins, the Chairman of the House Committee on Coinage, Weights, and Measures, House of Representatives, Washington: By unanimous resolution of the Kentucky Academy of Science adopted in regular session to-day, your committee is urged to aid legislation which will place the United States on the world-uniform metric basis in merchandising and in education.

Resolved: That the Secretary communicate to the President of the University of Kentucky expressions of appreciation and thanks of the Academy for the courtesies shown, and the accommodations and conveniences furnished the Academy at its present session.

Resolved: That it be recorded by this resolution that the thanks and sentiments of deep appreciation on the part of the Academy are tendered to Dr. Middleton for his earnest labors for the advancement of the Academy as its President, and especially for the valuable addition to the archives of the Academy which he has contributed in the annual address delivered at the present session.

Resolved: That the Academy tenders to Dr. Laughlin assurance of its professional good-will and support in recognition of the valuable service he is tendering to science, and to the progress of knowledge, and to the advancement of humanity and the very sincere thanks of the Academy for the valuable enlightenment he has given to the members and to the scientific world in the paper he has just read before the Academy, "The Principles of Eugenics."

Resolved: That the Council be instructed to take under most earnest consideration the devising of means by which the papers and proceedings of the Academy may be published annually, to the end that they may speedily be made available to members and to scientific men.

Resolved: That the Academy expresses its appreciation of the valuable, efficient and untiring services during the past year of all the officers now serving the Academy, and thanks them.

LYMAN CHALKLEY, Chairman
M. A. CALDWELL,
E. N. FERGUS.

The Academy adjourned sine die.

SECRETARY'S REPORT

Of the 35 persons elected to active membership in the Academy at the last meeting, 15 have paid the initiation fee and have been added to the roll of the Academy. We have lost one member by death since the last meeting, Professor Albert R. Crandall, of Milton, Wisconsin, a Corresponding Member. For many years Prof. Crandall was one of the geologists on the staff of the Kentucky Geological Survey and also professor in the A. & M. College of Kentucky.

The President appointed as the membership committee Messrs. V. F. Payne, Transylvania College, Lexington, Chairman; W. G. Burroughs, Berea College, Berea, and E. C. Vaughn, Experiment Station, Lexington.

During the year the Council elected 8 new members, voting by letter and these have duly qualified and been enrolled on the membership list. They are:

Dr. Edward A. Caslick, Veterinarian, Claiborne Stud, Paris, Ky.

Dr. Morris Flexner (M. D.), Francis Building, Louisville, Ky.

Dr. Alson Baker (M. D.), Berea, Ky.

Prof. William H. Walker, Professor of Psychology, Berea College, Berea, Ky.

Dr. William A. Guthrie, Southern Kentucky Sanatorium, Franklin, Ky.

Mr. John T. Lynch, Road Engineer, Frankfort, Ky.

Prof. John S. Bangson, Professor of Biology, Berea College, Berea, Ky.

Mr. George H. Parker, Kentucky Actuarial Bureau, Louisville, Ky.

Dr. Guthrie qualified as a life member. This gives us now two life members, Dr. Guthrie and Dr. Jillson.

In accordance with the resolution adopted at the last meeting, the Secretary wrote a letter of thanks to Dr. Jillson, to be transmitted to the donor of the Academy Medal. Dr. Jillson has not yet been able to effect a satisfactory arrangement with the proposed donor, so that the medal is not yet established.

Also in accordance with a resolution adopted at the meeting, approving the program of the American Forestry Association, copies of the resolution adopting the program were sent to all Kentucky representatives and Senators in Congress, to the daily press of the state and spread upon the minutes of the Academy.

A copy of the resolution passed by the Academy in favor of securing the Cook Forest in Pennsylvania as a forest reserve was sent to the Committee on Preservation of Natural Conditions of the Ecological Society of America, W. G. Waterman, Senior Chairman, Northwestern University, Evanston, Ill.

The Secretary received a number of copies of a pamphlet entitled "Wood—not Food" from the American Forestry Association, which he distributed to one or more members of the Academy or to County Agents in each Congressional District of Kentucky asking them to write to their Congressmen asking endorsement of the Association's program.

President Middleton appointed Dr. W. R. Jillson to act for the Academy in reporting to Secretary Livingston what transpires in the evolution controversy in Kentucky, including the doings of the legislature.

In response to the circular letter sent out at the request of the committee in charge of raising a scholarship fund for Mr. Scopes in recognition of his loyalty to the cause of science, $47.00 was raised among our membership and forwarded to the treasurer of the fund, Mr. Watson Davis, c|o Science News Service, Washington, D. C., on November 23rd, 1925.

We received from Dr. Livingston printed copies of the A. A. A. S.'s "Statements on Evolution" which were sent to several newspapers; Paducah News-Democrat, Paducah Sun, Lexington Herald and Leader, Cincinnati Enquirer, Louisville Courier Journal, Louisville Herald, and the publicity man of the College of Agriculture and to the school superintendent of McCracken County. The Secretary also sent to Secretary Livingston the addresses of all members of the Kentucky General Assembly and copies of the leaflet, 140 in number, were mailed to them from the Washington office.

The Secretary prepared and sent to Secretary Livingston a short history of the Kentucky Academy for filing in the records of the A. A. A. S.

The new ruling of the A. A. A. S. as to allowance to affiliated academies went into force October 1st, 1925, so that the Academy now receives fifty cents refund for each national member instead of one dollar.

The program and a short account of the 1925 meeting were forwarded to "Science" but did not appear in that journal.

On December 15th we wrote the Chairman of the House and Senate Committee on Forestry enclosing a copy of the resolution adopted by our Academy.

The Council of the Academy has endorsed the appointment of Dr. W. R. Jillson to represent the State of Kentucky in the 14th International Geological Congress, at Madrid, Spain, May 24-31, inclusive, and a letter was written Governor Fields to that effect. The governor appointed Dr. Jillson. A letter signed by the President and Secretary was given Dr. Jillson authorizing him to represent the Academy in the Congress.

The Secretary, as Councilor of the Academy, authorized Dr. M. N. States to act as his proxy in the meeting of the Council of the A. A. A. S. at its meeting in Kansas City in December, 1925. Inasmuch as the minutes of that meeting have been published in full in Science, it seems unnecessary to make further report here.

A. M. PETER, Secretary

The Effect of the Teaching of Evolution upon the Religious Convictions of Undergraduate Students as Evidenced by Theses upon this Subject. A. R. Middleton (President's Address)

Perhaps the principal argument against the teaching of evolution is the charge that the religious faith of students who become convinced of the truth of evolution is destroyed or at least seriously shaken. If this is true then there would seem little if any defense for the teaching of it to undergraduates. This charge is almost universally on the lips of clergymen who are opponents of the doctrine.

Professor Luba has attempted to show statistically that an increasing number of the students of any given class become atheistic or agnostic as the group proceeds thru the four years of college work. If asked whether he believes in a "personal God" a freshman student would doubtless answer without any material consideration of the implications of that term. When that same question is put to a senior student he would be prone to consider this phase of the question seriously. He might, therefore, answer that he did not believe in a "personal God" and not intend that it should be inferred from his answer that he did not believe in the existence of a Supreme Being. The same would be true of other questions submitted in a questionaire. Yet affirmative answers to such questions would seem to indicate that the student had lost his faith or become irreligious. I think that this is the answer to Professor Luba's calculations. Further, in certain cases, the normal decrease in the number of students from class to class would effect the percentages in question. In any case, such increasing percentages as those published by Professor Luba may be amply accounted for without a single student becoming agnostic or atheistic as a consequence of his exposure to an education.

It so happens that there are several large classes in the Biological Laboratories of the University of Louisville and it occurred to me that here was the opportunity to secure some direct testimony from the student himself on this question. Accordingly I called for a written thesis from each of these students on *any phase of the subject of evolution* that he might elect. I was gratified to find that 137 of them chose to discuss the effect of evolution upon their religious convictions. Of this 137 only 5 were anti-evolution. But from the point of view of the present paper the most significant fact is that of the 132 who are convinced of the truth of evolution 80 *state unequivocally that their realization of the truth of evolution has confirmed and strengthened their religious* *convictions while the remainder state that their religious convictions have not been weakened or modified in any manner.*

These papers were not written by the students in question with any knowledge that they would be put to the present use and I had no idea of using them in this way when I called for them. The results were so intensely gratifying to me personally that I described them to my friend Dr. J. F. Fraser, until recently pastor of the Fourth Avenue Baptist Church in Louisville, Ky., and we agreed that the Louisville Ministerial Association might wish to learn of them. The request of that association that I appear before them led to the preparation of this paper.

In reply to the charge that "evolution makes agnostics and atheists of students" we have the unbiased written statement of 132 students that such a result does not accrue while 80 of these state that it has *confirmed and strengthened* their religious convictions.

To afford the opportunity of judging of the characters of these students' papers I shall quote from certain typical ones of them, but first I wish to cite, by way of contrast, two rather characteristic ministerial tirades against evolution.

In the American Mercury of February, 1926, Rev. Charles F. Bluske, Asheville, N. C., is quoted as follows: "After many years of study I have found that every Bolshevist of Russia, socialist, infidel and anarchist, believes in evolution. . . This gang of infidels is joined by a narrow-minded set of devil-bound preachers, who stand in the church and blaspheme Christ, ... they are jackass preachers without faith. This gang consists of newspaper editors and scientists who should be exiled out of our country for insulting the high moral standard of the creation of human life, Christianity and civilization, for they are not one hundred percent American, but an insane set of ignorant educated fools. . . Take a jackass, a hog and a skunk and tie them together and you have a scientific evolutionist and a modernist."

I also have seen somewhere the statement that a preacher in the middle west has demanded that every evolutionist be crucified, head down.

Now, by way of refreshing contrast, let us see what students have to say upon this question:

A young man says "Evolution has solved for me problems that had troubled me for many years. I have a more broadened view of the higher things of life and my belief in God is strengthened. To my mind it is impossible for anyone to believe in evolution and then disbelieve in God."

A young woman writes: "The theory of evolution is one of the most potent influences for good that have come into man's experience. It is only those who are ignorant of our universe who are afraid science will make them lose their religion."

A young man writes: "Often you hear someone say that when a person believes in evolution he cannot believe in the Bible. This old statement has been disproved many times, and I think people are coming to realize how untrue it is. I do not believe that a man can understand the Bible unless he has some knowledge of evolution, because the two go hand in hand."

A young man writes: "Education and religion cannot help humanity as long as ignorant congressmen continue to pass such laws as the anti-evolution law. It would help much more if the congressmen would pass a law compelling each high-school student to take a course in general biology. If the state could spend all the money it now spends in keeping up poorhouses, jails, asylums, etc., on the biological education of its youth, what a wonderful land this would be. The only way we can better the human race is for the leaders of science, religion, education and art to get together and all pull together for the same goal."

A young woman writes: "Attempts by a church to keep evolutionary teachings from its young people is an admission, on the part of that church, of its failure to give its youth a religion which can meet the needs of everyday life. The anti-evolutionist says that evolution detracts from the power and glory of God. Evolution does not."

A young woman writes: "Religion is not undermined but strengthened by the theory of evolution. The evolution theory enhances our conception of Diety."

A young woman writes: "We realize anew the divine wisdom of God in His 'plan of life'."

A young woman writes: "Both science and religion have their place in the world. There can be no doubt as to the essential truth of religion; its fruits proclaim its worth. There can be no doubt of the essential truth of evolution. . . God is a deeper, finer, nobler something than hands, ears or eyes. The image of God lies within ourselves; it is that which makes us what we are. This it is that links us with the Eternal; this it is that makes it worth while that we should be eternal."

A young woman writes: "Instead of destroying all preconcieved ideas of God, it helps fashion a far nobler, far more beautiful conception than ever before has been concieved of Him Whose image lies within ourselves—the image that makes us what we are. Never has evolution weakened my faith in God, instead it has strengthened it. It is not the scientists of today who are disillusioning our college boys and girls, but the so-called men of God who for the sake of sensationalism, tear out by the roots the love, the reverence, the admiration that is inherent in them for things divine."

A young man writes: "Antipathy to it was all that I was familiar with. Today it is a wonderful discovery to me. The realization of the fact or idea of evolution came to me as a flood of light illuminating the whole of life." (This boy intends to enter the protestant ministry.)

A young Catholic man writes: "Thus the religion of the ecclesiast is a thing man-wrought, the religion of the scientist is a religion inspired by the Maker of all."

A young Jewess writes: "Not so long ago in actual time I never questioned the whys and wherefores of the doctrines of the religious faith I had been taught and brought up in, but I accepted them blindly. I would never think and reflect on my religious beliefs for fear of arousing any doubts. That was the trouble, I wished to steer clear of any doubts that might possibly arise, I truly feared to face the truth and know it for the truth, be it what it may. However, as soon as I began to understand the theory of evolution my religious beliefs, my ideals, indeed my opinions on any and every subject have become transformed from dim phantoms to substantial practicalities. There has been no marvelous miracle, just a plain clearing up in my mind by the throwing of light on heretofore unseen facts. In the past, when asked what God meant to me. my reply was evasive; and if pressed, I had to admit that I did not know. There was the reason for the disquieting thoughts I was always repressing. The generally accepted version did not satisfy me for I felt the need of a personal conception. That conception was given me by the theory of evolution. To me God is the source of life and all that is. Secure in this knowledge, I can face any questions, any arguments, any facts; . . Science, the revealer of that Source, has shown me the whys and wherefores, Its facts are the foundation for the realizing of all ideals of goodness and beauty which constitute, in their turn, the basis of race progress and betterment. I truly believe that Science reveals God's works, and Oh, what a revelation!"

A young man writes: "There is nothing in the concept of evolution to deny God or to make men irreligious or to lessen the aspiration of his soul."

A young woman writes: "Evolution means a reasonable, satisfying and ennobling conception of life, a conception that gives life infinite promise."

A young man writes: "There is nothing in the conception of evolution to deny God or to make men irreligious, or to lessen the aspiration of his soul."

A young man writes: "The clear-thinking men, both scientists and teachers of religion, have long realized that, basically and inevitably, there can be no conflict between the truths of religion and the truths of science."

A young man writes: "There is nothing more real and romantic in science than the colorful presentation of the actual record of evolution as read from the rocks and seen in existing life. Such interpretation, unadulterated by generalized philosophies and unsolvable inquiries into ultimate origins, only serves to strengthen the basic religious convictions of the students. Christ-like attitudes and broad evolutionary understandings are not incomparable.

A young man writes: "Does it not appear to be heathenish to believe God to have moulded an image from clay and breathed upon it? As human knowledge increases we should get away from such a crude conception of God. Evolution is too great, too true, too fascinating a tale to be known only to the specialist. Unless we know the story of evolution *we do not know ourselves.*

The above quotations have been selected from all religious beliefs represented in the department. They include Protestant, Catholic, Jewish and one Christian Scientist person. It is evident from all this THAT THE TEACHING OF EVOLUTION TENDS TO CONFIRM AND STRENGTHEN ALL THE TYPES OF THEOLOGICAL CONVICTION PREVALENT IN THIS COUNTRY. THERE WAS NOT REPORTED A SINGLE CASE IN WHICH RELIGIOUS CONVICTIONS WERE IN ANY MANNER UNDERMINED.

PAPERS PRESENTED

(1) The Growth of Chickens Raised Without Grit. G. Davis Buckner. Ky. Experiment Station. (Abstract)

An experiment is described in which two lots of 10 leghorn chicks each were raised from the egg to 8 months old, one entirely without grit and the other with grit as usual.

No significant differences were observed in growth, thriftiness or egg production between the two lots. The gizzards of the chickens that did get grit were distinctly heavier than those of the other lot, suggesting greater muscular activity. It appears that grit was not essential to the growth and egg-production of these chickens. The author thinks that chickens consume more grit than they need. (For the complete paper, see Poultry Science, Vol. V, June-July, 1926, pp. 203-208.

Kentucky Bluegrass—Whence Did it Come? J. S. McHargue, Kentucky Agricultural Experiment Station.

Two points of interest pertaining to *Poa pratensis*, Kentucky bluegrass, are somewhat obscure: How did it get the name, bluegrass, implying a property which the grass does not possess to any marked degree, and, is it a native of this country, particularly of the Bluegrass Region of central Kentucky? The purpose of this paper is to discuss each of these questions briefly, from the standpoint of historical research.

At the present time the term "bluegrass" is applied to a large number of species of grass. Sampson (1), in his book on Native American Forage plants, states that there are probably more than 200 species of bluegrass widely distributed in the temperate and cool regions of both hemispheres. In the United States about 90 species have been reported. However, in the central and northern portions of the United States only two species are of economic importance, *Poa pratensis*, Kentucky bluegrass, and *Poa compressa*, Canada bluegrass. One not familiar with either of these two grasses would naturally infer that they possess a characteristic blue color. Doubtless many persons have wondered how the word "blue" became associated with Poa pratensis, or Kentucky bluegrass, the foliage of which is intensely green.

A search of the literature for an explanation of this question reveals a very interesting fact which is not apparently well known to the laity.

Dr. John Torrey (2) who was one of the first and most outstanding authorities on botany in this country does not describe *Poa pratensis* as having any blue appearance—in fact the word "blue" is not used in his description of this grass at all. However, in his description of *Poa compressa* he says that the leaves are short, linear, carinate, smooth and glaucous. Blue grass.

Eaton's Manual of Botany of North America (3) published in 1829, describes *Poa pratensis* and *Poa compressa* and to the latter he assigns the common name "blue grass" and does not use the words "glaucous" or "blue" in connection with *Poa pratensis.*

Beal (4), in his discussion of *Poa compressa*, in his book on the Grasses of North America, says "It *(Poa compressa)* well deserves the name 'blue grass', by which it is often known, as the whole plant has a dark, bluish, glaucous-green color. It is to be regretted that the name 'blue grass' was ever applied to *Poa pratensis*, as is commonly the case in Kentucky and vicinity." Beal also quotes Professor D. L. Phares, as follows: "In his manual of grasses for the Southern States, he says: '*Poa compressa* is blue, the true blue grass, from which the genus received its trivial name. It has priority of claim to the name, *blue* grass, and justly too, as the leaves have a deep bluish tint' ". Beal, in further emphasizing the characteristic bluish hue of *Poa compressa*, writes (p 134) "We have a rather thin, short, late grass, with short leaves, a small top, and a flattened stem. This is very rich, of a dark bluish-green color, and is often called 'blue grass', a name which it richly deserves. It is *Poa compressa.*"

Piper (5), in discussing *Poa compressa*, says the whole herbage is pale and glaucous. Sampson (6), in his description of *Poa compressa*, says the species closely resembles Kentucky bluegrass *(P. pratensis)*, from which it differs in being lower in stature and having a bluer color, etc.

The only time *Poa pratensis* possesses any blueness of color during its growth is when the grass is in full bloom, the anthers have a purplish hue and when the grass is tall and thick on the ground a bluish cast may be seen in looking over a considerable expanse of the grass. However, the purplish color is very transient and is more pronounced if the weather happens to be warm and dry previous to and at the time of blooming which is usually the latter part of May for Kentucky. If the season happens to be rainy at the time of blooming, no purple color will be observed because the rain beats the anthers off about as fast as they appear.

From the literature just quoted it is to be concluded that *Poa compressa* is the original and true blue grass as shown by its more marked bluish green color and that *Poa pratensis*, (so-called Kentucky bluegrass), which in many respects is a much superior grass, has acquired the common name of an inferior species, *Poa compressa* (Canada bluegrass).

The Introduction of Poa pratensis into this Country. Recently local interest has been awakened in regard to whether or not *Poa pratensis* is a native of this country and particularly to the bluegrass region of Kentucky.

According to Carrier and Bort (7), the earliest reference to the native grasses found by the early English settlers in this country occurs in the records left by Captain John Smith (8). As early as 1612 he wrote: "Virginia doth afford many excellent vegetables and living creatures, yet grasses there are little or none but what groweth in lowe marshes for all the country is overgown with trees whose droppings continually turneth their grasse to weeds by reason of the rankness of the ground."

Again, in 1629, he is quoted as saying "James Towne is yet their chiefe seat most of the wood destroyed, little corne there planted, but all converted into pasture and gardens; wherein doth grow all manner of herbs and roots we have in England in abundance and as good grasse as can be, etc." And again, in 1630, Captain John Smith wrote, "There is grasse plenty though very long and thick stalked. You may have harsh sheare-grass enough to make hay of till you can cleare ground to make pasture; which will bear as good grasse as can grow anywhere as now it doth in Virginia."

From these statements of Captain John Smith it is reasonable to assume that *Poa pratensis* was one of the grasses grown in the pastures of Virginia as early as 1630 because bluegrass, orchard grass, red top, timothy and the clovers had their origin, according to various authorities, in the Eastern Hemisphere and were brought to this country by the early colonists that formed the first permanent settlements on the Atlantic coast.

According to Carrier and Bort loc cit, William Penn, in 1685, sowed English grass-seed in his courtyard and says that "it grew very thick but I ordered it to be fed (grazed) being in the nature of a grass plot on purpose to see if the roots lay firm, and though it had been mere sand cast out of the cellar but a year before, the seed took much root and held so fast and fastened itself so well in the earth that it held and fed like old English ground." Quoting further from the same authors, "Thomas Budd, in 1685, advised farmers to sow 'English grass-seed'; and the New England Almanack for 1720 makes the statement for the month of June, "Cut your English grass". If *Poa pratensis* had been native to New England it probably would not have been called "English grass." Since *Poa pratensis* is the only grass that reaches maturity in June, undoubtedly that was the grass referred to in the New England Almanack of 1720. The above citations lead the author to infer that *Poa pratensis* was grown at various points along the Atlantic coast for approximately one hundred and fifty years before the first permanent settlement was made west of the Allegheny mountains.

In 1782, Thomas Jefferson (9), published his "Notes on the State of Virginia". On page 76 of this book he discusses the various agricultural crops that were grown in Virginia at that time. He says "The following were found in Virginia when first visited by the English; but it is not said whether by spontaneous growth or by cultivation only. Most probably they were natives of more southern climates and handed along the continent from one nation to another of the savages." The list includes the following plants with their botanical names: Tobacco, *Nicotiana;* Maize, *Zea mays;* Round potatoes, *Solanum tuberosum:* Pumpkins, *Cucurbita pepo;* Cymlings, *Cucurbita verrucosa;* Squashes, *cucurbita melopepo.*

These were the native agricultural plants found in Virginia by the English in 1607 and those that followed soon after. Furthermore, Jefferson says, "There is an infinitude of other plants and flowers for an enumeration and scientific description of which I must refer to the Flora Virginica of our great botanist, Dr. John Clayton, published in 1762. This accurate observer was a native and resident of this State and passed a long life in exploring and describing its plants, and is supposed to have enlarged the botanical catalog as much as almost any man who has lived." Continuing he says, "Besides these plants, which are native, our farmers produce wheat, rye, barley, oats, buckwheat, broomcorn and Indian corn. The climate suits rice well enough, wherever the lands do. Tobacco, hemp, flax, and cotton are staple commodities. Indigo yields two cuttings. The silkworm is a native and the mulberry proper for its food grows kindly."

"We cultivate also potatoes, both the long and the round, turnips, carrots, parsnips, pumpkins, and ground nuts (Arachis). *Our grasses are lucern, St. foin, burnet, timothy, ray and orchard grass; red, white and yellow clover; greensward, blue grass, and crab grass.*"

It is interesting to note that Jefferson includes in his list of grasses cultivated in Virginia, *greensward* and *blue grass.* Piper (10), in his recent book on grasses, says that in Virginia, *Poa pratensis* was formerly known as *greensward.* This same author, in his description of *Poa compressa,* Canada bluegrass, says, "also known as Virginia bluegrass". From the foregoing statements it is evident that *Poa pratensis* and *Poa compressa,* were among the grasses commonly grown in Virginia, in the time of Thomas Jefferson. It is quite possible that *Poa pratensis* adorned the historical estates of both Washington and Jefferson.

Piper, in his discussion of *Poa pratensis,* says that in its ordinary cultivated form it is quite certainly not native to North America.

Hitchcock (11) says that forms of *Poa pratensis,* occur natively north of the United States in Canada and Alaska, but all of the United States material he has examined and all cultivated material is of the old world type and that as a cultivated plant Kentucky bluegrass is not American but European.

Rafinesque, (12) was one of the early botanists to make explorations in Kentucky. He does not mention bluegrass as occurring in Kentucky. John Filson's History of Kentucky (13) contains one of the earliest maps made of the country and on it are located cane brakes, the barrens, forest, but no place is labeled "bluegrass area". Neither does Filson make mention of having found bluegrass growing in Kentucky. Dr. Thomas Walker (14) explored Kentucky in 1749 and according to one historian partly for the purpose of botanical research. He describes the barrens but does not mention blue grass. No one has attributed any statement to Daniel Boone (15) as having seen bluegrass in Kentucky, altho he was undoubtedly familiar with *Poa pratensis* because he had at one time lived in Virginia and traveled extensively in other states before coming to the wilderness of Kentucky.

It is also of interest to note that apparently no mention of bluegrass is made in the first five or six volumes of the Kentucky Gazette, altho numerous farms and tracts of land are advertised for sale in the first volumes of this paper. The writer has scanned the pages of the first six volumes of the Kentucky Gazette, column after column, without finding any mention of bluegrass growing on the farm lands that are advertised for sale in its columns. Apparently this fact is of significance because if bluegrass pastures existed in Kentucky at that early date presumably the farmers would have taken particular pains to emphasize this important fact in their advertisements just as they do to-day.

In 1882, Dr. Robert Peter (16) and other authors contributed articles to Perrin's History of Fayette County. Dr. Peter wrote the first chapter in this book and the subject discussed by him is: *The Blue Grass Region.* On the first page of his article on the Blue Grass Region, Dr. Peter says, "The introduction of live stock by the white settlers caused the gradual extermination of the cane, which was almost the only under-growth on the rich land, and its place was soon monopolized, all over the region, by what has now a world-wide reputation as 'Kentucky blue grass' so that at this time the cane is found growing only in spots which are inaccessible to grazing animals, which are fond of its leaves and young shoots—a forage said to be very nourishing and fattening to them."

"But whence came the blue grass?" asks the author.

"The late Dr. John Torrey, of New York, one of the most learned and experienced botanists of our country, stated his belief that this grass had been introduced into this country from England (See Natural History of New York); and this seemed to be quite a prevalent belief with our farmers and early settlers, strengthened by the fact that this blue grass from time immemorial had been recognized as the "smooth-stalked meadow 'spear grass' of England, known to botanists as the *Poa pratensis*".

In the library of Transylvania College are copies of Torrey's (17) books on botany. In Volume 1 he describes *Poa pratensis*, and it is of interest to note that he does not use the common name "Kentucky blue grass" in his description. He does, however, insert the word "introduced" at the end of his description of *Poa pratensis*, thus showing that it was the opinion of one of the earliest and best authorities on botany that *Poa pratensis* was introduced and confirms the statement of the foregoing author quoted above.

In 1872, William Stickney (18) published a biography of his father-in-law, Amos Kendall, and in this connection he gives the following description of the original site of Lexington and the surrounding country. "Originally, the site of Lexington and the surrounding country were covered with heavy timber under which was a thick growth of cane so intertwined with pea-vine as to be almost impenetrable to man and beast. The leaf of the cane very much resembles that of Indian corn, and constituted the favorite food as well of the buffalo as of domestic cattle. As soon as the latter became numerous, they fed the cane so closely as to kill it as well as the pea-vine leaving the forest without any undergrowth. The cane and vine were soon replaced by a thick and luxuriant growth of bluegrass, affording the richest pastures in the world—as beautiful to look upon and wander over as pleasure-grounds kept in order by incessant labor in other regions."

Apart from the legendary and traditional evidence afforded in various stories of the Goff family bringing a piece of bluegrass sod from Virginia and the account of the seed being brought at an early date to Boonesboro by a member of the Boone party, we have an additional account of its introduction by Dr. J. B. Killebrew (19) who was a good authority on grasses. Writing to the farmers of Tennessee in 1878 he says:

"If the farmers will watch the system of managing bluegrass and learn it from those who have succeeded, they will soon become so enthusiastic that every acre capable of producing it, in Tennessee, will be seeded and we shall have a country as beautiful as the world-wide famous Bluegrass region of Kentucky. It may be interesting to know how and when that region began the cultivation of it. Dr. F. H. Gordon, of Smith County, Tenn., early became impressed with its importance and visited the neighborhood in which its culture began for the express purpose of investigation, and here is the result of his visit:

" 'Some 70 years ago,' says Dr. Gordon, writing in 1871, 'two young men named Cunningham, came from the south branch of the Potomac, in Virginia, to Strode's Creek, in Bourbon County, Kentucky. They had studied and practiced the bluegrass system on the Potomac. They jointly purchased 200 acres of land on Strode's Creek, and sowed the whole tract in timothy and bluegrass. In a few years their whole tract was covered with a luxuriant coat of grass. They had brought with them the seed, on a pack horse, all the way from Virginia. Their farm soon attracted the attention of their neighbors, who began to visit and learn how to manage grass. In 1835, I, too, went to see the Cunninghams, and many other farmers in the bluegrass region, in order to learn the system. I devoted many weeks to the study of the system, going with the best farmers over their farms and seeing their management; asking many questions and writing down their answers. Then the Cunninghams, like many others, had grown to be wealthy on the profits of the bluegrass. One of them, Robert, then had 2,000 acres in bluegrass and Isaac had 3,000 acres. Nearly all the farmers I visited owed the luxury of their bluegrass to the direct instruction of the Cunninghams. To me it was a feast to travel over and view the fine sod of grass on the first 200 acres which had caused the whole bluegrass region to become so beautiful, prosperous and wealthy.' "

This very interesting account carries conviction of its authenticity because the author had scientific training and experience in the subject dealt with and therefore would not have taken the pains to include it in an important publication of which he was the author, if it had been merely an idle tale or a stretch of the imagination.

The central part of Tennessee has a similar geological formation and similar soils to the bluegrass region of central Kentucky. If *Poa pratensis* was native to Kentucky it would have been native of Tennessee and it would not have been necessary for Dr. Killebrew to make such a strong appeal to the farmers of Tennessee at so late a date as 1878 to sow bluegrass seed and make the limestone soils of that state as beautiful with luxuriant bluegrass pastures as those in the bluegrass region of Kentucky.

There is some evidence on record from which conclusions have been drawn to the effect that *Poa pratensis* is native of this country. However, when such evidence is carefully considered from historical and scientific standpoints the idea is overwhelmed by more substantial evidence to the contrary. For example, Gray, (20) who is a well recognized authority on botany, states that *Poa pratensis* is a native of this country, yet Torrey, the man under whom Gray received much of his early training and experience, was of a contrary opinion. Gray was not born until 1810 and published his first text book on botany in 1836. There is much evidence that *Poa pratensis* had been grown in this country for at least one hundred years or longer before Gray was born.

Christopher Gist (21) recorded the presence of bluegrass north of the Ohio River in 1753. However, the statement is questioned by Durrett who published Gist's notes in the publications of the Filson Club. Gist was a surveyor and not a trained botanist and might easily have been mistaken in the identification of bluegrass, because his observation was probably no more than a casual one.

Long before any permanent settlements were made in the country west of the Alleghany Mountains, both French and English fur traders had traversed the country and had established an extensive trade and traffic in the furs of the wild animals that occupied the Mississippi Valley. Hence it is quite plausible that seeds of Poa pratensis could have been distributed to Indians for the purpose of sowing in the vicinity of the natural haunts, watering places and salt licks to attract the wild game and to aid the Indian in stalking and trapping game for food or for their furs.

The fact that bluegrass was first found in a greater abundance at grassy lick than at any other point in Kentucky is very strong evidence that the seeds were sown there by the Indian or white man for the purpose of alluring wild game.

Summary. The phrase "Kentucky bluegrass" as applied to *Poa pratensis*, is of recent and local origin. The word "blue" as commonly applied to *Poa pratensis* (Kentucky bluegrass) is a misnomer and apparently was acquired because of the similarity existing between so-called Kentucky bluegrass *(Poa pratensis)* and Canada bluegrass *(Poa compressa)*, the latter having bluish-green blades, received its common name because of this fact.

The best authorities on botany are of the opinion that *Poa pratensis* (so-called Kentucky bluegrass) is not a native of this country, but was introduced by the early colonists who came from England and other parts of Europe. If it had been a native of the Mississippi Valley its presence would have been widespread and such a fact would have been commented upon by the first explorers and early pioneers in the country west of the Alleghany mountains.

CITATIONS

1—Sampson, A. W. Native American Forage Plants. 1924, page 148.
2—Torrey, John. Flora in the North and Middle States. 1824.
3—Eaton's Manual of Botany of North America. 1829.
4—Beal, W. J. Grasses of North America. 1887. Page 139.
5—Piper, C. V. Important Cultivated Grasses. U. S. D. A., Farmers' Bull. 1254, 1922.
6—Sampson. Loc cit.

7—Carrier, L., and Bort, K. S. Jour. Soc. Agron. Vol. 8, No. 4, 1916.
8—Captain John Smith. Works, 1608-31, edited by Edward Arber, pp. 56, 887, 951. Birmingham. 1884.
9—Thomas Jefferson. Notes on Virginia. 1st ed., 1782, p. 76.
10—Piper. Loc cit.
11—Hitchcock, A. S. The Genera of Grasses in the U. S. U. S. D. A. Bull. 772, 1920.
12—Rafinesque, C. S. Ancient Annals of Kentucky or Introduction to the History and Antiquities of the State of Kentucky. Frankfort, Ky., 1824.
13—Filson, John. Journal. Filson Club Publication.
14—Walker, Dr. Thomas. Journal. Filson Club Publication No. 13.
15—Boone, Daniel. Autobiography, edited by John Filson. History of Kentucky. 1784.
16—Peter, Robert. Perrin's History of Fayette County, Kentucky. 1882. Page 2.
17—Dr. John Torrey. Flora in the North and Middle States, Vol. 1. 1824.
18—Amos Kendall, by William Stickney.
19—Killebrew, J. B. Grasses, Cereals and Forage Plants. Nashville, Tenn., 1878. page 163-180.
20—Gray, Asa. Manual of the Botany of the Northern United States. 1847.
21—Gist, Christopher. Journal. Filson Club Publication No. 13.

(3) The Regeneration of the Epithelium of the Urinary Bladder. Alfred Brauer.

A review of our present-day textbooks of histology shows that histologists are quite uniformly agreed that the regeneration of stratified epithelia takes place by mitosis in the deeper layers of the epithelium and that in consequence of the divisions of the cells in these lower strata the cells lying above them are gradually pushed outward to the surface where they become desquamated. All the cells of such an epithelium consequently occupy successively positions in each of the several strata of the epithelium during their life history.

In reviewing the literature on the transitional epithelium of the urinary tract one may find suggestions of *regeneration in the deeper strata* in the literature antedating the work of Flemming on mitosis of tissue cells and before it was known that this method of cell division played the important role that it does in the rebuilding of the tissues.

Burckhardt, 1859 (1) thought that the basal cells of this epithelium had their origin in the underlying connective tissue and that these basal cells, in turn, by elongating and constricting off their upper portion, produced the cells of the next more superficial layer. The cells would then be pushed up by the next generation forming below them.

Linck, 1864 (2) held that there was no continuous regeneration after the epithelium was once formed. He considered the epithelium of the bladder a composite of several epithelia and that the different strata originally were formed independently of each other.

Obersteiner, 1871 (3), and Paneth, 1876 (4) described only the structure of the epithelium and did not allude to the method of regeneration.

Hamburger, 1880 (5) also thought it probable that the cells of the lowest layer of the epithelium originated in the underlying connective tissue and that these, in turn, were responsible for the more superficial cells.

At this time, however, new light was thrown on the problem of regeneration of animal tissues by the well-known work of Walther Flemming 1879-1885 (6, 7, 9, 10, 11) on indirect division of tissue cells, and his observation on the method of regeneration of various animal tissues. His observations on epidermis of salamanders and finally on that of man and on the stratified squamous epithelium of the oesophagus led him to conclude that regeneration of stratified epithelia occurred by mitosis in the deeper strata.

Pfitzner, 1882 (8) noted that in the stratified epithelium of the urinary tract of salamanders "Mitotic figures were especially large and numerous, and occurred in various strata".

Oberdieck, 1884 (12) found that regeneration occurred by indirect cell division of the cells of the third stratum, but did not find mitoses in cells of any other layers. According to him the epithelium of the bladder consists of the First, or superficial stratum, a Second stratum of several rows of cells, and a Third, or basal stratum. Regeneration according to him, then, takes place by mitosis in the basal stratum. (After Dogiel)

Flemming, 1889 (13) however found amitotic division to be common in the cells of the bladder epithelium of salamanders, but that mitosis also occurred in the deeper strata.

Dogiel, 1890 (14) employing the improved technical methods which had been developed, studied the bladder epithelium of white rats, mice, dogs, cats and man. In all these he found amitotic nuclear division to be common in the superficial cells. In the basal layer (his fourth layer) he found mitosis to be not uncommon but he rarely found figures in the middle strata. His conclusion was that cell division in the epithelium was chiefly amitotic but was assisted by mitosis in the cells of the basal layer.

Practically all of our well known textbooks of histology state that the regeneration of stratified epithelia takes place by mitosis in the basal stratum or in the "deeper strata". I shall list some of these statements.

Lewis and Stohr (15) "In stratified epithelia the basal cells . . . multiply by mitosis and give rise to cells which are pushed toward the free surface."

Bohm, Davidoff, Huber (16) "It is clear that all cells of a stratified epithelium cannot be equally well nourished by the blood supply from the vessels in the highly vascular connective tissue beneath. The middle and outer layers of cells accordingly suffer. The deeper cells are much better nourished and as a consequence their cells increase much more rapidly than those above; they push outward, replacing the superficial cells as fast as they die or are thrown off.

The proliferation of cells in a stratified epithelium occurs, therefore, chiefly in the basal layers."

Schafer (17). "The deeper cells of a stratified epithelium multiply by karyokinesis. The newly formed cells tend as they enlarge to push those superficial to them nearer to the surface, from which they are eventually thrown off." Of transitional epithelium in particular he says: "The epithelium seems to be renewed by mitotic division of the deeper cells. It is possible that the superficial cells also multiply. It is stated that the division of their nuclei is amitotic.

Schaffer (18). "Originally mitosis occurs in the cells of the upper strata as well as in those of the lower ones and the division planes of the mitoses are at right angles to the upper surface. In the deeper strata they may also occur parallel to the surface. In this manner a stratified epithelium is formed; then the divisions in the upper strata disappear, and are found only in the basal layers, this applies to all stratified squamous epithelia in the finished state." Again he says: "The many cell forms of stratified epithelia may easily be explained genetically; cell division occurs only in the deeper strata by mitosis, and after the losses of successive superficial layers are slowly shoved upward."

Sczmonowisz-Krause (19) "Replacement of cells in stratified epithelia is brought about by mitotic divisions of the cells in the lowest layer, so that the lower strata are slowly shoved upward and after each superficial layer is thrown off, the next layer beneath it becomes the superficial one."

Jordan (20) "The deeper cells, those nearest the basement membrane, are nucleated, of soft consistence, and may contain mitotic figures indicating that it is at this level that cell reproduction is most active." Of transitional epithelium in particular he says: "The cells of the deeper layers divide by karyokinesis and push toward the surface to replace the more superficial cells which are gradually desquamated. Direct cell division occurs in the large, plate like cells of the superficial layer."

In 1924 Thuringer (21) observed in the epidermis of man that regeneration was accomplished not primarily by mitosis of the basal layer nor even in the deeper layers but by an active mitosis of the cells thruout the stratum spinosum.

Desiring to determine if this method of regeneration applied to other stratified epithelia, I decided upon the epithelium of the urinary bladder of mammals and have used for the purpose the bladders of five cats and five sheep.

Methods and Technique. Urinary bladders of freshly killed animals were fixed in Bouin's or Zenker's fluids, embedded in paraffin, sectioned at seven to ten microns and stained with hematoxylin and eosin. In order to secure rapid penetration by the fixing fluid the muscular coats of the sheep bladders were first removed. The sections were searched for mitotic figures, and when these were found they were recorded as to phase, stratum in which they were found and plane of division. The thickness of the epithelium in number of cell layers was likewise recorded. No figures were listed from parts where the epithelium was cut tangentially, nor from epithelium in the folds. Seven microns was the most favorable thickness of sections because it lessened chance of error as to position of the figures and plane of division. The sections were mounted serially from several different parts of the same bladder and the number of figures found in the different parts was later compared.

Mitosis in Epithelium. In the normal mucosa of the contracted bladder of the cat we found an epithelium of about four to five nuclear rows. The basal or first layer is composed of small more or less cuboidal cells consisting of a small amount of cytoplasm and relatively large densely staining nuclei. In the two or three middle strata the cells become larger with more cytoplasm and large nuclei. These cells may have long, slender processes extending downward between the more basal cells. In the sheep bladder these central cells may become tall and conical with a long, pointed, basal end. Some authors describe them as pyriform cells. The superficial cells may be quite flat or may be large and rounded on the free surface. They frequently contain two or even three vesicular nuclei. On the lower surface of these cells are depressions into which fit the upper surfaces of the cells of the more superficial central layer.

In examining the epithelium for the occurrence of mitosis we shall consider first that of the five cat bladders used. That of cat 1 was contracted. The epithelium consisted of 4—5 cell layers. Two hundred mitotic figures were listed. In this total 17 percent were in the basal stratum, 29 percent were in the second stratum, 42 percent in the third and 12 percent in the fourth. 64 percent of the mitotic spindles were parallel to the surface. The cat from which the material was taken was a young half-grown female.

The bladder of cat 2 was likewise fixed in contracted state. Thickness of epithelium was 4—5 strata. Total number of figures listed was 100. 16 percent of figures were in basal stratum, 16 percent were in the second, 8 percent were in the third, 38 percent were in the fourth. 76 percent of the spindles were parallel to the surface. The cat was a mature but young female.

Cat bladder 3 was slightly distended and was fixed in this condition. The total number of cell layers was 4. Number of figures counted was 200. 5 percent of the divisions were found in the basal layer, 60 percent in the second, 34 percent in the third, and 1 percent were in the fourth. 61 percent of spindles were paralled to the surface. The cat was a young but mature female. This epithelium was undergoing an active regeneration in all parts of the bladder. The number of cell layers was usually four but occasionally five. Due to the partial distention of the bladder the cells were somewhat more flattened and more of them were drawn toward the basal layer.

The bladder of cat 4 was fixed in a distended state by filling it with Bouin's fluid. Due to the distention half the cells of the epithelium were in the basal layer. The total number of figures listed was 100. 53 percent of the mitoses were in the basal layer, 40 percent were in the second and 7 percent in the third. The fourth layer was usually the superficial, but often the third was superficial.

The bladder of the 5th cat used was contracted. Epithelium consisted of 4—5 cell layers. Only 20 mitoses were listed. 20 percent were listed in the basal layer, 20 percent were in the second; 40 percent were in the third, and 20 percent were in the fourth. The fifth layer was superficial. 80 percent of spindles were parallel to the surface. Here again the large polygonal cells of the central strata were most actively mitotically, but the epithelium as a whole was undergoing very slow regeneration. The cat was a young, mature male.

The bladders of the first four sheep were from mature animals. The epithelium of the bladders was thick, not so much because of a larger number of strata but because the cells of the middle layers were tall. Unfortunately these epithelia were not undergoing active regeneration and only 100 figures could be listed. 15 percent of mitoses were found in the basal stratum, 35 percent were found in the second, 38 percent were in the third, and 12 percent were in the fourth. The epithelium was 5—6 cell layers in thickness. 48 percent of spindles were parallel to the surface.

Sheep 5 was a new-born lamb. Number of cell layers in epithelium was 4—5. 100 figures were listed. 15 percent of the divisions were found in the basal layer. 35 percent were found in the second; 38 percent occurred in the third, and 12 percent were in the fourth. The epithelium of this sheep bladder was completely formed and some superficial cells had been shed and were frequently found in the sections.

Discussion. The results of this study are at variance with the accepted views of the regeneration of transitional epithelium. The study reveals that mitosis not only is not confined to the cells of the deeper strata but that it takes place more actively thruout the middle strata. Due to the fact that the cells of the basal stratum are smaller and more crowded, about one-third of all the cells of contracted bladder epithelia are located here, leaving two-thirds for all the strata above this layer. This ratio applied to the contracted sheep bladders as well as to those of the cats. In the distended bladder about one-half of all the cells were located in this stratum. Conseqently, if these cells were more active mitotically than the larger cells of the middle layers, more than one-third of all of the divisions should have been found in this stratum. Furthermore, it would have been expected that the division plane of the majority of the mitoses in this stratum were parallel to the surface. Instead of this, *seventy per cent of the division planes of these basal cells were at right angles to the surface.* Since a larger percentage of the divisions was found in the larger polygonal cells, these must be considerably more active in proliferation than the smaller basal cells. A gradual upward movement to the superficial layer must be accomplished by a division of all the underlying cells, which would thus produce a crowding out of the cells of the central layers.

The plane of division of the central cells of the epithelium may be largely determined by the contraction or distention of the bladder. In the completely contracted sheep bladder the epithelium showed not only a larger number of strata but the central cells were tall with their nuclei at different levels, due to crowding. Here the long plane of the mitotic spindles was more frequently oblique to the surface. In the bladder of the fifth sheep the crowding was not nearly so apparent and consequently the majority of the spindles were parallel to the surface.

Thuringer, (20) suggests that a function of the stratum cylindricum of the skin epidermis might be to maintain the integrity of the epithelium. That would not seem an unlikely function of the basal layer of cells in transitional epithelium, especially since this epithelium does not rest upon a basement membrane but directly upon the connective tissue of the tunica propria.

Summary.. 1. Observations were made on normal transitional epithelium of the urinary bladders of cats and sheep; the mitotic figures were noted and recorded as to stratum in which they occurred and as to the plane of their division. 2. Mitotic divisions in this transitional epithelium were encountered regularly in all cells, from the basal layer up thru the central strata, until the cells showed signs of degeneration in the most superficial layers. 3. In all cases except one, that of a much distended bladder, the larger percentage of divisions was found in the central strata. 4. The long axes of the mitotic spindles were most frequently so directed that the division plane of the cells was at right angles to the surface and not parallel to it, so that the divisions do not cause directly, a movement upward of the more basal cells.

(Published, also, as "The Rejuvenation of Transitional Epithelium" The Anatomical Record Vol. 33, No. 2, June, 1926, pp 137-146, 4 Micrographs.)

1. Burckhardt, G. 1859. Das Epithelium der ableitenden Harnwege. Virchow's Arch., Bd. 17. S. 94.
2. Linck, H. 1864. Ueber das Epithel der Harnleitenden Wege. Arch. f. Anat. u. Physiol., Bd. 17, S. 137.
3. Obersteiner, Heinrich 1871. Die Harnblase und die Ureteren. Stricker's Handbuch der Geweblehre. S. 517.
4. Paneth, Joseph 1876. Ueber das Epithel der Harnblase. Sitzungsbericht der K. Akad. d. Wissensch. in Wien.
5. Hamburger, Ad. 1880. Zur Histologie des Nierenbackens und des Harnleiters. Arch. f. mikr. Anat., XVII. S. 14.
6. Flemming, Walther 1879 . Beitraege zur Kenntniss der Zelle, und ihrer Lebenserscheinungen. Arch. f. mikr. Anat., Bd. 16. S. 397.
8. Pfitzner, Wilhelm 1882. Beobachtung uber weiteres vorkommen der Karyokinese. Arch. f. mikr. Anat., Bd. 20. S. 135.

9. Flemming, Walther 1882. Beitraege zur Kenntniss der Zelle und ihrer Lebenserscheinungen. III. Theil. Arch. f. mikr. Anat., Bd. 20. E. 1.
10. Flemming, Walther 1884. Zur Kenntniss der Regeneration des Epidermis beim Saeugethier. Arch. f mikr. Anat., Bd. 23. S. 148.
11. Flemming, Walther 1885. Ueber die Regeneration verschiedener Epithelien durch mitotische Zelltheilung. Arch. f. mikr. Anat., Bd. 24. S. 372.
12. Oberdieck, 1884. Ueber Epithel und Druesen der Harnblase. Goettingen 1884. (After Dogiel, 14.)
13. Flemming, Walther 1889. Amitotische Kerntheilung im Blasenepithel des Salamanders. Arch. f. mikr. Anat., Bd. 34.
14. Dogiel, A. S. 1890. Zur Frage ueber Epithel der Harnblase. Arch. f. mikr. Anat., Bd. 35. S. 389.
15. Lewis and Stoehr 1913. A Textbook of Histology. 2nd. ed. p. 49.
16. Bohm, Davidoff, Huber. 1914. Textbook of Histology. 2nd. ed. p. 85.
17. Schafer, Sir Edward Sharpey, 1920. The Essentials of Histology. pp. 66 and 67.
18. Schaffer, Josef. 1922. Lehrbuch der Histologie und Histogenese. Zweite Auflage. S. 76 und 98.
19. Scymonowisz und Krause. 1924. Lehrbuch der Histologie. Fuenfte verbesserte Auflage. S. 96.
20. Jordan, Ernest 1924. A Textbook of Histology. p. 43. pp. 446, 447.
21. Thuringer, Joseph M. 1924. Regeneration of stratified squamous epithelium. Anat. Rec., V. 28. No. 1.

(4) Micrognathy and Accompanying Anomalies in a Lamb. Alfred Brauer, University of Kentucky.

Since the facial features are formed from a number of separate rudiments which must develop, grow and fuse properly, anomalies of the face are common. The most familiar of these are hare lip and cleft palate, which result when maxillary and nasal processes fail to fuse. Arrested development of rudiments sometimes also produces malformations of this region but these are far less common. The formation of the facial features is primarily dependent upon the development from the first branchial arch, two processes, the maxillary and the mandibular on each side of the neck.

Each of these grows medially. The former fuses with medial nasal and lateral nasal processes to form the upper jaw, upper lip and nose. The latter or mandibular process likewise grows medially and fuses on the medial ventral line with its fellow from the other side to form the lower jaw and chin. Later a cartilaginous shaft, *Meckel's cartilage*, develops in the mandibular processes. This, in turn, gives rise to the mandibles and two of the auditory ossicles.

Arrested development of the mandibular process would cause complete absence of the lower jaw, *agnathy*, or very poor development of it, *micrognathy*. This anomaly in turn brings about *synotus* or fusion of the ears across the ventral side of the neck and in *cyclostomus*, a very small circular mouth opening which is merely an opening thru the skin under the nose and does not communicate with a mouth cavity.

A case of micrognathy recently came under our observation when H. C. Downing a stockman living near Lexington brought to our laboratory a lamb apparently without lower jaw, and with ears fused on the ventral side of the neck. A desire to know how this deformity had affected the other structures dependent upon the development of the lower jaw led me to make a dissection of the head and neck. The structures which might thus have been affected are: mandibles, tongue, musculature of the mouth and neck, salivary glands, and auditory ossicles. Besides these parts the bones of the region involved, the blood vessels, nerves would be affected as to location.

Upon opening the skin of the neck it was found that a pair of mandibles had been formed. These were small but properly shaped and well ossified. The articulation between the mandibular condyle and the temporal bone was properly effected but due to the synotic condition had been carried far ventrally. They were lying flatly on the ventral side of the neck and their distal ends were directed caudally toward the larynx. They had not met and their symphasis therefore had not been accomplished. The distal end of each rested on the hyoid cartilage a half inch above the anterior end of the thyroid cartilage. The hyoid cartilage between the mandibles supported a rudimentary tongue. The muscles of the floor of the mouth were apparently all present but very small. Those identified were mylohyoideus, stylohyoideus, geniohyoideus, keratohyoideus, and hyoglossus. In the sides of the pharynx was a pair of tonsils. The cyclostomic opening thru the skin under the nose thus did not communicate with this mouth cavity under the skin of the neck.

Muscles of the neck affected by the anomalies were the sternomandibularis. They originate on the manubrium sterni and terminate normally on the mandibles. The terminal portions of these were poorly developed and had few muscular fibers. Some of their fibers mingled with those of the cleido mastoideus, others terminated just at the base of the mandibles. The omo-hyoideus muscles were present and normal. Ear muscles were all present. They were abnormal only because of their relation to other structures, as for example the paratido-auricularis which normally crosses the parotid gland was an inch anterior to the gland.

On the salivary glands, parotids and submaxillaries were identified. Sublinguals were not found. The parotids were in their normal position with reference to the ears. Submaxillaries lay on each side of the mandibles farther down in the neck than in the normal sheep.

The ears, as previously stated, were fused across the ventral side of the neck. On the median ventral line where the ears were fused was a common external auditory meatus which led to a single tympanum. In the cavity of the middle ear only one set of auditory ossicles could be located. This was the set belonging to the left ear. From each side of the cavity an eustachian tube led to the pharynx and opened into it. The inner ears were both present.

In development the ossicles are derived from two sources, as follows: in the first branchial arch a cartilaginous rod, Meckel's cartilage, develops. From the proximal portion of this rod two masses are constructed which become the anlagen of the malleus and the incus. In the second branchial arch a cartilaginous rod also develops which forms the lesser horn of the hyoid bone, the stylohyoid ligament, and the styloid process. In the mesoderm a mass of cartilage appears which gives rise to the stapes or third ossicle. It might, therefore, have been expected that both stapes were present.

The lamb was one of three dropped by the ewe. It was of average size and aside from the arrested development of the mandibular process had no doubt had a normal intrauterine development. Death came at birth when the placental circulation ceased, because there was no communication between the trachea and pharynx with the exterior. The lungs were those of the stillborn, small and in the dorsal part of the thorax.

(5) **The Effect of Diet upon the Rate of Learning and Forgetting by Domesticated Rats.** A. R. Middleton, Univ. of Louisville.

In the present investigation the attempt has been made to ascertain whether there is any effect of diet upon the rates of learning and forgetting by domestic rats. The problem-box method of discrimination was applied in the determination of possible modifications in the rates of learning and forgetting, arising as the result, perhaps, of modified physiological processes concomitant upon the oral administration of incretion products.

It is obvious that a diverse heredity might cause consistent differences in the rate of learning; therefore the experimental and the control groups of animals in each of the four experiments performed were composed of litter brothers and sisters.

The problem-box used afforded a choice between two alternatives, namely, an illuminated and a dark run-away, and the animals were trained to go to the light. This training was accomplished by the use of the reward-punishment method. The punishment administered consisted in a shock from a medical induction coil. The trials were given the animals in a light-proof and a sound-proof room. Provision was made for the elimination of smell and the prevention of the formation of the so-called 'direction habit'. The problem was considered correctly solved when the animal in question made one hundred correct consecutive choices at the rate of ten per day.

It was found that the experimental group of the first experiment learned its problem, on the average, in 11.25 days while the corresponding control group required an average of 17.25 days. This experimental group required an average of 5.50 days to forget the solution while its control group required an average of 4.75 days.

In experiment 2 the corresponding rates were 16.8 days for learning by the experimentals and 18.6 days for learning by the controls. The experimental group required 6.60 days to forget while their control group required an average of 5.40 days to forget.

In experiment 3 the corresponding rates were 6.75 days for learning by the experimentals and 9.60 days for learning by the controls. The experimental group required an average of 6.25 days to forget while the control group required an average of 4.60 days for forgetting.

In the 4th experiment the corresponding rates were an average of 5.33 days for learning by the experimentals and 6.00 days for the average rate of learning by the controls. The experimentals required an average of 6.00 days for forgetting while the controls required an average of 5.66 days for it.

Since the experimental agent used was "Hormotone", prepared by the G. W. Carnrick Company of New York City, which consists of thyroid, pituitary, testis and ovary, in tablet form, each tablet containing 1-10 grain of desiccated thyroid, and 1-20 grain of whole pituitary, there is no relation of the present work with "endocrine balance". The Hormotone used was furnished gratis by the Carnrick Company and a grant of money was also given to finance this work. Both these gifts are gratefully acknowledged in this connection.

As far as these experiments are concerned we may conclude: First; differences of diet do affect the rate of learning by domesticated rats in the problem-box method; second, that differences in diet also may modify the rate of forgetting of the same animals after having learned by the problem-box method.

It is, of course, recognized that the small number of animals used, 17 experimentals and 17 controls, does not justify one in drawing final conclusions from these results.

The demonstratable effects of differences in diet are probably the expression of induced modifications in the physiological processes concerned.

(6) Balanced Selection in the Fission Rate of Paramecium Caudatum. A. R. Middleton, Univ. of Louisville.

The question of the heritability of the effects of selection within the clone has been repeatedly investigated and, with almost perfect unanimity, all these investigations have shown the non-heritability of acquired characters in uniparental reproduction.

,In the work in which the non-inheritability of the effects of selection within the clone was shown, that heritability was tested by reversed selection or by randon selection. Middleton (1915)* pointed out the lack of precision in reversed selection and proposed the method of "balanced selection" as an adequate test of the heritability of differences in rate of division within the clone. Balanced selection is

*Heritable Variations and the Results of Selection in the Fission Rate of Stylonychia Pustulata. J. Exp. Zool., Vol. 19, No. 4, Nov. 1915.

the process of compensating for every selection that one is compelled to make by making the reverse selection at the next opportunity, i. e., one makes the same number of plus and minus selections in any given line during each successive time interval adopted. It was shown by actual experiment that reversed selection is *selection* and that, therefore, to reverse the direction of selection in a clone is not to test the heritability of results previously produced by selection but is to obliterate and ultimately to reverse those results.

In his "Heredity and Environment in the Development of Men" Prof. Conklin, referring to the later results obtained by Professor Jennings and to my results obtained in '15 and '16 says: "These results differ totally from Jennings' earlier work on *Paramecium*, which has been repeated and confirmed by Ackert. It is hard to believe that different organisms differ irreconcilably in so fundamental a matter and it seems much more probable that these discrepancies are due to an incomplete analysis of the phenomena in question. It is possible that the division of the cell body in these protozoans is not always into exactly equivalent halves, in which case variations might take place in the descendants, which might then be heaped up by selection; or perhaps there are multiple or modifying factors in this case also, so that selection has acted as in Castle's rats."

It now seems worth while to determine whether, in the absence of selection, variations in the rate of division of lines within a clone, will culminate in heritably different groups within the clone, as might result were the variations in question the expression of the presence of "multiple or modifying factors". If the two halves of a clone maintain the same average rate of division under balanced selection then it is evident that balanced selection is an accurate method of eliminating selection and that the results obtained by the present writer by this method in '15 were actually due to the cumulative effect of the selection of very slight variations in the rate of division of the members of a clone. Whether the variations in question are due to "multiple or modifying factors" would seem to be entirely beside the point, since we are here concerned with binary fission.

A single clone consisting of 40 lines of Paramecium caudatiun was isolated and cultivated for 52 days on ground-glass slides, one animal to a concavity. The first group of twenty lines underwent 1041 divisions and the other group of 20 lines underwent 1020 divisions, an average of 52.05 fissions for the former and of 51.00 for the latter. The range of the first set was 44 to 61 fissions, that of the latter, 46 to 57 fissions. The mode of each case was 51 fissions. The uniformity of the average fission rate of these 40 lines is further emphasized by the fact that the 20 *highest* lines gave an average of 1.042 fissions per line per day while the 20 *lowest* lines have an average of 0.903 fissions per line per day, an average excess of the fastest over the slowest of only 0.139 of a fission per line per day.

These experiments justify the conclusion that, in the particular clone in question if in no other, in the absence of selection, heritable differences in the average rate of division of the two halves of a clone do not occur. They also show that balanced selection is a demonstrably accurate method for the avoidance of selection.

(7) Some Relations of Science to Philosophy. M. A. Caldwell, University of Louisville. (Abstract)

Both science and philosophy represent vital and important endeavors of the human mind. They stand in close relationship, and each can and does aid the other. Science is the acquisition, description and explanation of facts. It is the systematic interpretation of some portion of reality, obtained by observation and experiment, and made socially available. It seeks knowledge which is accurate, universal and organized. It studies proximate causes. Philosophy attempts to gain an interpretation of reality as a whole. It tries to understand the universe and our place in it, not by knowing all details but by coordinating general truths. It seeks a comprehensive interpretation of experience. It tries to coordinate the sciences and to examine and criticize their presuppositions. It is theory concerning ultimate causes. It attempts to interpret nature and human values. It is a universal activity; every one philosophizes or holds a philosophy in some degree or other.

In seeking knowledge, science does not raise questions concerning the nature of the knower, the nature of truth, or the nature of knowledge. Philosophy does raise these questions. The philosopher critically examines various scientific concepts, believing that this will aid him in getting an interpretation of reality. Thus he may examine such concepts as those of matter, life, mind, space, time and causality, trying to find their ultimate nature.

Scientists and most philosophers have emphasized the use of reason. But a few philosophers have preferred intuition. The scientist generates and applies laws and principles. The philosopher tries to use these laws and principles in an interpretation of reality. There is no sharp dividing line between science and philosophy. Every science leads gradually into certain philosophic problems. Thus psychology may lead gradually into problems concerning the ultimate nature of mind. Biology may lead to questions concerning the ultimate nature of life.

The scientist uses mental imagery more than does the philosopher. The former's work is more concrete. The scientist uses measurement and the philosopher does not. But the latter uses generalizations from these measurements in his interpretations. Science makes many concrete predictions, while philosophy makes more general ones. Science gives us a great deal of control over nature, while philosophy influences our conduct and happiness. The scientist seeks truths. So does the philosopher, but he also tries to define truth itself. He will ask whether we discover truth or make it, and whether truth is subject to correction. He will try to define knowledge itself. He will ask whether we can gain certainty or merely probability. Many have held the view that those who say that they have no certainty and that they can gain none contradict themselves; for they are certain that they have no certainty and that they can gain none.

Science has influenced philosophy. Thus the philosophy which holds that everything is energy grew out of the study of physical sciences and psychology. And the scientfiic theory of relativity is influencing philosophy today. The philosopher may find ways of using the fact that size, motion and direction are all relative to an infinite number of arbitrary frames of reference. Each truth may be unchangeable, but relative to a context. Astronomy, with its discoveries concerning galaxies millions of light years from us, influences the philosophy of nature. Scientific discoveries may influence philosophy, and philosophy, in turn, may make speculations which may lead to further scientific research. Philosophy also tries to classify and evaluate the sciences.

Science and philosophy serve each other, and they both serve humanity. Science brings us many satisfactions, theoretical and practical, and so does philosophy. And we could gain relatively few practical results if we did not encourage theoretical activity. Theory and practice go hand in hand.

(8) **An Experience in Collecting Insects in a Sink-Hole Cave.** Harrison Garman.

Those who are unfamiliar with caves sometimes get fantastic ideas about these underground cavities from accounts written by agents of cave owners. After reading their highly colored descriptions one is likely to be disappointed in what he sees and to come out of a cave with a very different impression from that with which he entered. Our caves are wonderful enough to be described exactly as they are. Many of them are abandoned underground channels of streams, with a more or less gradual slope and an occasional fall, but in the main extending parallel with the surface. They are formed wholly or in part by the action of running water. If very old, they may be nearly or quite dry at all seasons of the year. If more recent in origin, they may be full of water in wet weather, when the soil is saturated and surface streams are at flood, and are dry enough to be entered with comfort only in midsummer. Some, now being excavated, are occupied with water at all times and constitute permanent subterranean branches of surface streams.

But there is another type of cave in Kentucky, one with which this brief narrative is especially concerned. It starts in the bottom of what we here call sink-holes. Water collects in a depression of the surface and remains there as a pond. It fills all crevices in the limestone beneath, and the carbonic acid in it dissolves the rock, eventually producing a very small channel finding an outlet at some lower level, possibly on the bank, or in the bed, of a creek, or river. Year after year the channel is enlarged by the dissolving action, and later by erosion resulting from carrying thru it soil and bits of rock, until at length it becomes so large that it allows the water to run out as fast as it comes in, thus leaving at the point of origin only a bowl-shaped hollow with a hole in its bottom. Within the last thirty years a sink-hole pond has been observed to go dry within the city limits of Lexington. Some one sought to clean it out and in removing mud and rubbish that had accumulated in it, opened an old outlet, when the water at once disappeared and the pool did not form again.

One of my experiences with a cave formed from a sink-hole came near being an adventure. A good many years ago a trip was being made with a companion down Green River in a canvas boat, starting at Greensburg and stopping at Mammoth Cave, a distance, following the windings of the stream, of perhaps sixty-five miles. In the course of the journey we saw and entered several caves that opened in the steep, rocky banks of the river. One day a heavy shower drove us to the shelter of overhanging rocks at the edge of the stream. While there we noticed the opening of a cave not much above the river, and lighting our candles proceeded to explore it. The walls were wet and the floor muddy, conditions thought to be the result of water having been backed into the entrance earlier in the season when the river was higher. We had gone in some distance, when it was observed that the flames of our candles were constantly turned toward the entrance by a slight current of air moving in that direction. It made seeing so bad finally that my companion went out. I was reluctant to leave without learning whether or not the cave harbored cave insects, but the current kept the flame of my candle in such a state that I was compelled to turn back, not, however, before several cave crickets were seen high up on the walls retreating into small crevices. We sat down outside waiting for the storm to subside, when suddenly there was a rush of water from the mouth of the cave we had just left, increasing before our eyes into a muddy torrent that plunged into the river carrying with it sticks and various other debris, not derived from the cave but evidently from the surface of the ground, how far away we did not learn. With this drift came numerous ground beetles of species found everywhere at the surface in soil and among rubbish. When I saw some of these insects floating on the water and clinging at its edge it seemed to be a good opportunity to obtain cave insects, but not a single cave cricket or other true cave species emerged.

What had occurred while we were in the cave was this: A sink-hole, perhaps a mile or more away, had received rainfall from its surrounding drainage area, and flowing into the upper part of the cave the water was coming rapidly down toward us driving the confined air before it, thus producing the current that had given us trouble. We had narrowly escaped a ducking, or something worse, it seemed; and tho we escaped, our experience illustrates the truth of Stefansson's claim that adventures are generally the result of inexperience and ignorance. The cave crickets knew more about sink-hole caves than we did. For, while the current of air caused them to retreat as it did us, they showed some sort of recognition of its meaning by seeking the highest part of the cave, while we went out merely because we could not see and in ignorance at the time of what caused the movement of air.

(9) Tests of "Moth-Proofing" Substances. Mary Didlake, Agricultural Experiment Station.

In March, 1925, large numbers of the Furniture Beetle *(Anthrenus vorax)* were found infesting an old sofa. A study of the life-history showed that eggs usually hatched in 10 to 14 days. Larval development varied greatly; some young ones kept for over a year were apparently only half grown, others nearly full grown, certain individuals being twice the size of others of the same age, and some a year old no larger than some only six weeks old. Larvae molted many times, usually 16 to 20 days apart, but often longer—27 and even 36 days between molts. During fall and winter there were practically no molts, larvae remaining 5 and 6 months without casting the skin tho active and feeding; and those which appeared to be full-grown in November did not pupate until March. They sometimes ate each other, choosing a victim in the quiescent stage of molting or pupating. The pupal period lasted 12 or 15 days (occasionally as long as 18 days); at about the 7th-9th day the elytral markings appeared, but it required 4 to 6 days longer for the adult to free itself from the old skin. Adults lived 2 or 3 weeks, depositing eggs on bits of flannel kept in the vials.

Thinking they might be more resistant than Clothes Moths, larvae of this species *(Anthrenus vorax)* were used to test several "moth-exterminating" and "moth proofing" commercial products,—Enoz, Larvex, Eulan F. Extra and Eulan B L.

Enoz proved a satisfactory insecticide; it was readily absorbed and drawn into the wool fibers, as watery solutions were not, and killed larvae even after the goods treated with it had been aired and dried for a week.

Pieces of woolen goods soaked in Larvex and Eulan seemed effectively protected for 5 months, which is as long as the experiment has lasted, the substances coming up pretty well to the claims made for them. It would seem that treatment of woolen goods at the factory and dry cleaners and dyers ("moth-proofing") might be very desirable. Soaking material is to be recommended rather than spraying, as it is difficult to saturate the wool with watery solutions. On a small scale, as used by housekeepers, the fluid Larvex is costly, and the powder for making the solution at home can be bought only in wholesale quantities. The Eulan F powder can be had in small or large amounts (but only from one firm) and is reasonable enough in price. Eulan BL seems expensive, but combines the two processes of cleaning and moth-proofing and the cost varies with the price of the solvent, carbon tetrachloride, for example, costing twice as much by the gallon as by wholesale and still more by pints and quarts.

Larvae of the Black Carpet Beetle *(Attagenus piceus)* were equally susceptible as those of *A. vorax*. The young of the Varied Carpet Beetle *(Anthrenus verbasci)* were more resistant, remaining alive longer than the others, but even they did not eat the treated goods to any noticeable extent.

An experiment with White Ants (Termites), on a very small scale indicated that the substances were effective against these pests also.

A butterfly already stretched and dried, was submerged in Eulan BL (using carbon tetrachloride for the solvent) without apparent injury to the specimen and the Cabinet Beetle *(Trogoderma tarsalis)* refused to attack it for several weeks, but finally penetrated to the interior of the body and fed on it, the check having been much more promptly and completely demolished.

(10) Steps Really Essential in the Production of Clean Milk. J. J. Hooper, University of Kentucky. (Abstract)

The routine at the Experiment Station dairy was described. Producing clean milk is not a matter of expensive equipment but of cleanliness in the use of equipment, preferably simple, speedy cooling and preservation at a low temperature. A healthy cow normally produces pure, clean milk and it is not difficult to keep it clean until it is delivered to the consumer.

(11) Notes on the Amphibia of Kentucky. Thelma MacIntyre, U. of Ky. (Abstract)

The expectation for Kentucky, based on Stejneger and Barbour, is twenty-nine species of tailed Amphibia and eighteen Anura. Seventeen of the former were secured or authentic records were obtained; thirteen of the latter. This makes a total of thirty out of a possible forty-seven, a fairly good showing for a year's collecting and study in so restricted a group. No new species have yet been revealed. Collaboration with the author on the part of the naturalists of Kentucky should bring to light the missing members of Kentucky's amphibian fauna.

(12) Fishes of Boone's Creek, Kentucky. Leonard Giovannoli, U. of Ky. (Abstract)

This survey was conducted for two purposes: (1) as a contribution to our knowledge of the life of the typical small stream of the Bluegrass Region; (2) as a part of a larger, state-wide ichthyological survey. Thirty-three species were recorded. The rapid fall of Bluegrass streams and the flooding of the mouths by the backwaters of the dams affect the number and distribution of fish species.

(13) The Falling Drop Method for Determining the Specific Gravity of Body Fluids. W. F. Hamilton and Henry G. Barbour, Univ. of Louisville. (Abstract)

A 10-cubic millimeter drop is timed as it falls a distance of 30 cm thru a mixture of xylene and bromobenzene in a tube of exactly 7.5 mm bore. Its falling time is compared with that of a 10-cubic millimeter drop of a standard solution of potassium sulfate of known density. By using an alignment chart correcting for temperature the density can be calculated with an accuracy of one in ten-thousand. The method is applicable to blood and other biological fluids and can be extended to other aqueous solutions and to oils. For the complete paper see J. Biol. Chem., Vol. 69, 1926, p. 625.

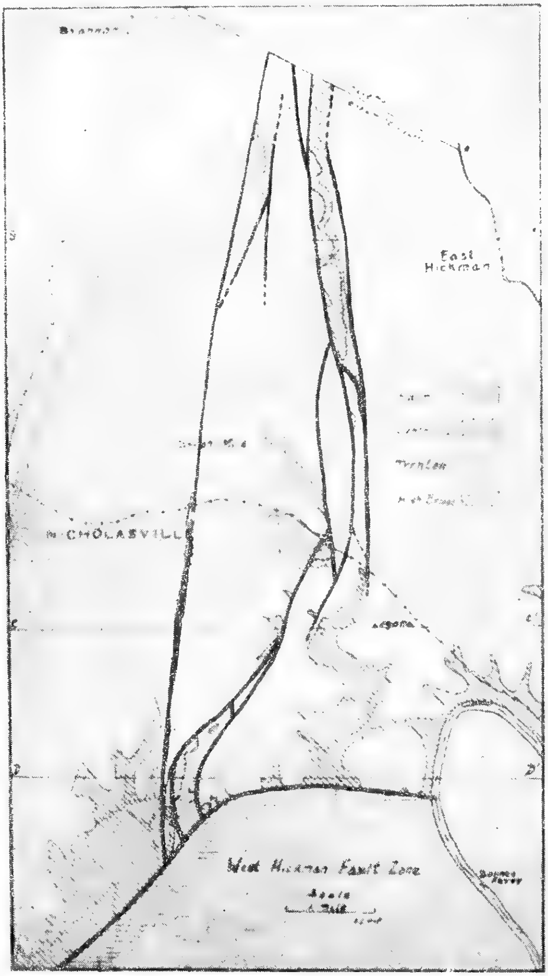
(14) **Achondroplasia in a Family Recently Investigated.** John S. Bangson, Berea College.

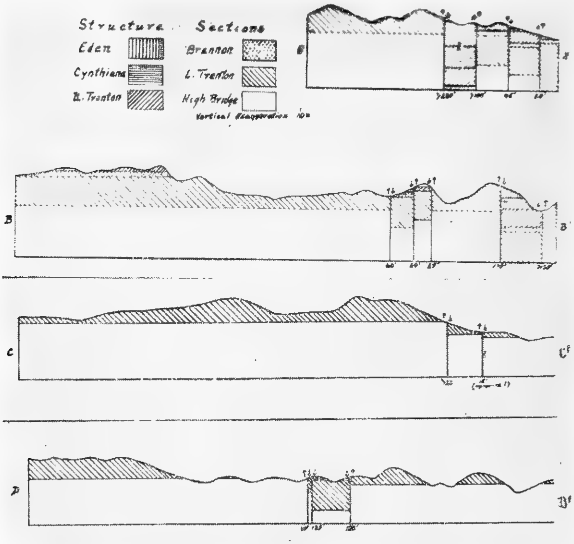
Three brothers, two normal and one a dwarf, came from Scotland to Virginia. One of the normal men married a normal woman and dwarfism was transmitted to a son, a great grandson and to three out of six great great grandchildren. Nothing is known about the descendants of the other two brothers. For the complete paper see Journal of Heredity, Vol. 17, No. 11, November, 1926, pp. 393-395.

(15) **The West Hickman Fault Zone of Jessamine and Fayette Counties, Kentucky.** A. C. McFarlan, U. of Ky.

The West Hickman fault zone is one of three systems of normal faults modifying the Jessamine dome of the central bluegrass region of Kentucky. The zone consists of eight more or less north-south faults and a number of transverse faults breaking up the major fault blocks. The greatest displacements are found a short distance south of the northern Jessamine County line. From here there is a general simplification of the system both to the north and south except for a rejuvenation of the zone in southern Jessamine County. Maximum displacement is something in excess of two hundred and thirty feet, where in northern Jessamine County the Eden is faulted below drainage.

The distribution and nature of the faults are shown in the accompanying areal sketch and structure sections.





(16) The Base of the "Big Lime" as a Key Horizon for Structural Work in Northeastern Kentucky. A. C. McFarlan, U. of Ky.

Field observations on the Mississippian limestones of northeastern Kentucky show that contrary to earlier published work, the St. Louis limestone is present at the base of the series over much of the area, and that where absent it is due to post St. Louis erosion instead of non-deposition. Where the St. Louis limestone is absent, the St. Genevieve limestone lies in contact with the Waverly shales. There is evidence to indicate that not only has this period of erosion resulted in the elimination of the St. Louis limestone over large areas but has also resulted in an irregular trenching of the Waverly beds. Such a contact, since it does not represent a stratigraphic plane, at least in detail, loses much of the value hitherto attached to it by geologists as a key horizon. Attention is likewise directed to a locality in northern

Greenup County where the Chester beds lie in contact with the Waverly shales.

(17) The Relation Between Drainage Area and Waterway Required for Culverts and Small Bridges in Kentucky. John T. Lynch, Kentucky State Highway Department.

In the construction of permanent highways, one of the most perplexing problems confronting the engineer is the determination of the proper sizes of openings for drainage structures. This is particularly difficult for the smaller structures, such as culverts, since it is often impossible to obtain definite high-water information for very small streams, frequently remote from dwellings. Furthermore, the cost of one such structure is generally not sufficient to justify extensive and costly investigations. It is, therefore, almost imperative to establish some method, of general application, whereby the required size of opening may be estimated from the size of the area drained and its physical characteristics.

There are, in more or less general use, a number of formulae which contain, as a definite term, the size of the drainage area and also contain a variable factor "C" to be determined according to the conditions existing in the particular area under consideration. Most of the formulae are of the form: $X = CA^n$, where "X" is the required size of opening in square feet, "A" the drainage area in acres or square miles, "n" a fractional exponent varying from 0.5 to 0.8 in the different formulae and "C" the variable factor.

Talbot's Formula states that the required waterway in square feet is equal to the three-fourths power of the drainage area in acres multiplied by a factor "C" which is to be determined according to local conditions. This formula has been widely used in the Mississippi Valley states and general experience indicates that the exponential term (three-fourths) takes care, with sufficient accuracy, of variations in area up to three or four square miles. The only problem then remaining in the application of this formula is the correct determination of the value of the variable factor "C" for the particular area under examination. Most text books suggest values of "C" varying from one-third for flat country to one for hilly country and on up to two for mountainous or very steep country, the assumption being that the required size of opening increases with the steepness of the area drained and that all other factors are negligible.

When, about two and a half years ago, I was first assigned the task of making field studies and recommendations for drainage structures to be built by the State Highway Department, there had never been any systematic study made of this problem and tables were in use giving values of "C" increasing with the steepness of the topography. On this basis, a much larger opening would be required for a drainage area in the eastern or mountainous part of the State than for one of equal size in the western, or flatter part. It soon became apparent, however, that the reverse was true and that smaller values could be used for "C" in the eastern than in the western sections. This discredited any method of determining "C" based on topography alone and if the formula was to be used at all, some new method had to be found for determining the variable factor, based on broader considerations and adapted to conditions as they exist in this particular State. It was obviously necessary to discard all preconceived theories and to begin to assemble data to be used as a basis for study.

After a drainage structure has been in use for a number of years, it is usually possible, by questioning local residents, to determine whether it is too large or too small and to estimate fairly closely the correct size for this location. Frequently, also, at locations where there are no existing structures, fairly reliable high-water information can be obtained and conditions are such that the required waterway can be estimated with a fair degree of accuracy. It was thought that if studies should be made of these locations where conditions were reasonably definite, rules might be evolved which could be applied to other locations where conditions were more uncertain.

From time to time, therefore, as the opportunity offered, such locations were examined and notes made as to the topography, shape of drainage area, vegetation and other factors which it was thought might affect run-off. Drainage areas were measured on maps or otherwise estimated as accurately as possible and the value of "C" in Talbot's Formula computed for each location. This information was recorded on blanks prepared for the purpose and filed for future reference. About 250 streams were thus examined and the results recorded. The investigations were made in 35 different counties, well distributed thruout the State.

From an examination of the assembled data, it appeared that for streams in a particular locality there was not a wide variation in the computed values of "C" but that for streams in widely separated sections there was a considerable variation. This suggested the preparation of a map giving average values of "C" for each section of the State. All of the values which had been computed for streams in a particular locality were therefore averaged and the resulting average value placed upon a map in its proper location.

After the average values for each locality had been thus plotted, the figures were studied with a view to determining their general trend so that values could be assigned to other localities where no data had been obtained. The figures showed a gradual increase from East to West, averaging 0.4 along the Big Sandy and about 1.0 in the Jackson Purchase. In Barren, Cumberland and Metcalfe counties, there appeared a group of abnormally high values ranging from 1.0 to 2.0.

An effort was then made to determine the cause for this sectional variation and several geologists were consulted with the thought that it might be due to variations in the porosity of the underlying strata. From these it was ascertained, that in Barren, Cumberland, Metcalfe and neighboring counties there is a particularly hard, impervious shale or slate lying close to the surface, which might account readily enough for the abnormal run-off found in that section. It was thought that the other variations might be similarly accounted for and accordingly a geologist was employed to prepare a map of the State showing variations in the porosity of the formations in the different sections. This map explained the abnormally high run-off above referred to as well as several other erratic groups of figures, but it failed to explain the gradual increase in values from East to West, which was the most striking and unexpected result of the investigation.

It was then thought that there might be some variations in storm rainfall intensity which would explain this condition and accordingly the Technical Reports of the Miami Conservancy District of Ohio were examined. These reports give the results of a study by the Morgan Engineering Company of storm rainfall in the eastern half of the United States, which was the most exhaustive that has ever been undertaken. They contain maps, called Isopluvial Charts prepared from the records of the U. S. Weather Bureau, showing variations in storm intensity in different sections. For example, one chart shows the maximum 24 hour rainfall, in inches, which on the basis of previous records, would be expected to occur on an average of once every fifteen years. Other charts give similar information for storms of different duration and for different periods of expectancy.

An examination of these charts, which all indicate similar trends, reveals that much heavier storms are to be expected in the western part of the State than in the eastern part. On an average of once every fifteen years, a maximum 24 hour rain of 2.8 inches might be expected in Eastern Kentucky while in Western Kentucky a maximum 24 hour rain of 5.2 inches might be expected with the same frequency.

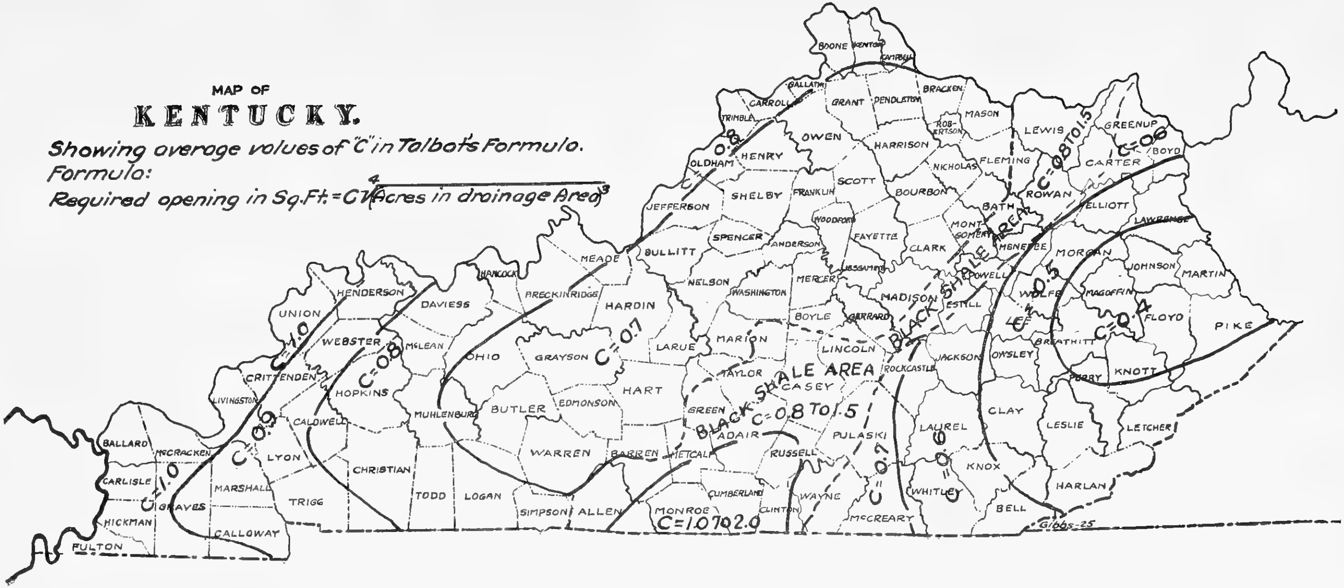
MAP OF

KENTUCKY.

Showing average values of "C" in Talbot's Formula.

Formula:

Required opening in Sq. Ft. = $C\sqrt[4]{(\text{Acres in drainage Area})^3}$



This condition gives at once a reasonable and satisfactory explanation for the increase from east to west of values of "C" in Talbot's Formula.

Having thus determined the causes for the sectional variations in the average values of "C" which had been computed, the map on which these had been plotted was completed by drawing lines, much like contour lines, assigning values to all sections of the State. These lines were made to conform to the computed values, which had been determined from actual field observations, and the Isopluvial Charts and the geological map were used as guides in projecting them across sections where no definite field information had been obtained.

The engineer in the field can, from this map, determine the average value required for "C" in Talbot's Formula in the section in which he is working. In applying this to a particular problem, he must consider whether the topographical conditions in the drainage area being examined might be considered normal for the general section and if not, he must use his judgment in making a corresponding adjustment. Factors, such as storm rainfall intensity, which he cannot determine from an examination of the ground, are taken care of in the average, sectional value, and with experience he should be able to make the adjustment required by variations in topography, etc.

The investigations were considerably handicapped because of the fact that only about half of the State has been topographically mapped and drainage areas could not be accurately determined in many sections without expensive surveys. It is hoped that further studies will permit the construction of a more accurate map and will also indicate more clearly the adjustment which should be made on account of variations in topography, vegetation and stream conditions.

(18) A Newly Discovered Prehistoric Fort in Kentucky.* Wilbur Greeley Burroughs, Berea College.

A prehistoric stronghold which white men have never before known existed, was discovered by the author, November 9, 1925. This fort is situated 3 1-2 miles east of Berea, Madison County, Kentucky, and one-half mile northeast of the north end of Indian Fort Mountain previously explored and surveyed by the author. The newly discovered fort includes the entire top of a knob which is separate from all other knobs except for a narrow ridge at the base of the cliffs on the west end of the fort. This ridge extends to the cliffs on a knob to the west of the fort. The lower portion of the knob on which is the prehistoric fort, consists of a steep shale and talus slope which rises rapidly four hundred feet vertically above the adjacent valleys. Above this slope, cliffs of Mammoth Cave and Gasper limestone, except at one point, completely surround the upper parts of the knob.

The limestone is broken in a few places by joint planes two to four feet wide up whose extremely steep floors an active climber can reach the top of the cliff. Two of these joint planes occur at the west end of the fort where the limestone cliff is fifty feet high. The east end also has a similar crevice. Along the north side the limestone has been worn away for a few yards but all of these points can be defended easily.

A narrow terrace occurs at the east and west ends of the knob and at irregular intervals along the sides where the limestone is capped by Pottsville conglomerate, in places forty feet high. Joint planes occasionally break this conglomerate cliff, but access to the crest could easily be prevented by determined people armed with stone weapons. At certain points the conglomerate and limestone cliffs unite and fall 200 feet straight down where the talus does not rise high along the base of the limestone. On the south side a stream has worn away the cliffs and formed a ravine which is the only readily accessible entrance to the top of the knob and fort.

Across this ravine the prehistoric people constructed a stone barricade 465 feet long which extends from the top of the limestone cliff on the east to the top of that on the west. The barricade is in the form of a V with the apex upstream. At present this rampart is in places five feet two inches vertically from the top to the bottom of the front side, and at this point seven feet across. The V shape of the barricade permitted the defenders to hurl missiles upon an attacking force from three sides. This barricade differs in shape from those on the large prehistoric fort of Indian Fort Mountain where barricades crossing ravines of equal width are crescent-shaped. The top of the newly discovered fort is gently rolling and covers about eighteen acres. ,

A few inches back from the edge of the conglomerate on the north central part of the fort is a roughly rectangular basin which has been hollowed out of the conglomerate. The rock here is exactly the same as in other exposed surfaces of this knob. The basin is eight feet by five feet eight inches by five inches deep. The long axis extends about northwest--southeast. The basin contains water. A theory for the origin of this basin which the author suggests is that since there is no spring within the walls of the fort, as far as known, the prehistoric people who held the fort may have drawn water up the side of the cliff and emptied it into the basin which they had hollowed in the rock. Skins could have been used to hold the water and grapevines or other material used for rope. On another promontory to the east is a smaller basin in the conglomerate which appears to have been just started when work was abandoned. This second basin is also rectangular and located near the edge of the precipice. These points are the best places on the fort for water to be drawn up the cliff and poured into the basins. Also, being exposed to the sky, they easily catch rain-water. Because of these basins, this knob will be called

"Basin Mountain", and the prehistoric stronghold, "Basin Mountain Fort".

Along the east and northeast sides of the fort especially where the conglomerate comes in contact with the underlying limestones, many of the joint planes have been enlarged by solution into long, narrow caves. Fifteen to twenty feet from the entrance to these caves, they usually become larger where the limestone floors have been dissolved away. In several caves are pits about 150 feet deep in the limestone. In two caves thus far explored are numerous pieces of charcoal and charred branches and sticks. Some of these pieces are far back toward the interior of the caves where water could not have washed them. Indeed it is doubtful whether water could have washed any of the pieces of charcoal from the entrance to their present positions as many large boulders of conglomerate cover the floor of the cave and block the passage so that these rocks have to be climbed over to penetrate the cavern.

It would appear as tho these pieces of charcoal had been taken into the caves by the prehistoric inhabitants while the charcoal was glowing. The warm charcoal would have given heat to those clustering around without making any disagreeable smoke. The ventilation is excellent in these caves and the temperature is comfortable even without fire when snow is falling out-of-doors. It would seem improbable that the charcoal and charred branches were carried to their present positions by white hunters, as in order to reach these caves on the northeast side of the knob, one has to descend a 20 to 30 foot cliff and move carefully along a narrow terrace below which the limestone falls away for about 100 feet. The most logical explanation for this charcoal is that it was taken into the caves by the prehistoric defenders of the fort, who lived in the caves during cold and rainy weather.

One cave has a large, oval-shaped mound of earth near the entrance. A boulder of conglomerate lies across the entrance, placed there evidently by the prehistoric people. It prevented the earth of the mound from being washed out of the cave. In the mound are scattered patches of the whitish substance similar to that found in the graves of the rock-houses of the Indian Fort Mountain stronghold. Pieces of charcoal are mixed thru the earth of the mound. It is a place of burial.

At the west end of the knob, below the limestone cliff, a perpendicular rock wall about 220 feet long and two to four feet high extends from near the south side of the joint plane in the limestone partially across the narrow ridge of land that stretches from the fort to the knob to the west. It is not a fence made by white men as it does not extend the entire length of the ridge and could not keep cattle confined to any spot on the slopes. It is probably part of the defences of "Basin Mountain Fort".

The fort has not as yet been thoroly explored and further investigation may reveal new facts about these prehistoric people.

(19) **On the Origin of Fibrous Serpentine.** L. C. Robinson, U. of Ky. (By title)

(20) **Subsurface Conditions in Northeastern Kentucky as Shown by Well Records.** E. S. Perry. (By title)

(21) **Geology of the Oil Shales of the Eastern United States.** W. R. Jillson, State Geologist, Frankfort, Kentucky. (Abstract)

It has been estimated that at the present rate of production and consumption—714,000,000 barrels in 1924—the known petroleum reserves of the United States will be exhausted within fifteen to twenty years. The oil shales of the United States broadly distributed and vast in quantity are suggested as the ultimate source of substitute artificially produced petroleums. The Green River (Eocene) oil shales

of the West, rich and extensive, having been abundantly discussed, this paper concerns itself only with the high-grade bituminous shales of the Eastern United States. These are divided into three groups, ascending stratigraphically: (1) Chattanooga, early Upper Devonian; (2) Sunbury, Lower Mississippian, and (3) various oil shales and cannel-shales of the Pennsylvanian.

The first group—Chattanooga (New Albany—Ohio) black shale of early Upper Devonian age is rich, thick and extensive. The type locality described is Southern Indiana and Ohio, Central Kentucky and Tennessee, and Northern Alabama, but low-grade correlatives extend into Missouri, Illinois, Iowa, Michigan, Ontario, New York, Pennsylvania, West Virginia and Virginia. This shale is estimated to present at the surface alone ready for operation when economic conditions became favorable 275,000,000 thousands of tons of easily workable deposits equivalent to 60,000,000 thousands of barrels of oil, a volume sufficient to supply the United States at the present rate of consumption for upwards of one hundred years or more. The Sunbury (Mississippian) and the various Pennsylvanian high-grade bituminous shales are regarded as oil shale reserves of secondary importance.

(The complete paper was read at the Fourteenth International Geological Congress, Madrid, Spain, May, 1926).

(22) **Some Electronic Structural Formulas.** V. F. Payne, Transylvania College. (Abstract)

Four structural formulas of hydrogen peroxide are considered :(1) H - O - **O** - H ; (2) Kingzett's formula, $\begin{matrix}H-\\H-\end{matrix}O = O$; (3) Bruhl's formula, (4) **H** - **O** $\equiv$ O - H ; and Rins' formula $\underset{\cdot H \cdot}{\overset{\cdot H \cdot}{O : : : O}}$.

It is pointed out that by dropping one bond between the oxy-

gen atoms in Kingzett's formula it becomes a tautomer of formula (1). The corresponding electronic formulas are (1)

$$H:\underset{\cdot\cdot}{\overset{\cdot\cdot}{O}}:\underset{\cdot\cdot}{\overset{\cdot\cdot}{O}}:H \text{ and } H:\underset{\cdot\cdot}{\overset{H}{O}}:\underset{\cdot\cdot}{\overset{\cdot\cdot}{O}}: .$$

(23) A Simple Method for the Determination of Inductance. R. B. Scott, U. of Ky.

Object: To make an absolute determination of self-inductance.

Theory: The usual method of measuring self-inductance by means of the Wheatstone's bridge (Rayleigh's method) is somewhat tedious because the bridge must be adjusted each time a different inductance is used. However, in measuring mutual inductance the method is very simple; the secondary circuit is connected directly to a ballistic galvanometer and the inductance is measured by calculating the quantity of charge, Q, from the galvanometer throw when the current in the primary is started or stopped. This simplicity suggests the possibility of a similar method for measuring self-inductance. The chief difficulty of the measurements lies in the fact that in measuring self-inductance the battery circuit and galvanometer circuit cannot be separated so there is danger of current from the battery passing thru the galvanometer. This difficulty is overcome in the circuit shown in figure 1. The current from the battery flows thru the inductance L and the resistance R_1, The switch S is especially constructed so that the switch arm leaves the two contacts as nearly simultaneously as possible, thus leaving the galvanometer in circuit with the inductance and resistance.

When the switch is opened, the self-inductance of L will cause a current to flow around the circuit L — R_1 — R_3 — G — L, the battery being disconnected. Calling the total resistance of the circuit R, the current thru the inductance as the switch is opened i_0, and the inductance L, we may

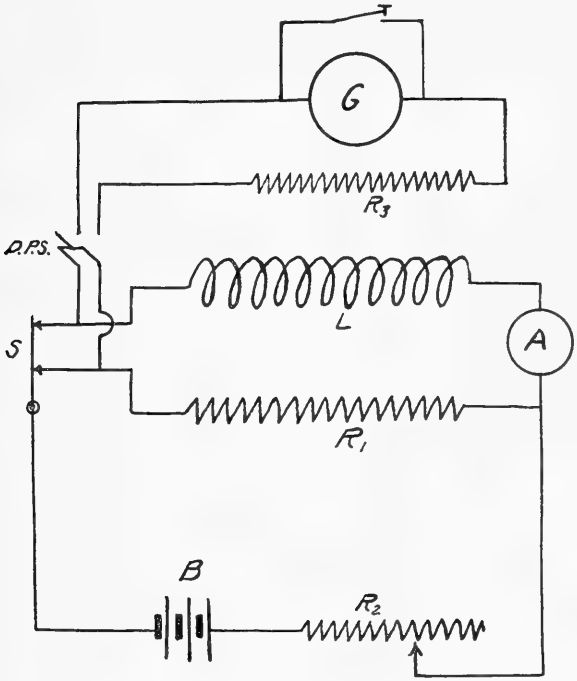


Fig. 1. Wiring diagram for inductance experiment.

make a determination of the inductance by measuring the quantity of electricity which flows thru the galvanometer.

When a circuit containing an inductance and carrying a current is suddenly opened the E. M. F. induced by the inductance is —L di/dt.

but $E = iR$
then $-L\,di/dt = Ri$
or $-L di = R\,idt$

Integrating both sides of this equation between the proper limits we obtain

$$Li = RQ$$

Where Q the quantity of electricity passing thru the galvanometer

then $L = RQ/i_0$

Q is a function of K, the galvanometer constant, t the period, d the deflection and r the damping factor of the circuit and galvanometer used or

$$Q = \frac{K\ t\ d\ r^{1/2}}{3.1416}$$

$$L = \frac{R\ K\ t\ r^{1/2}}{3.1416} \cdot \frac{d}{i}$$

If we keep the resistance of the galvanometer circuit constant, then the first term of the expression is a constant since the damping factor and period are constant for a given total external resistance of the galvanometer.

$$\text{Then } L = C \cdot \frac{d}{i}$$

This fact makes the method very easy and efficient for we may insert one inductance after another and measure them by reading the current thru the ammeter, which is the current thru the inductance, and noting the deflection.

Apparatus and Procedure: The apparatus used in the experiment consisted of the special switch, a ballistic galvanometer, and suitable noninductive resistance; also a double pole, double throw switch for reversing the galvanometer connection.

The problem of breaking the two circuits simultaneously was solved by having one element of the switch, as shown in Figure 2, in sliding contact with two parallel brass rods, and connected to a spring which, when released, would cause the element to slide along the brass rods until the ends were reached and then break both circuits. The fact that the sliding element reaches a high velocity before the contacts are broken tends to reduce the time interval between the

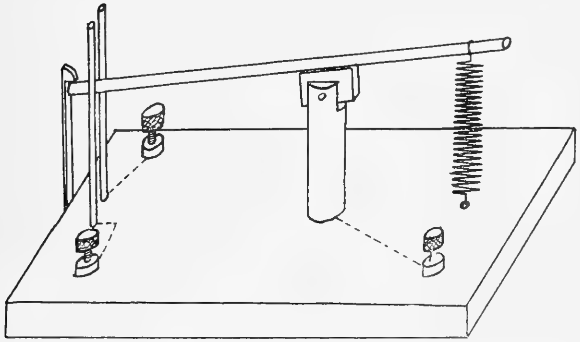


Fig. 2. Special switch for the experiment.

breaking of the contacts until it does not affect the readings, as shown by repeated experiments.

The method of measuring the inductance is rather straightforward. The switch must be adjusted, with the inductance replaced by a non-inductive resistance, until breaking the circuits does not deflect the galvanometer. This shows that the contacts are breaking simultaneously. Since there is some resistance in the sliding contacts there will probably be a potential drop across the galvanometer causing a constant deflection. This may be eliminated by adjusting the resistance, R_1, that is in parallel with the inductance. An easier and just as accurate method, however, is to leave the galvanometer switch open until ready to take a reading, then close the galvanometer switch and release the inductance switch in rapid succession. Of course if the constant deflection is too great some error will be introduced unless the resistance is adjusted. For measuring fairly large inductances where the inductance of the ammeter would be negligible it may be placed directly in the inductance circuit thus enabling one to read the current i_0 directly.

The range of deflection obtained in measuring the various inductances was from 1 to 6 centimeters. For this range the constant of the galvanometer was found to be 7.49×10^{-6} amps per radion.

The half period of the galvanometer was found to be 3.32 seconds.

The damping factor of the galvanometer for this circuit was $r^{1/2} = 1.098$.

The total resistance in the galvanometer circuit was 40507.

A standard inductance in the form of a variometer was first measured. This was a Leeds and Northrup instrument and had a scale calibrated in millihenrys. The inductance was measured for different settings and the results compared with the scale readings.

Other inductances measured were, a coil of wire consisting of 3000 turns of number 22 B & S gage, a large coil with an iron core, and a honeycomb coil such as is used in radio circuits.

					Deflection	
Inductance		R	R	I	R	B
Std.	.035	18.16	9.08	.307	3.15	3.08
Std.	.030	18.16	9.08	.307	2.7	2.5
Std.	.020	18.16	9.08	.307	1.7	1.7
Std.	.005	18.16	9.08	.307	.42	.4
3000T No. 22			9.08	.038	2.7	2.65
Iron Core			9.08	.401	1.75	1.83
H. C.			9.08	.056	1.92	1.82

$$L = \frac{R\ K\ t\ r^{1/2}}{3.1416} \times \frac{d}{i}$$

$$L \quad \frac{40507 \times 7.49 \times 10^{-6} \times 3.32 \times 1.098}{3.1416} \times \frac{d}{i}$$

$$L \quad .352 \times \frac{d}{i}$$

Substituting the values of d and i in this we obtain the values of L.

Inductance Measured		Value Obtained	% Diff
Std.	.035	.0357	+ 2.0%
Std.	.030	.0298	— .7%
Std.	.020	.0195	— 2.5%
Std.	.005	.0047	— 6. %
3000T No. 22		.247	
Iron Core		.0157	
HC		.117	

Conclusion: Since the error was much greater for small inductance, and correspondingly small deflections, we may conclude that the principal source of error is in reading the deflections, for larger deflections can be read more accurately. For inductances greater than 20 millihenrys the error was less than 2%, with an increase of accuracy for higher values of inductance. The accuracy for large inductances is limited only by observational error in reading the deflections and in determining the constants of the galvanometer.

(24) The Principles of Eugenics. Abstract of address by Harry H. Laughlin, Carnegie Institution of Washington.

Eugenics has been practiced for hundreds of human generations. The proof is found in the fact that man, during the many thousands of years since the origin of the human species, has greatly differentiated into races, each highly adapted to specific conditions. For the most part, this successful practice was not consciously directed toward race improvement, but was the natural and eugenically unconscious accompaniment of the struggle for self-preservation. This struggle prompted selective mating and selective elimination. Early human culture had not advanced far before it was observed by the leaders of clans and states that high fecundity on the part of the most valuable members of the social unit constituted the best assurance of future prosperity. As civilization advanced and the analytical sciences took rise, man began to reflect more upon the essential principles which govern his own racial and family fortunes. He was thus enabled to foresee a possible science of eugenics. The materials which he used for analysis were the actual records of past behavior of mankind in relation, particularly, to the forces which govern differential migration, mate selection and differential fecundity. A more accurate understanding of the rules of heredity of human physical, mental and temperamental qualities made the final major contribution to the essential "tools," so that finally and but recently the science of eugenics was successfully organized. Guided by science, the practice of eugenics can now take on a more conscious purpose. Without destroying the finest customs and the most cherished family relationships, it is within the power of the several families and races of man greatly to improve the hereditary physical, mental and temperamental endowments of their successive generations.

The science of eugenics did not spring forth full grown as an invention without ancestry, but rather it is the logical development of work in many allied sciences, such as biology, geology, anthropology, psychology, history, politics, geography, archaeology, statistics, psychiatry and theology. From these and from many other sources certain facts and principles have been taken and constructed into an harmonious whole. Galton did not call eugenics either a science or an art; he called it simply "the study of the agencies under social control which may improve or impair the racial qualities of future generations either physically or mentally". It is clear from this definition that eugenics in Galton's conception would develop into a science and also into a purposefully applied art. In genetics, as applied to plant and animal breeding, it must be acknowledged that the science arose long after the art of improvement of plants and animals under domestication had made tremendous headway. The rise of the science of genetics is logically expected to reflect back to the applied art new tools for greatly improved efficiency.

If, in eugenics, we tried to list categorically a number of basic principles, they might well be stated as follows:

1. Man is an animal and consequently, in reference to hereditary traits, is susceptible to the same laws of natural inheritance which govern other animals.

2. The end result, or development stage, of a human quality is the resultant of the interaction of hereditary elements with training and environment.

3. Environment and training being constant, the character of an individual, family or race depends primarily upon inborn endowment.

4. The hereditary endowment being constant, the resulting character of an individual, family or race depends upon training and environment.

5. A gene, which is the hereditary foundation of a trait or quality, is not affected by association in different combinations nor by training nor environment.

6. Within the limits of hereditary constitution of the population of one generation, the constitutional character of the next generation depends upon differential migration, differential mate selection and differential fecundity.

7. Mate selection depends primarily upon propinquity and compatibility.

8. Within the same race and social setting, and excepting within the extremes of poverty and luxury, differential fecundity and survival depend largely upon economic factors. The so-called high levels tend toward lower fecundity and more conservative survival rates.

9. Human migration is a phase of the struggle for existence among families and among races. Relative overpopulation and economic stress tend to produce migration to regions less densely populated or in which the struggle for existence is less severe.

10. Knowledge of the principles of eugenics makes possible the more purposeful control of the hereditary endowments of future families and races.

It is clear that a family or a nation must maintain high ideals concerning hereditary constitution, if it desires to raise or even to maintain its present inborn standards in future generations. The economic, the social, the educational and the religious world must work so to govern custom and so to elucidate the facts of eugenics, that more fit mate selections will be made, and that those who are best endowed by nature, so far as the standards of the family and the race are concerned, will have high fecundity, while those less well endowed in hereditary qualities must have the lowest fecundity. Finally, the state must see to it that the very lowest in inborn qualities must not be permitted to reproduce at all. Research and education must lead the way; legislation can function only in bringing up the rear.

When coldly considered, we know that there are assets which control falling in love, such as social position, wealth, talent, education, gracious behavior, charming personal qualities and comely features. When hereditary endowment becomes one of these major factors and possibly the overpowering factor in mate selection, altho the person who falls in love may not clearly recognize the fact, then family and consequently national eugenics will be established on a sound practical basis.

The whole task of eugenics is a continuous one. But the movement is under way and every future year should mark considerable headway, both in establishing the principles of eugenics thru analysis of facts, and in the practical application of these principles thru education and the organization of custom.

Finally, we conclude, in view of the evidence, that man achieved one of his major advances in history when he discovered that by applying certain essential principles, he could more purposefully direct his own evolution.

INDEX

Page

TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

AFFILIATED WITH THE A. A. A. S.

VOLUME THREE
(1927 - 1928)

Fourteenth and Fifteenth Meetings

LEXINGTON, KY.
1930

TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

AFFILIATED WITH THE A. A. A. S.

VOLUME THREE
(1927 - 1928)

Fourteenth and Fifteenth Meetings

This Volume was Edited by
A. M. PETER and ETHEL V. T. CASWALL

LEXINGTON, KY.
1930

PRESS OF
TRANSYLVANIA PRINTING CO.
LEXINGTON, KY.

3

CONTENTS

Kentucky Academy of Science

OFFICERS

1926-1927

President, W. G. Burroughs, Berea College, Berea.
Vice-President, Henry Meier, Sanger, California.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. R. Middleton, Louisville.

1927-1928

President, W. D. Valleau, Experiment Station, Lexington.
Vice-President, C. S. Crouse, University of Ky., Lexington.
Secretary, A. M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. R. Middleton, Louisville.

CONSTITUTION AND BY-LAWS

(As adopted May 8, 1914, and subsequently amended.)

ARTICLE I.—NAME. This organization shall be known as The Kentucky Academy of Science.

ARTICLE II.—OBJECT. The object of this Academy shall be to encourage scientific research, to promote the diffusion of useful scientific knowledge and to unify the scientific interests of the State.

ARTICLE III.—MEMBERSHIP. The membership of this Academy shall consist of Active Members, Corresponding Members and Honorary Members.

Active members shall be residents of Kentucky who are interested in science, or other persons actively engaged in scientific investigation within the state. Active members are of two classes, national and local. National members are members of the Academy and of the American Association for the Advancement of Science, local members are members of the Academy but not of the Association. Each active member shall pay to the Academy an initiation fee, upon election, and annual dues beginning October 1 next after election, the amounts to be fixed in the by-laws. The amount of annual dues to be paid by a national member shall equal the difference between the amount to be paid by a local member and the amount allowed per member by the A. A. A. S. Any member in good standing may become a life member by payment at one time of a suitable sum, prescribed in the by-laws, and is thereafter relieved from payment of dues.

Corresponding Members shall be persons who are actively engaged in scientific work not resident in the State of Kentucky. They shall have the same privileges and duties as Active Members but shall be free from all dues and shall not hold office.

Honorary Members shall be persons who have acquired special prominence in science not residents of the State of Kentucky and shall not exceed twenty in number at any time. They shall be free from dues.

For election to any class of membership the candidate must have been nominated in writing by two members, one of whom must know the applicant personally, receive a majority vote of the committee on membership and a three-fourths vote of the members of the Academy present at any session or, in the interim between meetings of the Academy, the unanimous vote of the members of the council, present or voting by letter.

Article IV.—OFFICERS. The officers of the Academy shall be chosen annually by ballot, at the recommendation of a nominating committee of three, appointed by the President, and shall consist of a president, vice-president, secretary, treasurer, and councilor of the American Association for the Advancement of Science, who shall perform the duties usually pertaining to their respective offices. Only the secretary, treasurer and councilor shall be eligible to reelection for consecutive terms.

ARTICLE V.—COUNCIL. The Council shall consist of the President, Vice-President, Secretary, Treasurer and President of the preceding year. The council shall direct the affairs of the Academy during the intervals between the regular meetings and shall fill all vacancies occurring during such intervals.

ARTICLE VI.—STANDING COMMITTEES. The Standing Committees shall be as follows:

A Committee on Membership appointed annually by the President consisting of three members.

A Committee on Publications consisting of the President, Secretary, and a third member chosen annually by the Academy.

A Committee on Legislation consisting of three members appointed annually by the President.

ARTICLE VII.—MEETINGS. The Regular meetings of the Academy shall be held at such time and place as the Council may select. The Council may call a special session, and a special session shall be called at the written request of twenty members.

ARTICLE VIII.—PUBLICATIONS. The Academy shall publish its transactions and papers which the Committee on Publications deem suitable. All members shall receive the publications of the Academy gratis.

ARTICLE IX.—AMENDMENTS. This Constitution may be amended at any regular annual meeting by a three-fourths vote of all active members present, provided a notice of said amendment has been sent to each member ten days in advance of the meeting.

BY-LAWS

I—The following shall be the order of business.

1. Call to order.
2. Report of Officers.
3. Report of Council.

4. Report of Standing Committees.
5. Election of Members.
6. Report of Special Committees.
7. Appointment of Special Committees.
8. Unfinished business.
9. New Business,
10. Election of Officers.
11. Program.
12. Adjournment.

II—No meeting of this Academy shall be held without thirty days' notice having been given by the Secretary to all members.

III—Twelve members shall constitute a quorum of the Academy for the transaction of business. Three of the Council shall constitute a quorum of the Council.

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

V—The initiation fee for active members shall be one dollar. Annual dues shall be two dollars and fifty cents, for local members, and two dollars for national members. A life membership shall be fifty dollars.

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

VII—The President shall annually appoint an auditing committee of three who shall examine and report in writing upon the account of the Treasurer.

VIII—The Secretary shall be free from all dues during his term of office.

IX—All papers intended to be presented on the program or abstract of same must be submitted to the Secretary previous to the meeting.

X—These by-laws may be amended or suspended by a two-thirds vote of the members present at any meeting.

XI—The program committee shall consist of the Secretary of the Academy and the Secretaries of the divisions with the President of the Academy, *ex officio*. They shall serve from one annual meeting to the next.

In Memoriam

They have crossed the river and are resting
in the shade of the trees:

Wayne Dickerson Iler, 1892-1928

Charles Joseph Norwood, 1853-1927

Louis B. Siff, 1865-1926

Stuart Weller, 1870-1927

COMPLETE MEMBERSHIP LIST FOR THE YEARS 1926-27 AND 1927-8

c indicates Corresponding member; h indicates Honorary member; l indicates Life member; * indicates No longer a member; † indicates Deceased. The date denotes the year of election to membership.

Name and address	Branch of Science
Allen, W. R., '23, University of Kentucky, Lexington	Zoology
*-Anderson, H. C., '23, W. Ky. State Normal School, Bowling Green	Physics
Anderson, W. M., '14, University of Louisville, Louisville	Physics
Anderson, W. S., '15, University of Kentucky, Lexington	Genetics
Averitt, S. D., '14, Experiment Station, Lexington	Chemistry
*-Baer, Louis, '23, University of Louisville, Louisville	Chemistry
Baker, Alson, '26, Berea	Anthropology
*-Bales, C. E., '23, Louisville Fire Brick Co., Louisville	Chemistry
c-Bancroft, George R., '19, Univ. of West Va., Morgantown, W. Virginia	Chemistry
Bangson, John S., '26, Berea College, Berea,	Biology
Barbour, Henry G., '25, Univ. of Louisville, Louisville	Physiology
Bassett, G. C., '27, Univ. of Kentucky, Lexington	Psychology
Bear, Robert M., '27, Centre College, Danville	Education
Beckner, Lucien, '20, Winchester	Geology
*-Beebe, Morris W., '23, Univ. of Kentucky, Lexington	Mining & Metallurgy
Birckhead, E. F., '28, Supt. City Schools, Winchester	Education
c-Blumenthal, P. L., '16, 316 Parker Ave., Buffalo, N. Y.	Chemistry
Boggs, Jos. S., '23, Waverly Apartments, Lexington	Engineering
Boyd, P. P., '14, Univ. of Kentucky, Lexington	Mathematics
*-Branham, J. C., '24, Massie School, Versailles	Science
Brauer, Alfred, '26, Univ. of Kentucky, Lexington	Zoology
Brown, L. A., '15, Experiment Station, Lexington	Chemistry
Browning, Iley B., '22, Ashland	Geology
c-Bucher, Walter, '22, Univ. of Cincinnati, Cincinnati, Ohio	Geology
Buckner, G. Davis, '15, Experiment Station, Lexington	Chemistry
Bullard, John F., '26, Experiment Station	Vet. Science
Bullitt, William Marshall, '28, Inter-Southern Bldg., Louisville	Science
Burroughs, W. G., '22, Berea College, Berea	Geology
h-Butts, Charles, '22, U. S. Geol. Survey, Washington, D. C.	Geology
Caldwell, Morley A., '15, Univ. of Louisville, Louisville	Psychology
Capps, Julian H., '28, Berea College, Berea	Chemistry
Carmichael, H. T., '24, Ky. Asphalt Co., Kyrock, Ky	————

Caslick, Edward A., '26, Claiborne Stud, Paris .... Vet. Med.
Chalkley, Lyman, '22, Univ. of Kentucky, Lexington .... Law
c-Clark, Friend E., '15, Univ. of West Virginia, Morgantown,
W. Virginia .... Chemistry
Cook, E. Wilbur, '28, Centre College, Danville .... Biology
*-Cooper, Dr. Homer E., '26, Dean State Normal School,
Richmond .... Education
Cooper, Mrs. Clara C., '26, Wallace Court, Richmond .... Education
Cooper, Thomas P., '18, Director Experiment Station,
Lexington .... Agriculture
h-Coulter, Stanley, '14, LaFayette, Indiana, Purdue Univ. .... Botany
c-Cox, Benjamin B., '22, 855 Ontario St., Shreveport, La. .... Geology
*-Cox, Meredith, '24, Eastern Ky. State Normal School,
Richmond .... Chemistry
*-Craig, W. J., '20, W. Ky State Normal School, Bowling
Green .... Physics & Chem.
Crooks, C. G., '15, Centre College, Danville .... Mathematics
Crouse, C. S., '21, Univ. of Kentucky, Lexington .... Mining Eng.
c-Currier, L. W., '22, Syracuse, N. Y. .... Geology
Davies, P. A., '26, University of Louisville, Louisville .... Biology
h-Day, Arthur L., '17, Director Geophysical Lab., Washington,
D. C. .... Geology
h-Detlefsen, J. A., '18, Wistar Inst., Philadelphia, Pa .... Genetics
Didlake, Miss Mary L., '14, Experiment Station, Lexington
.... Ent. & Botany
Dimock, W. W., '20, Experiment Station, Lexington .... Vet. Science
*-Downing, H. H., '14, Univ. of Kentucky, Lexington .... Mathematics
Edwards, Philip R., '26, Experiment Station, Lexington .... Vet. Science
Erikson, Miss Statie, '26, Univ. of Kentucky, Lexington........................ Home. Ecs.
*-Eyl, William C., '22, Lexington .... Geology
Fehn, Arthur R., '24, Centre College, Danville .... Mathematics
Fergus, E. N., '21, Experiment Station, Lexington .... Agronomy
Flexner, Dr. Morris, '26, Francis Building, Louisville .... Medicine
Foerster, M. H., '16, Consolidation Coal Co., Jenkins .... Forestry
c-Fohs, F. Julius, '15, 60 Broadway, New York, N. Y. .... Geology
Ford, M. C., '23, W. Ky State Normal School, Bowling
Green .... Agriculture
Frank, Dr. Louis, '26, The Heyburn Bldg., Louisville .... Medicine
Funkhouser, W. D., '19, Univ. of Kentucky, Lexington .... Zoology
c-Gardner, J. H., '15, 505 Exchange Nat. Bank Bldg., Tulsa,
Oklahoma .... Geology
Garman, H., '14, Experiment Station, Lexington .... Biology
*-Gentry, H. V., '23, Louisville Gas & Electric Co.,
Louisville .... Chemistry
Giovannoli, Leonard, '26, 162 N. Ashland Ave., Lexington........................ Zoology

h-Glenn, L. C., '22, Vanderbilt Univ., Nashville, Tenn ....Geology
Good, E. S., '14, Experiment Station, Lexington ....Animal Husb.
*-Gott, E. J., '18, Lexington ....Bacteriology
Graham, Charles C., '25, Berea College, Berea ....Science
Graham, James L., '27, Univ. of Kentucky, Lexington ....Psychology
*-Grinstead, Wren James, '21, Univ. of Penna., Philadelphia,
Penna. ....Psychology
Guilliams, John Milton, '25, Berea Normal School, Berea....Mathematics
l-Guthrie, Dr. William A., '26, So. Ky. Sanitorium,
Franklin ....Med. Science
Hamilton, W. F., '26, Univ. of Louisville, Louisville ....Geology
Harms, Miss Amanda, '19, Experiment Station, Lexington ....Biology
h-Hart, E. B., '19, Univ. of Wisconsin, Madison, Wis. ....Nutrition
c-Havenhill, Mark, '19, 629 Poirier St., Oakland, Calif.....
....Farm mechanics
Healy, Daniel J., '14, Experiment Station, Lexington ....Bacteriology
c-Hendrick, H. D., '14, Takoma Park, Washington, D. C..........Agronomy
Hendricks, T. A., '27, Berea College, Berea .... ——————
Hinton, Robert T., '14, Georgetown College, Georgetown ....Biology
Hire, Charles, '28, State Normal School, Murray ....Physics
Homberger, A. W., '19, Univ. of Louisville, Louisville ....Chemistry
*-Hooper, J. J., '17, ...Biology
Hopkins, Miss Mariel, '26, Univ. of Kentucky, Lexington.........Home Ecs.
Hudnall, James S., '21, Coleman, Texas ....Geology
Hull, F. E., '26, Experiment Station, Lexington ....Vet. Science
Hutchins, William J., '25, President Berea College, Berea ....Education
†-Iler, W. D., '18, Experiment Station, Lexington.....................Chemistry
*-Ingerson, M. J., '23, Centre College, Danville ....Geology
*-Irvine, George A., '24, Ky. Utilities Co., Danville.................——————
Jewett, H. H., '21, Experiment Station, Lexington ....Entomology
l-Jillson, W. R., '19, State Geologist, Frankfort ....Geology
Johnson, E. M., '25, Experiment Station, Lexington ....Agronomy
Jones, S. C., '14, Experiment Station, Lexington ....Agronomy
Karraker, P. E., '15, Experiment Station, Lexington ....Agronomy
c-Kercher, Otis, '19, Pike Co. Farm Bureau, Pittsfield, Ill.....Agriculture
*-Killebrew, C. D., '15, Alabama Polytechnic Inst., Auburn,
Alabama ....Physics
King, Miss Effie, '25, Morehead State Normal School,
Morehead ....Biology
Kinney, E. J., '15, Experiment Station, Lexington ....Agronomy
c-Kiplinger, C. C., '18, Mt. Union College, Alliance, Ohio ......Chemistry
c-Knapp, R. E., '14, 2232 Cliff St., San Diego, Calif. ....Bacteriology
*-Koffman, Gladstone, '23, Principal High School, Frankfort......Physics
Koppius, O. T., '25, Univ. of Kentucky, Lexington ....Physics
Kornhauser, S. I., '23, Univ. of Louisville, Louisville ....Anatomy

Lane, R. C., '26, Coleman, Texas .... Geology
Lee, F. S., '23, Middlesboro .... Geology
c-Leigh, Townes R., '19, Univ. of Florida, Gainesville, Florida .... Chemistry
Lester, William J., '26, Russellville, Arkansas .... ————
LeStourgeon, Miss Elizabeth, '24, Univ. of Kentucky, Lexington .... Mathematics
*-Lewis, Charles D., '15, Dean, Morehead Normal School, Morehead .... Nat. Science
Ligon, M. E., '28, Univ. of Kentucky, Lexington .... Education
Lynch, John T., '26, Road Engineering Dept., Frankfort .... Engineering
McAllister, Cloyd N., '17, Berea College, Berea .... Psychology
McCormack, A. T., '20, State Board of Health, Louisville .... Sanitation
McFarlan, Arthur C., '24, Univ. of Kentucky, Lexington .... Geology
*-McFarland, Frank T., '14, Univ. of Kentucky, Lexington .... Botany
McHargue, J. S., '14, Experiment Station, Lexington .... Chemistry
MacIntyre, Miss Thelma, '26, Springfield, Ky. .... Zoology
*-McKinnon, Miss Jean, '19 .... Home Ecs.
McNamara, Miss Catherine B., '25, Geological Survey, Frankfort .... Geology
McVey, Frank L., '18, President, Univ. of Kentucky, Lexington .... Economics
Marshall, Malcolm Y., M. D., '27, Henderson .... Medicine
Martin, J. H., '15, Experiment Station, Lexington .... Chemistry
Mathews, C. W., '16, Univ. of Kentucky, Lexington .... Horticulture
Mayfield, Samuel M., '23, Berea College, Berea .... Nat. Science
Meader, A. L., '23, Experiment Station, Lexington .... Chemistry
Meier, Henry, '15, 1820 Date Ave., Sanger, Calif. .... Math. & Astronomy
Middleton, Austin R., '22, Univ. of Louisville, Louisville .... Biology
Miller, A. M., '14, Belleview Cottage, Sunset Drive, Asheville, N. C. .... Geology
h-Miller, Dayton C., '15, Case School of Applied Science, Cleveland, Ohio .... Physics
Miller, J. W., '23, Univ. of Louisville, Louisville .... Medicine
Miller, Raymond, '26, Univ. of Kentucky, Lexington .... Geology
Miller, W. Byron, '22, Wallins Creek .... Engineering
h-Millikan, R. A. '20, Calif. Inst. of Technology, Pasadena, Calif. .... Physics
Miner, J. B., '22, Univ. of Kentucky, Lexington .... Psychology
c-Morgan, Thomas H., '15, Columbia University, New York .... Biology
h-Moulton, F. R., '16, Univ. of Chicago, Chicago, Ill. .... Astronomy
Munroe, Donald James, '28, Sun Oil Co., Dallas, Texas .... Geology
*-Newton, H. P., '21, ... Chemistry
Nicholls, W. D., '14, Univ. of Kentucky, Lexington .... Farm Ecs.
Nickell, Clarence, '25, Morehead Normal School, Morehead .... Chemistry

c-Nollau, E. H., '14, Norton St., Newburg, N. Y. ....Chemistry
Norton, Mrs. Charles F., '27, Transylvania College, Lexington ....Library
†-Norwood, C. J., '14, Univ. of Kentucky, Lexington........................Mining & Metallurgy
O'Bannon, Lester S., '23, Univ. of Kentucky, Lexington ....Engineering
Olney, Albert J., '20, Univ. of Kentucky, Lexington ....Horticulture
Parker, George H., '26, Ky Actuarial Bureau, Louisville......Engineering
Payne, V. F., '24, Transylvania College, Lexington ....Chemistry
*-Pence, M. L., 14, Univ. of Kentucky, Lexington ....Physics
Peter, Alfred M., '14, Experiment Station, Lexington ....Chemistry
Pierce, J. Stanton, '26, Georgetown College, Georgetown ......Chemistry
*-Piper, W. C., '23, Danville ....Physics
*-Porter, R. E., '23, Ashland Leather Co., Ashland ....Chemistry
Posey, M. E. S., '25, Dept. Roads & Highways, Frankfort—Engineering
Pryor, J. W., '14, Univ. of Kentucky, Lexington ....Physiology
Pyles, Henry M., '26, Wesleyan College, Winchester ....Biology
Rainey, F. L., '14, Centre College, Danville ....Biology & Geology
*-Rees, E. L., '14, Univ. of Kentucky, Lexington ....Mathematics
Rhoads, McHenry, '21, Supt. Public Instruction, Frankfort....Education
Rhoads, Wayland, '22, Experiment Station, Lexington ....Animal Husb.
h-Richardson, Charles H., '22, Syracuse Univ., Syracuse N. Y. ....Geology
h-Ries, H., '22, Cornell Univ., Ithaca, N. Y. ....Geology
Roberts, George, '14, Experiment Station, Lexington ....Agronomy
c-Roe, Miss Mabel, '19, 257 Roswell Ave., Long Beach, Calif. ....Plant Pathology
*-Rogers, John C., '22, Lab. Preventive Medicine, Univ. of Chicago ....Medicine
Routt, Grover C., '14, County Agent, Mayfield, Graves .... County ....Biology
c-Ryland, Garnett, '14, Richmond College, Richmond, Va.....Chemistry
*-Sandstrom, W. M., '23, Univ. of Louisville, Louisville ......Chemistry
Saunders, J. M., '25, 339 Park Ave., Lexington ....————
*Scherago, Morris, '23, Univ. of Kentucky, Lexington ......Bacteriology
Schnieb, Miss Anna A., '26, E. Ky. State Normal School, Richmond ....Psychology
Scott, Miss Hattie M., '25, Ky. Geological Survey, Frankfort ....Geology
Shelton, William A., '25, Principal High School, Vine Grove....Education
Shephard, Nat L., '28, Franklin Fluorspar Co., Marion........Chemistry
†-Siff, Louis, '15, Univ. of Louisville, Louisville ....Mathematics
Smith, George D., '20, E. Ky. State Normal School,................ Richmond ....Nat. Science
c-Smith, N. F., '15, Citadel College, Charleston, S. C. ....Physics

h-Smith, William Benjamin, '23, 9 Price Ave., Columbia, Mo. .... Philosophy
Solomon, Leon L., '20, The Solomon Clinic, Louisville .... Medicine
South, Lillian H., '20, State Board of Health, Louisville .... Bacteriology
c-Spahr, R. H., '14, ... Physics
States, M. N., '17, Univ. of Kentucky, Lexington .... Physics
c-Stiles, Charles F., '14, A. & M. College, Stillwater Okla. .... Entomology
Strandskov, Herluf H., '25, Univ. of Louisville, Louisville .... Plant Physiology
Suter, Arthur Lee, '20, Suter's Drug Store, Washington, D. C. .... Pharmacology
c-Tashof, Ivan P., '14, 724 Ninth St., N. W., Washington, D. C. .... Mining & Metallurgy
Taylor, L. W., '28, Experiment Station, Lexington .... Poultry
Taylor, William S., '26, Univ. of Kentucky, Lexington .... Education
Terrell, Glanville, '27, Univ. of Kentucky, Lexington .... Philosophy
Threlkeld, Miss Hilda, '27, Dean of Hamilton College, Lexington .... Education
Thruston, R. C. Ballard, '15, Louisville .... Geology
Todd, E. N., '25, Dept. Roads & Highways, Frankfort .... Engineering
*-Trelease, Sam, '24, Columbia Univ., New York, N. Y. .... Plant physiology
*-Tuttle, F. E., '14, Univ. of Kentucky, Lexington .... Chemistry
Valleau, W. D., '20, Experiment Station, Lexington .... Plant pathology
Van Slyke, Edgar, '26, Centre College, Danville .... Biology
Van Winkle, John S., '24, Centre College, Danville .... Geology
Vaughn, Erle C., '14, Experiment Station, Lexington .... Ent. & botany
Walker, William H., '26, Berea College, Berea .... Psychology
h-Ward, Henry B., '21, Univ. of Illinois, Urbana, Ill. .... Zoology
*-Waugh, Karl, '23, Berea College, Berea .... Psychology
*-Webb, William S., '14, Univ. of Kentucky, Lexington .... Physics
Weidler, Albert G., '27, Berea College, Berea .... ———
†-Weller, Stuart, '22, Univ. of Chicago, Chicago .... Geology
Will, R. G., '28, Centre College, Danville .... Psychology
*-Williams, A. B., '24, Ky. Geological Survey, Frankfort .... Geology
Williams, Charles W., '23, 215-25 Central Ave., Louisville .... Chemistry
*-Wilson, A. H., '24, 41 S. 17th St., Richmond, Ind .... Geology & Zoology
Wilson, Gordon, '27, Bowling Green .... ———
Wilson, Samuel M., '26, Lexington .... Law
Wurtz, George B., '28, Weather Bureau, Lexington .... Meteorology
Wyckoff, R. Tyson, '26 .... Education

MINUTES OF THE 14th, ANNUAL MEETING,

MAY 7, 1927

The meeting was called to order by president Burroughs at 9:15 o'clock, A. M., in room 200 of the Physics Building, University of Kentucky. Present, about 30 members.

The President announced that Dr. Middleton's Presidential address of last year, on the effect of the teaching of evolution on the religious convictions of undergraduate students, had been printed in book form and that Dr. Middleton had brought copies for distribution.

Treasurer Anderson presented his report showing a balance of $369.62 in the treasury and $51.00 invested to cover a life membership. On motion the report was received and referred to an auditing committe, composed of Dr. Boyd, Dr. Middleton and Mr. Payne.

Secretary Peter presented his report in outline. Upon motion it was accepted.

Dr. Buckner moved that the Academy prepare resolutions on the deaths of Prof. Norwood and Dr. Siff, Academy members, to be spread on the minutes and sent to the bereaved families. Seconded by McHargue and adopted unanimously. The resolutions follow.

PROFESSOR CHARLES JOSEPH NORWOOD

The death of Dean Norwood has caused the Kentucky Academy of Science to lose one of its most valued members. Professor Norwood, aged 73 years, Head of the Department of Mines and Metallurgy of the College of Engineering of the University of Kentucky, died at his residence in Lexington, Kentucky, on January 20th, 1927.

Charles Joseph Norwood was born at New Harmony, Indiana, on September 17, 1853. The son of a distinguished scientist, Joseph Granville Norwood, he inherited characteristics

CHARLES JOSEPH NORWOOD, 1853-1927

which placed him in the front rank as a teacher, scientist and leader of men. He received his education at the University of Missouri and under private teachers. He was given the degree of Master of Science, in 1906, by the Kentucky State College, now the University of Kentucky.

After many years spent as a geologist and mining engineer, Professor Norwood came to the University of Kentucky, in 1901, as professor of mining engineering. In 1911, Professor Norwood became Dean of the College of Mining and Metallurgy, a position he held until the consolidation of the engineering colleges in 1918.

Professor Norwood was a teacher of the highest ability and produced many valuable publications which record his contributions to science. He was instrumental in a large measure in developing the coal mining industry of Kentucky.

The Kentucky Academy of Science mourns the loss of one of its most valued and respected members.

DOCTOR LOUIS SIFF

By the death of Doctor Louis Siff, Professor of Mathematics in the University of Louisville, on December 26th, 1926, the Kentucky Academy of Science has lost a valued member.

Louis Siff was born in Rasien, Russia, in the year 1865. He was the son of a Rabbi and his early education was with the view of following his father's calling. At the age of 19 he came to America, having had an education well grounded in languages by private tutors and the Rabbinical College at Rasien. He studied at Worcester. He was a student of the highest order, spoke several languages, read several more and took special pleasure in the study of mathematics. Somewhat later he moved to New York City and studied music. Professor Siff had held the professorships of languages in the University of Maine and in Union College, Barbourville, Ky., before accepting the chair of mathematics in the University of Louisville. This latter position he held at the time of his death. Professor

Siff was a serious-minded man, studious and conscientious in his teaching.

The report of the Council was read by President Burroughs.

The report of the Membership Committee was read by Chairman Payne. Upon motion, the report was adopted and the Secretary was ordered to cast one ballot for all the nominees. Accordingly, the following named persons were declared duly elected active members of the Academy:

James Llewellyn Leggett, M. A., Professor of Psychology and Education, Transylvania College.

Mrs. Charles F. Norton, A. B., Librarian, Transylvania College.

Miss Florence Schoenleber, A. M., Professor in Home Economics, Hamilton College.

Elmer Elsworth Snoddy, M. A., Professor of Philosophy, Transylvania College and The College of the Bible.

James Clyde Vannetter, A. B., M. D., Assistant Professor of Biology, Transylvania College.

Miss Hilda Threlkeld, A. B., Dean of Hamilton College.

The President appointed as nominating committee Messrs. Jillson, Crouse and Buckner, to report nominations for officers of the Academy at the afternoon session.

The Publications Committee reported thru Dr. Peter that part of the manuscript for Volume II. of the Transactions had been given to the Jas. M. Byrnes Company for printing. This volume will cover the 11th, 12th, and 13th meetings.

Dr. Middleton gave a short report on the meeting of the A. A. A. S., in Philadelphia, which he attended as representative of the Academy in the Council of the Association.

Dr. Jillson announced that he had brought a number of publications of the Kentucky Geological Survey for distribution to any one wanting them.

President Burroughs read his presidential address on "The prehistoric forts of Kentucky."

Dr. Oscar Riddle, by invitation, gave an illustrated lecture on "Studies on the thyroid glands."

At 10:45 the general session adjourned until 2 P. M. and the Divisions assembled in separate rooms for reading papers.

The general session was called to order at 2 P. M.

Dr. Martin H. Fischer, of the University of Cincinnati delivered an address on "The constitution of living matter."

The nominating committee reported as follows:

For President, W. D. Valleau.
For Vice-President, C. S. Crouse.
For Secretary, A. M. Peter.
For Treasurer, W. S. Anderson.
Councilor to the A. A. A. S., A. R. Middleton.

Upon motion, the report was adopted and the Secretary was ordered to cast one ballot for the nominees. They were then declared elected unanimously.

The Divisions reported election of officers as follows: Biological sciences—G. D. Buckner, President; E. N. Fergus, Secretary. Physical and Mathematical Sciences—W. R. Jillson, President; C. S. Crouse, Secretary. Philosophy and Psychology—M. A. Caldwell, President and Secretary.

A telegram was read conveying a greeting from the session of the North Carolina Academy. The Secretary was directed to send the following reply: "Appreciate your message. Kentucky Academy sends cordial greetings to the Carolina Academy."

There being no further business, the Academy adjourned *sine die*.

SECRETARY'S REPORT, 1926-7

The President appointed the following committees to serve during the year 1926-7: Memberhip: V. F. Payne, Transylvania College, Chairman; E. C. Vaughn, Experiment Station, and Lucien Beckner, Winchester.

Legislation: W. R. Jillson, Frankfort, Chairman; J. S. McHargue, Experiment Station, and John S. Bangson, Berea College.

Of the 23 persons elected to active membership at the last meeting, 18 have paid the initiation fee and have been added to the roll of the Academy. Besides these, since the meeting, 3 have come in thru the A. A. A. S. (Frank, Lester and Schnieb) and 8 were elected by the council (Terrell, Boynton, Graham, Bassett, Bear, Hendricks, Hatcher and Weidler), 4 of whom have paid the initiation fee and have been added to the roll. We have lost 2 members by death: Prof. Charles J. Norwood, of the University of Kentucky, and Dr. Louis Siff, of the University of Louisville.

The total membership is now 174, including 86 national and 51 local members, making 137 active members, besides 23 corresponding members and 14 honorary members.

The membership may be classified as follows:

Active members in good standing, including 2 life members	101
Active members in arrears 1 year	24
Active members in arrears 2 years	12
Corresponding members	23
Honorary members	14
	174
Number of members at last meeting (1926)	179
Dropped from the roll for all reasons	30
	149
New Members added	25
	174

Classified geographically and as to educational institutions the active membership includes:

55 from the University of Kentucky, Lexington,
9 from the University of Louisville, Louisville,
11 from Berea College, Berea,
5 from Centre College, Danville,
5 from Eastern State Normal School, Richmond,
3 from the Western State Normal School, Bowling Green,
2 from Morehead State Normal School, Morehead,
2 from Georgetown College, Georgetown,
1 from Transylvania University, Lexington,
1 from Massie School, Versailles,
1 from the Kentucky Wesleyan College, Winchester.

Not connected with educational institutions in the state are 8 from Frankfort, 8 from Louisville, 3 from Lexington, 2 from Berea, 2 from Ashland, and 1 each from Owensboro, Middlesboro, Kyrock, Winchester, Paris, Jenkins, Danville, Wallins Creek, Mayfield and Vine Grove. Besides these there are 6 active members outside the state.

Your Secretary had some correspondence with Dr. Gerhard Dietrichson, of the Massachusetts Institute of Technology, Secretary of Section C of the A. A. A. S., in regard to the program for the Chemistry Section of the A. A. A. S. for the Philadelphia meeting. The Council approved the program by letter vote.

The council has considered the advisability of forming a division of philosophy and psychology of the Academy (this being left to them for decision by the last annual meeting) and has appointed Dr. M. A. Caldwell, of the University of Louisville, as Secretary of the division, with instructions to prepare a program and organize the Division at the coming meeting.

The matter of making this a physics meeting memorial to Isaac Newton, the 200th anniversary of whose death occurs this year, was proposed by Dr. Boyd and taken up by the council. This was not approved.

Two meetings of the Program Committee were held in Dr. Peter's office. No meetings of the Council were held but business transacted by letter.

A letter was received from A. G. McCall, Executive Secretary of the First International Congress of Soil Science to be held at Washington, D. C., June 13 to 22, 1927, asking for a committee to cooperate with the general committee. The president appointed George Roberts, Chairman; P. E. Karraker and J. S. McHargue.

In December a letter was written to our Senators in Washington urging them to do all they could to help forward the passage of the McNary-Woodruff Bill providing for increasing the acreage of the National Forests in the Eastern part of the United States.

The Secretary took up with Dr. Livingston the matter of the National Association sending a delegate to the meetings of the Academy, to which Dr. Livingston replied at length. A delegate was not appointed.

As noted in the minutes of our last meeting, Governor Fields appointed Dr. W. R. Jillson to represent the State of Kentucky at the 14th International Geological Congress at Madrid, Spain, May 24 to 31, inclusive, 1926. Dr. Jillson attended and also represented the Kentucky Academy.

Dr. Austin R. Middleton, of the University of Louisville, attended the council meetings at the Philadelphia meeting of the A. A. A. S. last December, as representative of the Academy.

A letter was received from Hon. Samuel M. Wilson inviting the Academy to join in the celebration in memory of Henry Clay and Thomas Jefferson, on April 12, 1927, in Lexington.

The Secretary sent the telegram to Hon. Randolph Perkins, as instructed in the resolutions, and also wrote letters of thanks to President McVey and to Dr. Laughlin.

Respectfully submitted,

A. M. PETER, Secretary.

Discusses certain chemicophysical effects of high pressure, its direct effect on germination, and on the percentages of soft and hard seeds. The application of 2,000 atmospheres hydraulic pressure to seeds of *Medicago sativa* (alfalfa) increased the total germination over 50 per cent when the seeds were dried and were germinated after 30 days and after 6 months. Application of 2,000 atmospheres pressure between 5 and 20 minutes to seeds of *Melilotus alba* (sweet clover) increased the total germination over 200 per cent when the seeds were dried and stored for 30 days before the tests were made. An increase of over 150 per cent in germination was obtained with seeds from the same bulks when the seeds were dried for 6 months before the germination tests were made. The application of 500 atmospheres hydraulic pressure for 2 and 8 hours failed to produce the high percentage germination obtained with 2,000 atmospheres. Short exposures at high pressures are more advantageous than long exposures at low pressures. For a full account of the work see Jour. Gen. Physiol., Vol. 9, pp., 805-9, 1926, and Amer. Jour. Botany, Vol. 15, pp. 149-56 and pp. 433-36. 1928.

6. **Breeding Red Clover.** E. N. Fergus. Ky. Agricultural Experiment Station.

Red clover is a decidedly variable plant. From being grown in different localities for many years numerous geographic varieties have arisen. These varieties often show some morphological differences, but exhibit greater physiological variations. Consequently, the yield of clover grown on the Station farm from different lots of seed has ranged from nothing to about 2½ tons of mow-cured hay to the acre, under uniform conditions. Photografs were exhibited showing the differences described. An attempt is being made to further improve adapted strains by modern methods of crop breeding.

7. **The Effect of Chlorides in the Fertilizer Application on the Chlorine Content of Burley Tobacco.** P. E. Karraker. Ky Agricultural Experiment Station. By title.

8. **A Chemical Analysis of the Bean and Pod of the Kentucky Coffee-Nut Tree** (Gymnocladus canadensis). C. A. Barkenbus and A. J. Zimmerman, Chemistry Department, U. of Ky.

Besides the chemical analyses of the bean and pod the physical and chemical constants of the oil were reported. For a full account of the work see Jour. Am. Chem. Soc., Vol. 49, pp. 2061-64. 1927.

9. **The Mountain Flora of Kentucky.** Geo. D. Smith, Eastern Kentucky State Normal School.

Exhibited many fine lantern slides of wild plants, and commented on them.

10. **An Organism Isolated From the Feces of a Colitis Patient.** Earle K. Borman. Ky. Agricultural Experiment Station.

The organism was first thought to be *Salmonella morgani* but differs in producing acid in sucrose broth. Further work is planned.

11. **Geology of the Island Creek Oil Pool.*** (Abstract) W. R. Jillson, State Geologist of Kentucky.

The Island Creek Oil Pool is situated in southwestern Owsley County, Kentucky, in the central western part of the Eastern Kentucky coal field. It is fifteen miles in an air line slightly west of south of Beattyville and twenty miles in an air line slightly west of south of the Big Sinking Oil Pool in Northern Lee County. Island Creek, the principal line of local drainage, is an entrenched eastward flowing tributary of the South Fork of the Kentucky River. Physical relief varies from 50 to 450 feet in this district which, broadly described, is maturely dissected and steep of slope. The valley bottoms are entrenched and meandering, while the ridge tops are narrow and winding.

The hard rocks exposed at the surface and to a depth of

*See Ky. Geol. Survey Series VI., Pamplet XII., 20, Illust., 55pp. 1927.

athletics and non-participants revealed only a negligible mental difference and a five point difference in academic averages. The younger students were brighter and more successful, as a rule, than the older. Students from Kentucky high schools compared favorably with those from the East and from the North Central States and did better work than those from the South. The study suggests a close relation between intelligence and purpose in college with success within its halls. For a detailed account, see Jour. of Applied Psychology, Vol. 12, No. 5, pp. 517-23.

20. A Study of Moral Judgment. Paul L. Boynton, Psychology Department, Univ. of Ky.

The results of 10 tests are reported. Students in the Psychology Department, 74 girls and 80 boys, took part. The papers were turned in unsigned. The following conclusions are drawn: Boys judge less strictly in moral situations such as those presented in this test than do girls, the average score for boys being 532.2, and for girls, 582.1. Girls show more intra-group disagreement than do boys, in practically all instances. It is worse for a girl to commit a given immoral or questionable act than for a boy to do it. A slight tendency appears for girls to be more uniform in their judgments than boys. Very great variation in moral standards appeared.

21. The Social Origins of Religion. William H. Walker, Berea College.

The theory that there is an impersonal stage of religion before the personal rests on a false interpretation of the religion of primitive peoples, like the Australians and the Todas. It assumes that primitive man develops from the impersonal to the personal, which is false psychologically. The reverse is the case, in spite of vague conceptions of the personal.

The theory is due to the over-working of the definition of religion as "the effort to conserve socially recognized values." That would make religion coextensive with all the activities of primitive man save actual eating and procreation. The differentiation of religion is in the agency thru which such conservation is sought, namely, God or gods.

But the idea of God develops for its own sake before it is used as a means to the conservation of other values. Man could not live in an unsocial world. Hence on the one side came the formation of social groups. On the other, came the socialization of the universe, the peopling of it with creations of his fancy, his need, with whom he could hold fellowship, to whom he could appeal for help. Only exceptionally has he ever been able to persuade himself that he is in an unresponsive world.

22. **The Relation of Philosophy to Science.** Glanville Terrell. Philosophy Department, Univ. of Ky.

The line of argument was to show that science deals with facts while philosophy is an exercise of pure reasoning (a priori) without the facts. Before the facts have been found, the question is said to be in the philosophical or metaphysical stage. As soon as the facts are reached the question at once passes over into the scientific stage. The speaker endeavored especially to show that the fruitfulness and economy of all scientific experimentation depend largely on the accuracy and correctness of the thinking done while the question is still philosophical. Further, that the importance of facts, on which scientists are inclined to lay so much stress, is due largely to the interpretation of these facts by the human mind and the demonstration of the relation of these facts to the universe in which we live. This last is philosophy no less than the thinking which precedes the facts and leads to their discovery. An isolated fact is without meaning. All great scientists have combined the philosophical attitude of mind, the ability to reason without the facts (a priori) and the scientific attitude, the ability to reason from the facts. The errors of one method, pure reason, must be corrected by the other, the evidence of the senses.

23. **The Constitution of Living Matter.** (Abstract.) Martin H. Fischer, Laboratory of Physiology, University of Cincinnati, Ohio.

I. LYOPHILIC COLLOIDS.

The characteristics of lyophilic colloid systems are best explained on the assumption that they are mutually soluble systems of the type phenol/water, butyric acid/water, etc.

Any lyophilic colloid system (like soap/water or protein/water) is, like phenol/water, capable of forming two types of solution, one of phenol in water and a second of water in phenol. When an ordinary soap/water system is permitted to cool, say from 100° to room temperature, it changes from the first of these two types of solutions to the second. In the course of such change two zones of mixed systems are passed which are of special significance. As shown in the diagrams of Figure 1 we pass from the original non-colloid, "molecular" or "ionized" "solution" of soap in water (zones A) thru a first type of mixed system which is a dispersion of solvated soap in soaped-solvent (zones B, C. D. E) into a second which is a dispersion of soaped-solvent in solvated soap (zones V. W. X. Y). At the bottom lies the second type of true solution which we have called water in soap (zones Z). All the systems between the true solution at the top and the true solution at the bottom are, if the dimensions are correct, "colloid."

This concept explains readily the "peculiarities" of the so-called lyophilic colloid systems. Obviously it sets no limitations upon the nature of the materials that may make up such a colloid system and makes no specifications as to the nature of the forces which guarantee its stability. They are any or all which may appear or be operative whenever "solution" of any kind occurs. Electrical notions of colloid stability are at present particularly acceptable. But how can such be the dominant factors in those most typical lyophilic colloids which consist of nothing but nitrocellulose with ether and alcohol, agar-agar with water, or rubbed with benzene? They are of minor significance even in those lyophilic colloid systems which are composed of an "electrolyte" and water (like soap/water). The most stabile of these systems show the least evidences of electrical charges. When such appear they are not the cause of the colloid behavior but the accidental consequence of having an overplus of "solvent" present in the system into which some of the soap has gone in true solution with secondary hydrolysis and electrolytic dissociation.

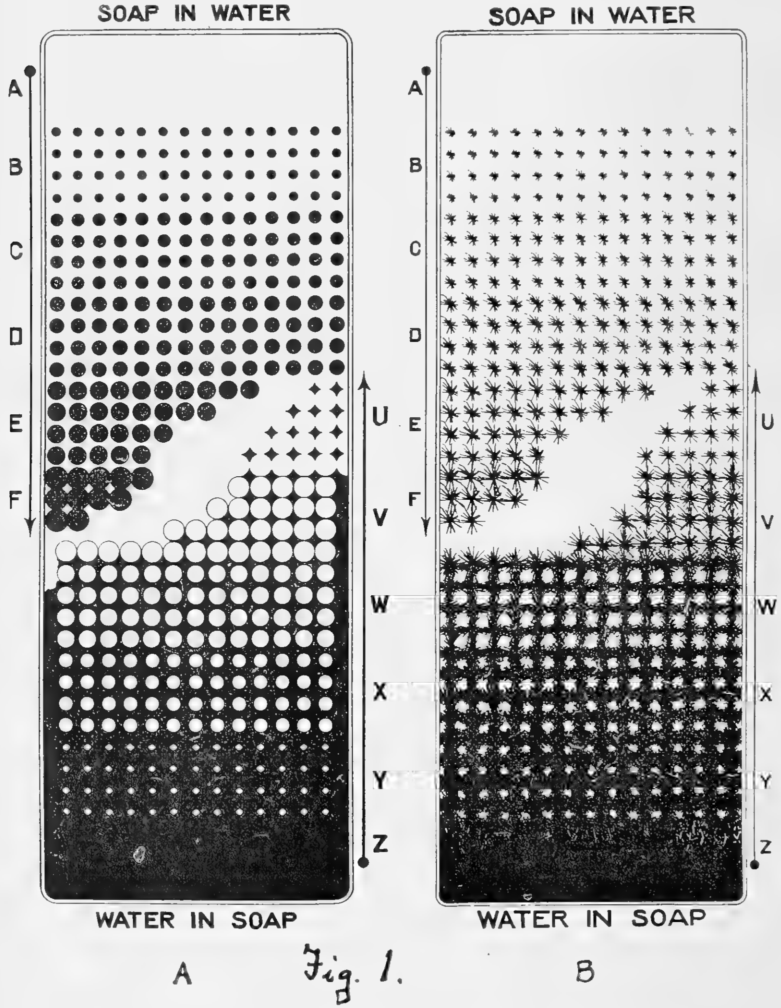


Fig. 1.

This theory of the solvated colloid clarifies the concepts of *hysteresis, gelation capacity, swelling* and *syneresis*. Hysteresis is the expression of the fact that solution takes time, wherefore two mutually soluble substances cannot quickly come to equilibrium. The point at which a lyophilic colloid "gels" (zones F) is that at which the solvated colloid phase becomes the external one. The system as a whole still carries at this point as an internal phase a solution of the colloid in the solvent. The combination marks the gelation capacity of a colloid with its solvent and is always greater than the solvation capacity of the colloid. The latter is a measure only of the solubility of the solvent in the colloid material. The increase in the volume of the latter as the solvent is taken up measures its ability to "swell." The zone Z in the diagrams covers the swelling capacity of a given material with its solvent; the gelation capacity embraces all the zones above this up to and including the zone V. As soon as this zone is passed the external solvated colloid phase may not inclose all the solution of colloid in solvent, wherefore the system as a whole begins to sweat; in other words, exhibits the phenomenon known as syneresis. Colloid systems in which one of the mutually soluble materials is solid (diagram B) will obviously fail more easily to inclose adequately the internal phase than will such in which both materials are liquid (diagram A), wherefore colloids of the type sodium stearate/water, silicic acid/water, etc., show a greater liability to syneresis than more liquid ones like sodium oleate/water, rubber/benzene, etc.

II. CELLS AS COLLOID SYSTEMS.

Living cells behave like hydrophilic (lyophilic) colloids. Not only are the laws which govern *water* absorption or secretion by the two identical but the absorption and secretion of *dissolved substances* are identical in both.

These analogies between living matter and lyophilic colloid systems demand that the former find some place in the diagrams of Figure 1. The physico-chemical properties of protoplasm are such as place it definitely in the lower regions of the diagrams. Protoplasm is essentially, in other words, a solution of water in protoplasm. The more solid structures of the body never, normally, lie above the middle of the diagrams and even such liquid protoplasmic structures as blood and lymph cannot lie much above the level E. On the other hand, the more aqueous *secretions* from the body, like urine and sweat, approximate the level A (that of the true solutions) tho even these, thru admixture with colloid substances (colloid salts and proteins) are better comparable to levels like B or C. The physical chemists have for the most part sought the solution of physiological behavior by trying to rediscover in living matter the laws of the dilute solutions. But protoplasm does not lie in or near the levels A of the diagrams but nearest the levels Z. *The physico-chemical laws which govern systems of this type are those which are most likely to find unobjectionable applicability to protoplasm.*

III. MUTUALLY SOLUBLE SYSTEMS AND PROTOPLASM.

The system phenol/water in its two phases, water-dissolved in-phenol and phenol-dissolved-in-water, yields in handy laboratory fashion the analogues respectively of the zones Z and A of the diagrams of Figure 1.

Phenol is a crystalline material which, upon the addition of water, becomes an oily liquid. A chemist caught unawares is likely to say that this is a concentrated (95 per cent) solution of phenol in water. But when more water is poured upon the oily mass two layers are formed. The first liquid was really a solution (about 5 per cent) of water in phenol and the new solution formed over the oily one is one of (about 5 per cent) phenol in water. If the thing is done quantitatively (50 cc. of melted phenol crystals being mixed with 50 cc. of distilled water) the picture represented diagrammatically in Tube 1 of Figure 2 is obtained. Above a lower stratum of 65 cc. of hydrated phenol is found an upper one of (nearly) 35 cc. of phenolated water. *The lower one of these phases corresponds with the black zones Z of Figure 1, the upper one with the white zones A. Let it be emphasized at once that the properties of living matter are rediscoverable in the lower phase (that of hydrated phenol) and not in the upper one (of phenolated water) as we have been taught.* Proof for this may be brought as follows.

1. **Living matter does not mix with water.** A fowl, or a piece of muscle or a bone may be stewed or boiled indefinitely to make soup but it does not dissolve or mix with the water. Rained on, or in swimming, we do not dissolve in the surrounding waters. Neither does hydrated phenol dissolve in or mix with the water phase that covers it. When Tube 1 of Figure 2 is shaken, the hydrated phenol breaks into droplets which float about in the water like so many amebae.

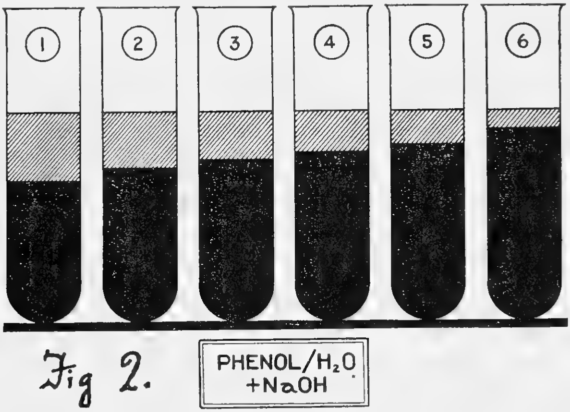


Fig 2.

2. **The hydrophilic colloids derived from living plant or animal structures "swell" when thrown into water. Phenol, similarly, shows a 30 per cent volume increase when exposed to water.** The basic hydration of the protein colloids of the tissues may be enormously increased thru the addition of any alkali or acid. Similarly, alkalies increase the "swelling" capacity of hydrated phenol as shown in the tubes marked 2 3, 4, 5, and 6 of Figure 2.

3. **Living matter rarely "dissolves" any proffered substance as would an equal volume of water or any salt solution.** Certain things like the anesthetics and various dyes dissolve better in living substance than in water; others, like eosin or iodine, occupy a middle position; while various salts, particularly those of the heavier metals dissolve in protoplasm so poorly that some authors teach that they never enter the living cells. The same may be said, not only in general, but almost specifically of the solubility characteristics of the hydrated phenol phase as compared with the solubility characteristics for the same substance of the phenolated water phase.

4. **The electrical resistance of protoplasm is unexpectedly high.** In spite of the fact that living matter contains a fair fraction of electrolyte (say 1 per cent of salt in the ordinary soft tissue) it is nevertheless a very poor conductor of electricity as compared with a solution of these salts in water. Where, with standard electrodes, a 1 per cent salt solution will register a resistance of several ohms, the fluids (blood or lymph) or tissues of the body will register several hundred. The same is true when the two phases, phenol-dissolved-in-water and water-dissolved-in-phenol are compared. Even tho the former contains only one twentieth as much "electrolyte" as the latter, the first shows a resistance of only 50 ohms, or less, compared with a resistance of 20,000 ohms shown by the second.

The initially high electrical resistance of living matter is reduced thru "injury," by acids, alkalies, various anesthetics and certain salts. The addition of the same materials to the hydrated phenol phase lowers its electrical resistance in the same striking fashion.

IV. CELL "PERMEABILITY."

These findings are of significance for a better understanding of certain aspects of cell behavior, more particularly the phenomena of "permeability" of "cell membranes" or of "protoplasm" in general. The attempt is still being made to understand these phenomena thru some modification of Pfeffer and de Vries' osmotic concept of the living cell or Overton's lipoid membrane modification of it. The physico-chemical and biological objections which may be raised against either of these notions are too numerous to need repetition here. The living cell is capable of absorbing and secreting water, of absorbing and secreting the most varied types of dissolved materials, the two moving at times in the same direction and at times in opposite directions. There can be no adequate physico-chemical concept of the living cell which does not contain within it the possibility of understanding all these characteristics at one and the same time.

The volume of the hydrated phenol phase described above "swells" and "shrinks" when subjected to the action of alkalies or of salts; it shows, in other words, the biological phenomena of plasmoptysis and plasmolysis, just as does any hydrophilic colloid (protein) or the living cell. But such a phenol system shows also the "strange" phenomena of permeability to dissolved substances so characteristic of living matter. It is quickly permeable, for example, to the most varied dyes; to another group of such or to iodine it is less permeable. While permeable to the salts, hydrated phenol takes these up most slowly and in certain instances practically not at all. Identical observations are characteristic of protoplasm and the living cell.

The high electrical resistance characteristic of living matter has always been difficult to understand as long as we held to the view that protoplasm was essentially a somewhat modified dilute solution. In spite of the conclusion that a physiological salt solution is supposed to be osmotically comparable with the salts dissolved in a living animal or its body fluids, the former will register only 1-5 to 1-35 the electrical resistance of the latter. This old biological truth can be understood only by denying to the salts found in protoplasm any large existence in uncombined form or by concluding that the cell is a different sort of solvent for these salts than is water. Experimental evidence supports both these conclusions. Aside from the fact that the electrolytes are for the most part "combined" with the protoplasmic constituents and are not "free" as in an ordinary salt solution, the high electrical resistance of protoplasm is further accounted for as soon as it is remembered that protoplasm is not a solution of protoplasmic material in water but one of water in protoplasmic material, a solution comparable, in other words, to the solution of water in phenol. The effects of acids, of alkalies, of single salts, of anesthetics, etc., all of which reduce the normal electrical resistance of living matter, are then to be understood in the same terms in which these factors reduce the electrical resistance of systems of the type, hydrated phenol. Even the physiological antagonism between different salts so characteristic of living matter reappears in the case of hydrated phenol.

V. REMARKS ON HYDRATION.

These analogies between mutually soluble systems, hydrophilic colloids and living matter compel the conclusion that in the last named system we have to deal with what is essentially a solution of water in the protoplasmic mass, a system which bears no relation in its fundamentals, therefore, to the ordinary dilute solution of our chemical laboratories and to the properties of which we have been so long accustomed to look for the explanation of physiological or biological behavior. If, now, we ask regarding the nature of such inverse type of solution, say of water in phenol, water in a colloid or water in protoplasm, the answer, somewhat dogmatically expressed, is that in all these the water is no longer "free" but combined with the material which is hydrated. The combination is also quantitative in character, in other words, it is "chemical." Can something be picked out of chemical laboratory experience to make clearer what is meant? This can be done. When a solid soap, like sodium stearate in water or alcohol, changes on cooling to what even the chemists are willing to call a "solid solution" of the solvent in the soap, we have before us, in the end, something strongly reminiscent of the crystallization of any compound with several molecules of water of crystallization. When, on the other hand, some crystals of phenol take up a limited amount of water to yield an oily solution of water in phenol, this is the analogue of what is seen when sulphur trioxide changes to the oily sulphuric acid upon the addition of water. In a certain sense, in all these illustrations, an anhydride becomes hydrated.

If this general statement is correct, we should be able to find in homely laboratory materials the analogues of the properties here emphasized for various colloid systems.

The ordinary sulphuric acid of our laboratories is viscid and exhibits a Tyndall cone. These are properties familiar to us when discussing solvated colloids. Upon exposure to an atmosphere which contains water, concentrated sulphuric acid takes this up. The sulphuric acid, in other words, "swells." Such swelling whether of sulphuric acid or of a colloid is associated with the liberation of heat.

How, now, does the ordinary concentrated sulphuric acid of our laboratories behave electrically? As every chemist knows, not as simply as might be expected. The electrical resistance of dilute sulphuric acid decreases with every increase in the concentration of the acid. But this law is valid only for the heavily diluted acid. As soon as more concentrated sulphuric acid/water mixtures are approached, the electrical resistance *increases* with every increase in the concentration of the H_2SO_4, proof again that, with change in concentration, we pass from what was originally more of a solution of the sulphuric acid in the water to one of water in the sulphuric acid.

VI. REMARKS.

The significance of the point of view which is here being urged can be demonstrated by some simple laboratory experiments. Other differences besides those already discussed should be discoverable between the two types of solutions, A dissolved in B and B dissolved in A. To two of these which are of great significance for our every day biological thinking, I want to refer now. The first has to do with the behavior of indicators and the second with the type of equilibrium establishable in consequence of the fact that a chemical reaction is allowed to take place in the one or the other of these two types of solution.

1. Experiments with Indicators.

Suppose we ask what is the reaction of any chemically neutral soap like a mixture of 20 per cent potassium oleate with water. Such a mixture is viscid and reminiscent of blood plasma or egg white. To test the neutrality, we drop into the liquid a little phenolphthalein solution. The mixture remains colorless. Water is now carefully poured down the side of the tube until it is filled. *The tube contents become increasingly red as the dilution becomes greater.* At the bottom, the soap/water mixture is still colorless, but at the top it is bright red. Between the bottom of the tube and the top any pH that suits us may be read off. The physical chemists tell us that we have in this instance begun with a "concentrated" solution of an electrolyte in water—a solution in which ionization was "suppressed"—and that thru dilution with water, increasing hydrolysis was invited. Potassium hydroxide being a stronger alkali than oleic acid is an acid, an overplus of hydroxyl ions yielded the red color with phenolphthalein. I do not deny that some of these things do happen but the first and primary change in this experiment has been missed. *This is the conversion thru dilution of what was originally a solution of the water in the soap to one of the soap in the water.* The indicator serves to show us that these two solutions are different. What is of importance to us is the fact that we have been using indicator methods derived from and perhaps applicable to the study of solutions of the type, electrolyte dissolved in water, upon solutions of the opposite type (blood, lymph, body tissues) as tho these were solutions of the same construction. Obviously there is danger in such thinking.

In the case of potassium oleate with water, the solution of water in soap passes smoothly and quickly into the solution of soap in water. What is here discussed can, therefore, be even more strikingly illustrated if, instead of a liquid soap/water system, a hydrated solid soap/water system is chosen. Any cake of toilet soap which contains a considerable fraction of water may be used, tho the experiment can be made more scientific and expensive by utilizing a chemically neutral solid white soap of the acetic series. If some phenolphthalein is poured over the surface of such a cake, no color change takes place. As soon, however, as distilled water is sprayed upon it, the cake drips red. Here is the fundamental answer, I think, of how a neutral pancreas, salivary gland or kidney comes to yield an alkaline secretion.

An acid "secretion" may be derived from a neutral source when, instead of a soap, a chemically neutral acid proteinate is diluted with water.

Such indicator experiments may be repeated upon the concentrated sulphuric acid which has just been declared to be a hydrated system not dissimilar to the hydrated colloids. Methyl red turns red in acids and yellow in alkalies. When this indicator is added to concentrated (Sp. Gr. 1.84) sulphuric acid, it turns bright yellow. Sulphuric acid is, therefore, violently alkaline. Distilled water is now added. With a little, the sulphuric acid, to judge by the indicator, turns neutral, and with more, the mixture becomes increasingly acid. In the fact of such facts, what must be thought of the present-day unrestricted application of indicator methods to even the ordinary chemical systems of the "concentrated" type found in our laboratories, or specifically to the biological systems upon which the physiologist or biologist works daily?

2. Synthesis in Living Matter.

The evidence indicates, therefore, that neither living matter nor any fraction of it is to be thought of primarily as a dilute solution or as anything approximating such a system. It is, rather, a protein to which the salts have been bound chemically (fundamentally as a base-protein-acid compound) and in which the water has then been "dissolved" (or to which the water has been bound as a hydrate). This triple affair is to my mind the fundamental unit of the living mass.

If this conclusion is accepted, then the chemical reactions which occur in living matter must occur in a medium far different from ordinary water. *But this compels the conclusion that living matter is normally a practically anhydrous medium.* The view brings significant corollaries with it. *It means that the chemical reactions characteristic of the normal life of the cell occur in an anhydrous medium and that their course and products must, in consequence, be quite different from the course and products of these same reactions occurring and familiar to us in aqueous solution.*

The physiologists and the biochemists are always astonished at living matter's remarkable powers of *chemical synthesis.* While the chemist, by the use of acids and alkalies, or heat and water, or thru the gentler action of those fragments of the living mass which he calls ferments has been able to break up the complex organic proteins, carbohydrates and fats into their simpler building blocks, he has had great difficulty in resynthesizing these materials into their original forms. Yet living matter does this with the greatest ease. A beefsteak with bread and butter which melts in the lumen of the intestine into amino-acids, simple sugars and fatty acids and glycerine and is thus "absorbed," is so rapidly resynthesized into protein, glycogen and fat by the living cells that the building blocks can scarcely be discovered in the blood or lymph which carries the absorbed meal away. It was a great step forward when A. Croft Hill, Kastle and Loevenhart, Hanriot and their successors first showed that the ferments were capable of catalyzing not only an analysis but a synthesis. It must be said, however, that in test tube experiments this "reversible action of the ferments" never proved to be very great so far as the synthesis half of the problem was concerned. Still, in the body, synthesis is as easy as analysis. *The answer to the problem is, I believe, written in the fact that nature always makes her analyses in an aqueous medium and her syntheses in an anhydrous one. The agencies which digest a meal in the alimentary tract always work in the presence of much "free" water; the same agencies working in the body substance operate in the presence of none.*

The importance of this arrangement is illustrated in the making of soap. To make soap, a fatty acid and a suitable quantity of an alkali are put together with very little water. As chemical combination takes place, the soap as formed binds the water so that in the end 100 per cent of hydrated soap is formed—synthesis, in other words, is carried to completion. When water is added to the reaction mixture, the soap hydrolyzes into alkali and free fatty acid—a reaction which again, at proper concentration, tends to be complete. With a medium amount of water either reaction "tends toward an equilibrium"—in other words, to a mixture of soap with alkali and fatty acid.

Iron and iodine combine directly to iron iodide. If this reaction is carried out in water, nothing but a reddish green mixture of a little iron iodide, much iron hydroxide and hydriodic acid is obtained. Add cane sugar to the original mixture (which combines with the water to make "syrup") and a clear solution of ferric iodide in the hydrated sugar is obtained,—in other words, with water, hydrolysis and analysis, without it, synthesis.

Over what route, in general, does the organic chemist accomplish his syntheses? The fact has to be whispered to the pure line physical chemists—the anhydrous one. Fat production in the body is ester production. What is the approved method for producing an ester? When, to illustrate the general truth, ethyl butyrate is diluted with a considerable quantity of water, the ethyl butyrate collar becomes perceptibly thinner because it hydrolyzes rather rapidly into ethyl alcohol and butyric acid both of which are readily soluble in water. This hydrolysis may be hastened by adding sulphuric acid. We deal here with the decomposition of an ester in the presence of much water (the analogue of the digestion of a "fat" into fatty acid and alcohol in the lumen of the gut).

In the reverse of this experiment butyric acid has added to it a molar equivalent of absolute ethyl alcohol (17.6 gms. butyric acid + 9.2 gms. ethyl alcohol). If the mixture is merely allowed to stand, a considerable synthesis of ethyl butyrate takes place within a few days. To hasten the matter, the contents of the tube are divided between two tubes. While one is kept as control, the second has added to it a few drops of concentrated sulphuric acid. The contents of both tubes are now diluted with much water. *The original mixture mixes with the water to yield a water-white fluid but the mixture treated with sulphuric acid has a thick collar of ethyl butyrate at the top.*

In place of the butyric acid any other water-soluble fatty acid (thru valeric) may be employed and in place of ethyl alcohol and other water-soluble alcohol (thru butyl) while instead of sulphuric acid any one of several other "driers," like phosphorus pentoxide, calcium chloride or any colloid capable of maintaining its water-holding powers in the mixture may be used. The essential thing is the removal of the "free" water present in the original mixture or formed chemically.[1]

VI. CLOSE.

Where must the new physiologist or biochemist look to get answer to his eternal question regarding the nature and the constitution of living matter? He can obviously not get it thru further increase in his knowledge of what living matter yields upon chemical analysis. And his living mass is evidently not, as so long taught, a dilute solution of these materials in water. Wherefore it seems that he must forsake increasingly the methods, findings and modes of thought of the dilute solution chemists. Living matter is a solution of the "concentrated" type, to use the words of the physical chemist, and of the solvated, water-dissolved-in-x type to use the terminology of the colloid chemist. It is the properties of such systems which will interest the physiologist of the future.

(1) The same is true of nitration and sulphonation. In nitration the sulphuric acid of the nitric-sulphuric acid mixture used does not appear in the end products but serves to keep the reaction mixture anhydrous, while in sulphonation the excess of sulphuric acid used serves the same end.

We are only on the threshold of an understanding of their properties, laws and behaviors but as such is obtained we shall discover as corollary an understanding of the nature of living matter itself.

MINUTES OF THE FIFTEENTH ANNUAL MEETING

MAY 12TH, 1928

The meeting was called to order at 9 o'clock, a. m., by President Valleau in room 200 of the Physics Building, University of Kentucky. About 14 persons were present at the beginning, others coming in later.

The Secretary's report was read in outline by Dr. Peter.

The Treasurer's report was read by Prof. Anderson. The President appointed as auditing committee, Messrs. Jewett, Marshall and Fergus.

Dr. Peter reported that the council had held one meeting for routine business and approving accounts. The election of the 10 members was by letter vote.

Dr. Peter submitted volume 2 of the Transactions as the report of the publications committee.

Report of the membership committee was read by Dr. Koppius, submitting 16 names, which included the 10 mentioned above. Resolved that the Secretary cast one ballot for all members and they were elected unanimously.

The President appointed Messrs. Bangson, McHargue and Payne as nominating committee.

The President delivered his address on tobacco disease investigations in Kentucky.

The general meeting then rose, and the divisions separated.

The general session was called to order by President Valleau at 2 o'clock.

The report of the auditing committee showing that the Treasurer's accounts had been examined and found correct was adopted unanimously.

Dr. Koppius, for the Membership Committee, presented a supplementary report recommending the following persons for membership:

C. J. Latimer, Dept. of Mathematics, University of Kentucky.
R. I. Rush, Head, Department of Chemistry, Centre College, Danville, Ky.
George B. Wurtz, Weather Bureau, Lexington, Ky.
R. G. Will, Centre College, Danville, Ky.
R. C. Miller, Animal Husb. Dept., Experiment Station, Lexington.
E. G. Campbell, Ph. D., Dean of Men and Head of Biology Dept. Transylvania College.
William M. Clay, Instructor, Biology Dept., Transylvania College, Lexington.
J. L. Leggett, Professor of Psychology and Education, Transylvania College, Lexington.
Frank M. Shipman, Asst. Prof. Chemistry, Univ of Louisville, Louisville.
Grover L. Corley, Ph. D., Asst. Prof. Chemistry, Univ. of Louisville, Louisville.
J. H. Capps, Dept. of Chemistry, Berea College, Berea, Ky.

The report was adopted and these persons were unanimously elected members of the Academy.

The Nominating Committee reported nominations for officers as follows:

For President: G. Davis Buckner.
For Vice-President George D. Smith.
For Secretary: A. M. Peter.
For Treasurer: W. S. Anderson.
For Member of the Publications Committee: W. R. Jillson.
For Representative in the Council of the A. A. A. S.: A. R. Middleton.

The report was adopted and, upon motion, duly seconded and carried unanimously, the Secretary was ordered to cast one ballot for all the nominees. This having been done, these persons were declared unanimously elected to their respective offices.

Professor Roberts reported briefly on the First International Soil Congress.

The following resolution was adopted unanimously:

Whereas The Fifteenth International Geological Congress will meet in Pretoria, South Africa, next May. Resolved that Dr. Jillson represent the Academy at this Congress."

President Valleau gave a short report of the Publications Committee stating that it was their opinion that the Transactions should be published each year but the material included be cut down so that it comes within the income of the Academy.

Dr. Stakman then delivered a very interesting illustrated lecture on "Biologic Specialization" followed by a general discussion in which several members participated.

There being no further business, the Academy adjourned *sine die.*

A. M. PETER, Secretary.

REPORT OF THE SECRETARY FOR 1927-8

The President appointed the following Membership Committee: O. T. Koppius, Chairman; S. M. Mayfield. and M. A. Caldwell.

The following 4 persons who were elected at the last meeting have qualified and been added to the roll:
Prof. James L. Graham, University of Kentucky.
Mrs. Charles F. Norton, Transylvania College.
Miss Hilda Threlkeld, Hamilton College.
Prof. G. C. Bassett, University of Kentucky.

The following 10 persons elected by the council have qualified;

Dr. Malcolm Y. Marshall, Henderson, Ky.
Prof. Gordon Wilson, Bowling Green, Ky.
Prof. E. Wilbur Cook, Centre College, Danville, Ky.
Mr. William Marshall Bullitt, 1711-26 Inter-Southern Bldg. Louisville, Ky.
Prof. Charles Hire, State Normal School, Murray, Ky.
Mr. Nat L. Shepard, c/o Franklin Fluorspar Co., Marion, Ky.
Mr. L. W. Taylor, Poultry Dept., Experiment Station, Lexington.
Prof. M. E. Ligon, University of Kentucky, Lexington.
Mr. Donald James Munroe, 374 Spring St., Lexington, Ky.
Prof. E. F. Birkhead, Supt. City Schools, Winchester, Ky.

Nine persons have been dropt from the roll for various reasons: Stuart Weller, Jean McKinnon, Homer Cooper, R E. Porter, W. J. Craig, J. J. Hooper, Gladstone Koffman, Karl Waugh and W. S. Webb.

Dr. Lester has resigned to take effect at the end of the fiscal year, he having left the state.

The total membership is now 179, including 90 national and 54 local members, making 144 active members, besides 22 corresponding members and 13 honorary members.

The membership may be classified as follows:

Active members in good standing, including two life members	114
Active members in arrears 1 year	10
Active members in arrears 2 years	20
Corresponding members	22
Honorary members	13
Total	179

Number of members at time of last meeting (1927)	174
Dropped for all reasons	9
	165
New Members added	14
Total	179

In January of last year President Burroughs appointed the following committee to attend the First International Congress of Soil Science at Washington, in June 1927: George Roberts, Chairman; P. E. Karraker and Dr. J. S. McHargue. These men attended the meeting.

At the request of Shirley W. Allen, Forester, The American Forestry Association, the Secretary wrote to our congressmen in Washington (Dec. 31/27) urging the passage of the McNary-Woodruff Bill (S. 1181) which was to come up very shortly thereafter for hearing. These letters were duly acknowledged.

The Secretary received a report from the Kentucky Section of the Mathematical Association of America, by Arthur R. Fehn, of Centre College, Danville, Ky., August 20, 1927. with regard to their forming a separate division in the Academy. The letter follows:

"My dear Dr. Peter:

I have been instructed to inform you that the Kentucky Section of the Mathematical Association of America does not favor becoming affiliated and holding joint sessions with the Kentucky Academy of Science. However, it is the opinion of the Association that mathematics should be recognized by the Kentucky Academy of Science and therefore it recommends to the Academy of Science that the name "Physical Section" be changed to read the "Mathematical and Physical Section" of the Kentucky

Academy of Science. This action was taken at the meeting May 14, 1927, of the Kentucky Section of the Math Assoc. of America.

Sincerely yours,

(Signed) ARTHUR R. FEHN, Sec'y-Treas.

Ky. Sec. of M. A. of A.

Volume II. of the Transactions has been received from the printer and distributed to all members not in arrears for dues.

Respectfully submitted,

A. M. PETER, Secretary.

TREASURER'S REPORT

Balance in bank May 4, 1927	$ 369.62
Receipts from May 4, 1927 to May 10, 1928	468.72
Total	$ 838.34
Total expenditures from May 4. 1927 to May 10, 1928	574.83
Balance in Bank	$ 263.51

Investments of Life Membership funds:

Lexington Building & Loan Stock	$ 51.00
U. S. Postal Savings Certificate	25.00
	$ 76.00

W. S. ANDERSON, Treasurer.

PAPERS READ AT THE 15TH ANNUAL MEETING, MAY 12, 1928.

1. **Tobacco Disease Investigations at the Kentucky Agricultural Experiment Station.** W. D. Valleau. President's address. (Abstract.)

Among the most important diseases of tobacco studied by the Agronomy Department in the past 8 years are black root-rot of Burley tobacco, the so-called brown root-rot, the virus diseases, of which mosaic is the well-known representative, the leaf-spot disease, known variously as wildfire, rust, blackfire, fieldfire and angular leaf-spot, thought to be caused by at least three distinct species of bacteria, and a physiological disease called frenching.

Black Root-Rot. Caused by a soil-inhabiting fungus of very wide distribution (*Thielaviopsis basicola* (Berk) Ferraris) causes most damage in the Burley district, probably because of a difference in soil reaction, inasmuch as neutral or slightly acid reaction seems to favor the disease.* Black root-rot causes serious loss in about a third of the crops in the Burley district. Tests at Lexington indicate that the common varieties of dark tobacco and Burley are very susceptible, except certain moderately resistant strains of Burley. Extensive breeding work has been done to develop resistant strains of both Burley and dark tobacco and the moderately resistant burley has been used quite largely, with success.

Brown Root-Rot. Appears to be present in all tobacco-growing areas of Kentucky, tho not recognized by growers. It causes rotting of the new rootlets as they develop, following setting and apparently during the rest of the season. The disease appears not to persist in the soil, and growing tobacco year after year on the same land seems not to have a cumulative effect, but rather the opposite. Control probably is to be expected thru cultural methods.

*Mass. Agr. Expt. Sta. Bull. 299. 1926.

Leaf-Spot Diseases. These are of great economic importance especially during wet seasons. Two bacterial diseases, angular leaf-spot and wild-fire are concerned but their importance has probably been over emphasized as factors in spotting of nearly mature tobacco. There appears to be a physiological disease occurring toward maturity and during wet periods which has been confused with the bacterial diseases. This type of spot is characterized by concentric zones. It has been produced in the greenhouse in the absence of the leaf-spot bacteria and cases have been observed in the field where complete control has been obtained thru the use of sufficient quantities of well rotted manure. Sanitary measures have been found insufficient to control the bacterial diseases in the plant bed and the suggestion is made that weeds may act as over-wintering hosts of angular leaf-spot and wild fire.

Mosaic. Caused by a "filterable virus" and present almost everywhere that tobacco is grown. At least four distinct strains were observed. It is an important disease to many Kentucky growers, tho some suffer little loss from it. Apparently, infection occurred during transplanting, the plants in the bed being free from the disease. The possibility of infection from the hands of the workers suggested itself, inasmuch as they habitually chewed natural leaf tobacco. Experiments showed that when these men kept their hands clean and chewed only sterile tobacco while pulling and setting plants, infection in the field averaged less than 0.5 per cent, against about 8 per cent ordinarily. Also, if the hands of the workers were dipped in a decoction of natural leaf tobacco, before pulling plants, infection ranged as high as 80 per cent. The simple precaution of having the men who pull and set the plants, chew only sterile tobacco, avoids infection almost entirely.

Tests of old samples showed that the disease may persist in the dried tobacco leaf for 31 years. Tests of commercial tobacco showed that most of the granulated smoking tobacco, cigarettes and five commonly-used plug tobaccos were somewhat viruliferous. Most of the plug tobaccos, however, and 10 or 12 of the twists tested, were free from the disease.

Other Virus Diseases. Several diseases were studied, the viruses of which do not survive in cured tobacco but over-winter on perennial hosts. We have named these Ringspot, Puff, Vein-banding, Etch, Etch +, Severe Etch, and Coarse Etch, They are injurious to other plants than tobacco, such as tomatoes. Probably some or all were derived from potatoes.

Frenching. True frenching is quite commmon in Kentucky but is not serious except in spots in an occasional field and then, perhaps, only in certain seasons. It is characterized by the top of the plant becoming quite chlorotic, sometimes nearly white. Our experiments, using a forest soil and sand culture, show that the disease is caused by lack of available nitrogen in the growing point of an otherwise healthy, rapidly-growing plant. In this soil the remedy is application of nitrogenous fertilizer, as needed. This work on frenching may lead to the understanding of certain diseases of other plants.

2. **Recent Developments in Investigations of Vitamin B.** Miss Statie Erikson. Home Economics Department, Univ. of Ky.

A preliminary report of work in progress.

3. **Mineral Metabolism During Pregnancy.** Daniel J. Healy and Floyd E. Hull. Ky. Agricutural Experiment Station.

In a study made at the Experiment Station the authors obtained the following results: Average inorganic blood-calcium content of 8 normal sheep, in July, 13.1 mg per 100 cc of serum; of 5 normal pregnant ewes, in December, 9.5 mg; of 7 normal pregnant ewes, at term, 9.1 mg; of 13 ewes having acidosis of pregnancy, 6.6 mg. The average content of phosphorus and of potassium for the same normal ewes, at term. was 5.1 mg and 22.4 mg, respectively, per 100 cc of serum, and for the ewes with acidosis, 5.6 mg and 43.0 mg, respectively. The average ratios of calcium to phosphorus to potassium were 1 : 0.56 : 2.47 for the normal ewes at term, and 1 : 0.86 : 6.5 for those with acidosis. With diminished buffer value in acidosis of pregant ewes, there are unbalanced calcium, phosphorus and potassium ratios. For the full report, see Jour. Am. Vet. Med. Asso., 72 (1928) p. 511, and Cornell Veterinarian, 1928, p. 73.

4. Hemoglobin Determinations. J. S. McHargue and Daniel J. Healy. Ky. Agricultural Experiment Station.

The von Fleischl, Dare, Tallquist and Newcomer methods were compared using 18 samples of blood from as many different white rats. The average readings, as per cent, were: von Fleischl, 86.7; Dare, by McHargue, 78.7, by Healy, 87.1; Tallquist, 76.5; Newcomer, 90.4. Agreement of readings by the two observers was good, except with the Dare method. The authors prefer the von Fleischl method for clinical use because of its rapidity, the small quantity of blood required, the close agreement between different observers and the agreement of the readings with the condition of the animals.

5. The Production of CO_2 From Irreversibly Injured Cells of *Nitella Flexilis*. P. A. Davies, Laboratory of Plant Physiology, University of Louisville.

It is a well established principle that CO_2 is produced abnormally in stimulated and injured tissue. The mechanism of CO_2 production by "dead tissue" is in doubt. "Irreversible injury" and "death" are not synonymous terms, for irreversible injury may be considered to occur at that point on a curve of injury beyond which the cells fail to recover beyond a certain point, while "death" signifies inability to recover to any degree.

The author's experiments seem to indicate that the rate of CO_2 production from cells of *Nitella flexilis* drops below the normal rate at the time of, or very shortly after, irreversible injury occurs. The findings are not in agreement with those of other workers, who found an increased rate (above the normal) of CO_2 production with other types of tissue for an extended period after the cells were dead. For complete data, see Bot. Gaz. 87; 660-664, 1929.

6. Canebrakes of Kentucky in Prehistoric Time and the Importance of Cane as a Forage Plant. J. S. McHargue, E. S. Hill and W. A. Anderson, Jr., Kentucky Agricultural Experiment Station.

Analyses of 2 samples of native cane are reported. See p. 72.

Analyses as per cent of the moisture-free material:

	Leaves Samp. 1	Leaves Samp. 2	Branches	Stalks	Young Stalks	Sheaths from young staiks
Ash	8.56	10.80	6.090	2.546	6.570	6.776
Silica, SiO_2	7.89	8.165	3.968	.717	.340	2.826
Iron, Fe	.019	.032	.025	.007	.056	.047
Manganese, Mn	.016	.001	.001	.001	.002	.007
Calcium, Ca	.456	.237	.086	tr.	.124	.138
Magnesium, Mg	.310	.145	.081	tr.	.622	1.820
Phosphorus, P	.207	.230	.114	.073	.305	.200
Potassium, K.	1.100	1.720	1.100	.954	n. e.	1.610
Sodium, Na	.174	.270	.248	.064	" "	.288
Sulfur, S	.313	.187	.083	n. e.	" "	n. e.
Nitrogen, N	2.20	2.280	.963	.288	" "	" "
Protein (N x 6.25)	13.75	14.25	2.020	1.800	" "	" "
Ether ext. (fat)		3.440	1.730	.842	" "	" "

The protein content of the leaves equals that of the common forage grasses.

A historical review is given to show the abundance of cane in Kentucky in pioneer times and that certain wild animals subsisted on it. Also that it was found to be an excellent forage for livestock, both summer and winter.

7. **Experiments in Methods of Inoculating Soybeans.** P. E. Karraker, Ky. Agricultural Experiment Station.

Results were reported from field experiments planned to determine the relative effectiveness of applying inoculating soil in different ways. Various amounts of soil were applied broadcast, mixed with the seeds in the hopper of the drill, and adhering to moistened seed. Small amounts of soil applied directly with the seed in either of the latter two ways gave better production of nodules than the broadcast application. Equal production of nodules was secured from half as much soil adhering to the seed as when mixed with the seed in the hopper of the drill. Soil gotten three years after soybeans had been grown on the land gave good production of nodules, but that gotten within one year was somewhat more effective. Soil taken from around the roots of soybeans grown in rows was appreciably more effective than that taken from midway between the rows. Soil after remaining in air dry condition three months was slightly less effective than that kept moist.

Inoculation increased the weight of hay one year but not the other. The percentage of nitrogen in the hay was markedly increased both years.

8. **Chicken Feed and Mold.** L. V. Amburgey, Department of Feed Control, Ky. Agricultural Experiment Station.

During the starting and growing period of chicks in the spring, the Department of Feed Control receives numerous samples of starting and growing mashes. The feeds usually are accompanied with the statement that the chicks are dying and that the feeds are suspected of poisoning them. Frequently it is stated that the feed is moldy.

In March, 1928, two such samples were received from different sections of the same county; one sender complained that baby chicks were dying in "piles"; the other, that pullets were dying at the rate of 40 a day. A microscopic and chemical analysis of these feeds failed to reveal the cause of the birds' death, unless it was due to molds which were present in each feed. With the object of determining whether or not these molds were responsible for the death of the chicks, the following experiments were carried out.

A sterile raisin agar medium was prepared and inoculated with very small amounts of feeds. At the end of twenty-four hours, molds had developed enough to be visible to the naked eye. In seventy-two hours fruiting bodies had developed and an attempt was made at classification. Numerous molds were present and the one that was most conspicuous was isolated and classified as Fusarium. Two portions, of about 100 grams each, of a different feed were taken, one of which was inoculated with the isolated mold, the other with all the molds. These feeds were then placed in an incubator at room temperature and left there for one week. During this time, molds had developed on both feeds to such an extent that there appeared to be more molds than feed. Enough fresh feed was thoroly mixed with each of the two 100 gram portions of moldy feed to feed two pens, No. 1 and No. 2, of two pullets each, for a period of ten days. Pen No. 3 of one pullet was used as a check. The following results were obtained:

Pen No. 1 fed isolated mold (Fusarium) with no ill effect.

Pen No. 2 fed all the molds with no ill effect.

In order to test the possibility that the original feed did not sicken the pullets, this feed was fed to the check pullet with no ill effect. Therefore, we formed the following conclusions:

1. Moldy feed does not ordinarily cause the death of chickens.
2. The feed in the first place did not cause the chickens' death.

This investigation will be continued as circumstances permit.

9. Oxidation of Sulfur in Limed and Unlimed Soils. O. M. Shedd. Ky. Agricultural Experiment Station.

This investigation consisted of a study of the oxidation of sulfur, both in the presence and absence of calcium carbonate, when added to 31 Kentucky surface soils. The treated soils containing 15 per cent of water were incubated at room temperature for 4 months. with occasional stirring. Sulfate sulfur, hydrogen ion contentration, acidity and alkalinity determinations were made. Sufficient quantities of sulfur were oxidized in every soil, with or without calcium carbonate, even after 30 days, to supply the sulfur requirements of almost any crop under maximum production. Very little consistent relation was found between the hydrogen ion concentrations of the treated soils, either in the initial or final pH values, and their acidity or alkalinity by nitration or the amounts of sulphur oxidized by them. For a detailed account of the experiments, see Soil Science, 26 (2), pp. 93-105.

10. Causes Affecting the Apparent Geographical Distribution of Cancer Mortality in Kentucky. W. G. Burroughs, Berea College.

According to statistics of the State Board of Health, the death rate from cancer, per 100,000 for 1911-1921, in the principal physiographic divisions of the state was: Bluegrass, 62.4; Southern and Southwestern carboniferous Plateau, 47.9; Knobs 40.8; Jackson Purchase, 37.8; Western Coal Field, 36.4; Mountains, 20.9. The death rate is decidedly greater in cities than in rural districts, perhaps because of the presence of hospitals in the cities, and because of better diagnosis. This circumstance may account for part of the difference in different areas. but other causes must operate. Differences in the character of the food should be studied, especially with reference to possible causes of irritation.

11. Gravitation. Daniel J. Healy, Ky. Agricultural Experiment Station.

The swinging of a chemical balance with 100 g. in each pan, was timed, at about 8 A. M. and 5 P. M. The number of seconds required for the deviation of the pointer of the swinging balance to change from 10 to 5 on the scale was observed. The average of many observations showed an appreciably longer time in the afternoon than in the morning. On certain days, the time was much longer than the average. The author argues that variation in the force of gravitation is indicated.

12. Air Adsorption in Water Vessels. Charles Hire, Murray State Teachers College.

Everyone has observed the accumulation of bubbles of gas on the bottom and sides of a vessel in which water is being heated. It is commonly believed and sometimes stated in science texts and by science teachers that these bubbles consist of air which has been driven from the water as its temperature rises. Knowing, as we do, that water readily absorbs air and many other gases under ordinary conditions of temperature and pressure, this statement is believed without difficulty unless one asks why the air bubbles should go to the bottom and sides of the vessel as they form rather than the top. A study of this question and the fact that some vessels, for instance everwear aluminum, collect more bubbles than others, lead to the experiments described in the following paragraphs.

Two pyrex beakers of 600 ccm, capacity were washed in warm soap water, rinsed with tap water and wiped dry with a towel which had been slightly used in the laboratory. The beakers were then partially filled with tap water and heated. Bubbles formed in the ordinary manner. Both beakers were then emptied, one washed, rinsed and dried again, both partially filled with tap water and heated. The beaker which had been washed the second time accumulated practically the same amount of gas bubbles as before, while the one which had not been washed the second time accumulated almost none. Both beakers were again emptied and allowed to stand in the open air for about an hour after which they were refilled with tap water and heated. Both accumulated practically the same amount of gas as in the first test. Both beakers were again emptied, washed in a warm chromic acid cleaning solution which removed all traces of organic matter, rinsed with tap water, refilled, and heated, and practically no bubbles formed on either. However, when the beakers were washed with the warm chromic acid, rinsed, and wiped with the laboratory towel which probably was not entirely free from fatty and other animal matter, both accumulated bubbles very readily. Briefly, it was found that either or both beakers could be prevented from accumulating the gas bubbles by cleansing thoroly with warm chromic acid, rinsing, refilling and heating quickly. However, bubbles formed if several moments were allowed to elapse, with the beakers either empty or full, between the rinsing and heating. These tests were repeated with distilled water with exactly the same results.

Several variations of the tests were tried, but an example from one other series will suffice for this paper. The beakers were cleaned with chromic acid, rinsed, and dried with heat. A cross of organic material was then marked on the bottom of one beaker by means of the experimenter's index finger which he had rubbed across his face. Both beakers were then partially filled with distilled water and the bunsen applied As the temperature rose, the cross became clearly visible as two intersecting lines of bubbles. This was used as the "index cross." Some redistilled water was boiled in a chemically clean vessel for several moments to remove all absorbed gases then quickly cooled to room temperature by setting the vessel in an ice bath. The beakers, which had been cleaned and heat dried, just previously, and one of which had been marked with the index cross, were partially filled with this gas-free water. So far as could be judged by the eye, heating this water formed the index cross as plainly as it had been formed in other tests where tap water had been used. Of course practically no bubbles were formed on any other part of this beaker and none were formed in the other beaker.

These simple tests do not give any information as to the composition of the bubbles. They may be made up of air which had been adsorbed by the vessel due to the presence of the organic material, or they may have been made up wholly of the organic material in a gaseous state. Several ccm. of this gas were caught above the water by means of a funnel. No analysis of the gas was made but it is evident that if the gas had been of organic composition, it would have gone back to its liquid or solid state upon cooling. As this did not occur, it is concluded that the bubbles were composed of air. The role played by the organic matter is not exactly clear. This matter may have been the agency of air adsorption, or its presence may have made the glass a good adsorber. The volume of gas given off indicated that the strong forces of adsorption came into play, but the precise manner of their action is not evident.

The tests show that no considerable amount of the air within the bubbles could have come from the water, but that it came from the surface of the vessel itself. It is also shown by the tests that the amount of gas forming in bubbles is determined by the state of cleanliness of the vessel containing the water.

It is hoped that quantitative results on these tests can be shown in a later paper.

13. Recent Developments in Oil Shale Technology. C. S Crouse, Dept. of Mines and Metallurgy, Univ. of Kentucky. (By title.)

14. A Reversed Compton Effect. T. M. Hahn, Physics Department, Univ. of Kentucky.

Using an improved form of X-ray spectrometer designed in this laboratory, photographic spectra of the fourth order of the Molybdenum $K\alpha_1$ and $K\alpha_2$ lines were obtained with a separation of 0.16 centimeter, where the width of the α, line on the photographic film was 0.01 centimeter. With this resolving power there was no evidence of fine structure in either α_1 or α_2 line, but there was a pronounced broadening of both the α_1 and α_2 lines, resembling very much the Compton effect for scattering at a very small angle, but with a shift of approximately 0.0003 Angstrom unit toward the *short wave-length side.* Similar results were obtained in second order spectra.

It is presumed that this indicates an actual absorption of energy by the X-ray beam from the high-speed cathode stream of electrons, due to collisions between X-ray quanta and electrons, with a resultant change in direction and increase in energy for the quanta, and a corresponding loss in energy by the electron, assuming that the ordinary relativistic laws of conservation of energy and momentum are valid in this case as in the Compton effect. The increase in energy here observed must necessarily be small, since only X-rays which had been deflected thru a small angle could enter the slit system. The energy of a quantum of Kα radiation, hc/λ, is 2.76×10^{-8} ergs, whereas the energy Ve of an electron which has fallen thru a potential of 30,000 volts is 4.77×10^{-8} ergs, nearly twice as much as that of the quantum.

If one postulates an equipartition of energy in an equilibrium between quanta and electrons, as in two gases of different temperature mixed together, it is seen at once that all wave-lengths, up to the minimum $\lambda = hc/Ve$ would result. Thus this also indicates that the general radiation from an X-ray target may be due to a reversed Compton effect.

15. Note on the High Phosphate Areas of the Middle Cincinnatian. S. D. Averitt, Ky. Agricultural Experiment Station.

Small areas of soil, geologically well up in the Cincinnatian, containing distinctly more phosphorus than is usual in that horizon, have been known for some years. Such soil was collected by the writer in 1916, on Bullskin Creek in Western and Northwestern Shelby County, Ky., always first or second bottom, and associated with Arnheim limestone.* Samples from Shelby and other counties analyze from 0.2 to 0.7 per cent of phosphorus. Two samples of Arnheim limestone analyzed for the Ky. Geological Survey yielded 0.39 and 0.36 per cent of phosphorus, and a selected sample, 0.81 per cent.

*Soil Survey of Shelby Co., Ky., Field Operations of the Bureau of Soils, 1916, pp. 59 and 63. Elg Silt Loam and Huntington Silt Loam.

The phosphatic character of this limestone is thought to account for the unusual phosphorus content of these soils. The Arnheim limestone occurs above the middle of the Cincinnatian series, at the top of Maysville.

16. Verification of Lord Kelvin's Theory of Radio-Frequency Resistance. R. B. Scott, Physics Dept., Univ. of Ky. (Abstract.)

The first practical solution of the problem of alternating current resistance was given by Lord Kelvin in 1889. His solution has since been used for the computation of tables which give the ratio of alternating current resistance to direct current resistance for wires of any diameter. Various experimenters have checked Kelvin's solution for certain frequencies but the author has seen no extended experimental study of this subject. In view of this fact the work was planned to cover a considerable range of frequencies and wire diameters. The source of power used was a simple vacuum tube oscillator and the measuring instrument was a vacuum tube voltmeter. For the most part the results checked with the theory, with an error of less than two per cent.

17. Purification of Helium. D. S. Hughes, Physics Dept. U. of Ky.

18. Series Spectra in Helium. Daniel Bailey, Physics Dept., U. of Ky.

An analysis was made of the spectrum of neutral helium produced by a condensed discharge in a quartz discharge tube, and analyzed by means of a concave grating spectrograph. The formula giving the position of any line in any series is as follows:

$$(M, K, k) \qquad \frac{R}{M \quad K \quad k \quad (M, K, k)}$$

where R is the Rydberg constant and M, K and k depend upon the series under consideration. All the lines in the spectra of Parhelium and Orthohelium in the principal, first subordinate and second subordinate series, which were in the range of sensitivity of the photographic plate used, were identified, with the exception of two lines in the second subordinate series of Parhelium.

19. The Value of the Acceleration of Gravity at Lexington. S. C. Gladden, Physics Dept., U. of Ky.

A history of pendulum determinations of the acceleration of gravity was compiled, access being obtained to many rare papers dealing with the work of Kater, Sabine, Foster, and other pioneers in this field.

An absolute determination of the acceleration of gravity at Lexington, Kentucky, was made, employing a chronograph and standard clock in conjunction with a Kater's pendulum of late model. A cathetometer was employed to measure the distance between the knife edges, and corrections were made for temperature effects, arc of swing, and flexure of the pendulum support. The acceleration of gravity was found to be 979.2 cm./sec.^{2}, with a probable error of 0.24 cm./sec^2.

20. A Comparative Study of Delinquents and Non-Delinquents. Clara Chassell Cooper, Eastern Ky. State Teachers College. (Abstract.*)

The method of the present study consists in a tabular presentation for paired delinquent and non-delinquent groups of certain prescribed information obtained from studies made by many investigators, and the subsequent statistical reduction of selected data by means of the calculation of coefficients of colligation. Ninety-five coefficients were calculated for the following groups: Feeble-minded, Adult Criminals, Juvenile Delinquents, Sex Offenders, and Alcoholics. The countries represented by these results are the United States, Porto Rico, the Philippine Islands, Canada, Great Britain, Ireland, Sweden,

*See **The Relation between Morality and Intellect: A Compendium of Evidence Contributed by Psychology, Criminology, and Sociology.** (Address Bureau of Publications, Teachers College, Columbia University, New York City.)

Germany, Austria-Hungary, Switzerland, Belgium, France, and Australia.

The principal findings of the study are concerned with the relation between delinquency and mental inferiority, as disclosed by the following types of evidence: Reports of the Prevalence of Delinquency, Estimates of the Prevalence of Mental Deficiency, Reports of Educational Status (The Prevalence of Illiteracy, the Amount of Schooling, School Progress, Educational Achievement), and Results of Intelligence Tests (Tests of Verbal Abstract Intelligence, Army Mental Tests, Tests of Non-Verbal Concrete Intelligence, Tests of Mechanical Intelligence).

The central tendencies of the coefficients for the several groups consistently disclose a relation between delinquency and mental inferiority in each of the types of evidence tabulated. The degree of relationship indicated, however, varies from group to group and from one type of evidence to another. The median of the ninety-five coefficients representing all groups and all types of evidence is .48.

The study is a part of a research of much wider scope on the relation between morality and intellect. The central tendencies of the correlational results for all parts of the research support the finding of a positive correlation between delinquency and mental inferiority, and at the same time reveal a positive correlation between moral character and intelligence: but suggest a somewhat lower degree of relationship between morality and intellect than that indicated by the central tendency of the correlational results for the comparative study of delinquents and non-delinquents.

21. The Results of a Consanguineous Marriage. R. G. Will, Centre College.

A young man, unwittingly, married his half sister. Both apparently, were of normal intelligence, as were their parents. Eleven of the descendants were feeble minded, four being in the third generation, one in the fourth and six, probably seven in the fifth, the economic situation in each generation is worse than in the one before.

22. **Some Phases of Measurement in the Field of Latin.*** R. Tyson Wyckoff.

The test movement may be said to have been born with the present century and to have originated in the simple spelling lists or embryonic tests evolved by Dr. J. M. Rice in 1894-5. His idea that a test on a part may indicate proficiency in the whole met with a storm of disapproval and he was unable to give a scientific base to his contentions. His arguments, however, were of such sort as to draw the attention of Dr. E. L. Thorndike and to result in studies on the theory of educational measurement and statistical method which culminated in Dr. Thorndike's *Mental and Social Measurements,* published in 1904, and in the various tests and scales prepared by his students for use in the elementary school.

The first noticeable effect of the test movement in the field of Latin or in the other high school subjects occurred when Dr. Gonzales Lodge counted the frequency of Latin words in Caesar's *De Bello Galico,* books I-V; the six commonly read orations of Cicero; and Vergil's *Aeneid,* books I.-VI. When he published his statistics in the *Vocabulary of High School Latin* in 1907, figures for the first time were made available whereby a teacher might determine which words were most common and therefore most deserving of emphasis in preparation for Caesar, Cicero, and Vergil. Lodge's methods of vocabulary analysis were imitated in Byrne's *Syntax of High School Latin,*— a study of the frequency of occurrence of the various types of syntax in Caesar, Cicero, and Vergil.

*The content of this paper was based upon a tabulated analysis of sixty four Latin tests, twenty-nine of which are partly standardized and thirty-five non-standardized tests composed by seven different authors. All the non-standardized tests were made in 1925 or later. It was necessary in making the tabulation to assume that an author's failure to mention any certain essential item of information constituted an admission that the particular test was lacking in just that respect. The tests were judged by the Otis **Scale For Rating Tests.**

In 1912 Dr. Paul H. Hanus of Harvard decided that, since the successful elaboration of elementary school tests had already been demonstrated by Thorndike in handwriting and Stone and Courtis in arithmetic, it should be possible to apply test principles to measurement in Latin. Accordingly, with the help of three graduate students, he prepared Latin tests on grammer, vocabulary, and translation, with the endeavor of measuring growth in power in Latin and the correlation existing between the three language skills assumed. Altho the tests were an advance over the subjective tests of the past, they could certainly not be classed as objective in any true sense of the word. The author succeeded in indicating that, so far as the tests showed, there seemed to be little correspondence between the types of abilities necessary for success in grammar, translation, or vocabulary. It is not required especially that we interpret this lack of correspondence as indicating failure of the three skills to function in Latin attainment. Dr. Hanus did not attempt to establish either the validity or the reliability of his tests, altho he did provide some tentative median norms of achievement by the various years.

Dr. H. A. Brown, now President of the State Normal School, Oshkosh, Wisconsin, in 1915-17, elaborated tests on isolated Latin sentences, connected Latin, Latin grammar, and isolated Latin vocabulary. These tests were administered to between 813 and 2,160 pupils and tentative median norms were obtained for each test by years. Neither reliability nor validity of the tests is stated in the published bulletins on the development of the tests. Dr. Brown attempted to score his connected Latin test objectively by dividing the passage into so-called thought units, which were made to serve as a scoring key. The words of his vocabulary test were chosen from a list found to be common to seven elementary Latin texts. He seemed to make little attempt at objectivity in scoring the sentence and grammar tests.

The Starch Latin Tests appeared in 1915 and again as the Starch-Watters Latin Test in 1918. This test consists of a section on vocabulary, which was obtained by taking every twentieth word in Lodge's list, and a section on translation of sentences which were found by selecting sentences located at equal intervals in five first-year texts and in Caesar, Cicero, and Vergil. Median norms were calculated on five hundred pupils by years of Latin studied. The scoring was highly subjective.

In general, the tests published between 1912 and 1920 dealt with translation, mostly of unconnected discourse or vocabulary, and with syntactical analysis. No test had equivalent forms. Brown's connected Latin Test seems to have been the only test with which a scoring key or suitable directions for scoring were provided. The objectivity of the scoring was questionable. In most cases the spaces for answers were so arranged on the page that error in scoring was likely. Tentative median norms were found for each test. There were no directions for interpretation or application of results. No sample exercises preceded the tests to show the pupil the character of the construction of the test. There was no attempt to limit a test to a particular grade or year of Latin. Very little endeavor was made to arrange the test content in order of difficulty. There was no manual with any test and no effort to obtain validity or reliability.

The Henmon Latin Tests had been published in 1917 and revised in 1921. In revised form Tests I., II., III., and IV. became somewhat comparable. The scoring of these tests was more objective than that of previous tests and the spaces for answers were arranged conveniently for scoring. For the first time a manual, directions for scoring, and a class record sheet were supplied, but there was no scoring key. In the period from 1920-24, among others were published the Pressey Latin Syntax Test, the Tyler-Pressey Latin Forms Test, and the Ullman-Kirby Latin Comprehension in two forms in 1922; Briggs' Semester Latin Test, Inglis' Latin Syntax, Vocabulary, and Morphology Tests in several forms, the Lohr-Latshaw Latin Forms Tests, the Godsey Latin Composition Test, the

Stevenson Latin Vocabulary Test, and the Stevenson-Coxe Latin Derivative Test in 1923; and the White Latin Test in 1924. These tests show considerable advance in objectivity simplicity of scoring, use of scoring key, preparation of equivalent forms, isolation of particular types or elements to allow for diagnosis of difficulties, lessening the amount of time required for reading the preparatory instructions of the tests and for making explanations. Several of the tests give limited suggestions in interpretation, such as methods of obtaining medians and percentiles, and in application of results, such as in class sectioning (White), comparison of individual's or class standing with absolute attainment (Inglis), tabulation of types of errors for diagnosis (Godsey, Pressey, Tyler-Pressey, New York Latin Achievement Tests). Whereas, from 1912-20 most of the tests either had not been published for distribution or were sold by the test or by the hundred tests, it came to be the custom to put them up in packages of twenty-five.

It may be rather interesting in passing to compare different methods of score derivation employed by two men in the same institution. Dr. Inglis felt that the words of his vocabulary test should be scored upon the basis of their frequency of occurrence. That is to say, the more often a word is met, the more important the word and the greater the amount the student should be penalized for not knowing the word. Then, the commoner the word, the higher the score to be assigned to it as its value. In line with about the same type of reasoning, Dr. Hanus also felt that his vocabulary test should be scored upon the frequency of occurrence of the words. Accordingly, a word which is met frequently is less difficult than another word met less frequently. The rarer the word is and therefore the more difficult, the greater the assigned score should be and the commoner the word is and therefore the less difficult, the lower the score must be. Apparently we have no great reason to consider those two vocabulary tests equivalent, except in inverse ratio, unless we assume that the fact the authors were both teachers in Harvard would be sufficient justification for concluding reliability.

During the period from 1920-24 Latin test development seemed to be directed toward refining and making more careful application of test principles. The Ullman-Kirby Latin Comprehension Test measures understanding of passage content much more skilfully than its predecessor, the Brown Connected Latin Test, which was striving awkwardly after the same aim. Moreover, the former test is somewhat more objective than the latter. The Ullman-Kirby, the Godsey, the Pressey, and the Tyler-Pressey seem to be of some value, altho no one of these may be considered as a highly dependable measure when used alone. It is desirable to employ a Latin achievement test in comparing class standing thru successive semesters or years, in the same classes or in different classes, schools, or systems; but when the individual is judged, one should have an average of several tests, of one or more tests and a habit-rating scale, teachers' marks, teachers' rankings, or some other means.

Since the publication of the *Classical Investigation Report* in the spring of 1924 the quality of Latin tests has been on the whole higher than in the two preceding periods. The Deferrari Test in Vocabulary and Forms, so far without norms, and the Deferrari Test in Latin Comprehension, with norms for the fifth and seventh semesters were published in 1925. The Orleans-Solomon Latin Prognosis Test (1926) and the Wyckoff Latin Prognosis Test (1927) both show marked reliability and validity and pre-high school norms. The New York Latin Achievement Tests for first and second semester pupils were published in 1928 with norms but with no stated validity or reliability. Each of the two New York tests is a composite of a number of sections which contain but few items per section. Several of the tests published since 1924 are inconvenient to use because they are too long to be given in the ordinary class period.

The most promising aspect of Latin test development has proceeded directly from the emphasis placed upon test construction by the Service Bureau For Classical Teachers.

Columbia University, New York. Under the influence of the Service Bureau excellent non-standardized tests have been made by Dr. Mason D. Gray, Miss Simpson, Miss Downes, and others. These tests for the most part cover phases which have been dealt with very little or not at all in previous tests. Some of these phases are the cultural, the historical, derivatives, general language ability, quotations, Latin in English spelling, Latin phrases, prefixes, rhetorical figures, word order. In the Service Bureau tests we find the following types of test organization: completion, recognition, classification, old-type translation, recall, true-false, matching, listing, analogies, opposites, ranking. Two criticisms to be made of the Service Bureau tests are that, while the tests are skilfully prepared in point of choice of material for inclusion, the number of items in any one test is probably too few. Also, in some instances three or four different types of test development are employed in the same test, so that gross item scores of the various parts are certainly not at all comparable. Both objections may be met, if a series of tests be given and the items of all the series be classified according to the different types of test development employed. Then, when all items of each type are added, there will be a sufficient number of items that the scores for each type may be thrown into a frequency distribution, an approximation of the normal curve applied, and consequently the errors pointed out in the two objections may be avoided.

The Holz tests and the Sellers tests of the Emporia, Kansas, State Teachers' College and the North Carolina High School Senior Examination (Section H on Latin) are among the most recently published non-standardized. The same objections may be raised to these as were made in respect to the Service Bureau test. In addition, the Holz tests and the Sellers tests, which are composite tests, do not seem to preserve proportion in the amount of space devoted to the several skills dealt with. The North Carolina Examination puts an undue amount of emphasis on isolated vocabulary, very little stress upon comprehension, even of isolated sentences and comprehension of connected discourse is completely ignored.

It would seem for effective test making that there is great need to determine what are the Latin aims (probably sufficiently handled in the *Classical Investigation Report*, Vol. III.), what skills are concerned with the aims, how much of each skill we shall want acquired, and what activities enter into the desirable skills. We may approach the matter by disintegration of aims to obtain activities or by building up activities to obtain aims. The latter method will presuppose that existing activities in Latin are worth-while activities and that they will lead to desirable aims. We have great need for Latin tests which will really begin to reach the Latin objectives rather than merely the kind of tests we have now which deal with small skills that enter into the Latin objectives we do not know how much or how little.

BIBLIOGRAPHY OF PUBLISHED TESTS

Anderson, F. M.: **A True-False Test For Comprehension of Archias.** Service Bureau For Classical Teachers, Columbia University, No. 198.

Briggs, T. H.: An Examination in First Term Latin. **Classical Weekly,** March 19, 1923, v. XVI., No. 19, Whole No. 442.

*Brown, H. A.: Connected Latin Test, Latin Sentence Tests, Latin Grammar Test, and Latin Vocabulary Test. Are contained in Brown, H. A.: **Latin In Secondary Schools** (1919) and **A Survey of Instruction In Latin In New Hampshire Secondary Schools** (1921). State Normal School, Oshkosh, Wisconsin.

***Deferrari-Foran Latin Comprehension Test.** 1925. The Catholic Education Press, 1326 Quincy St., Washington, D. C.

Deferrari-Foran Tests in Vocabulary and Forms. 1925. The Catholic Education Press, 1326 Quincy St., Brookland Sta., Washington, D. C.

Downes, Juanita: **Latin Tests For the Eighth Grade.** March, 1928. Service Bureau For Classical Teachers, Columbia University, No. 302.

Downes, Juanita: **Latin Tests For the Ninth Grade.** March, 1928. Service Bureau For Classical Teachers, Columbia University, No. 303.

*Godsey, Edith R.: **Diagnostic Latin Composition Test.** 1922. World Book Company, Yonkers-on-Hudson, New York.

---

*Has norms.

Gray, Dr. Mason D.: **A Written Lesson to Test the Pupil's Understanding of the Background of the Orations Against Catiline.** March, 1928 Service Bureau For Classical Teachers, Columbia University, No. 305.

*Hanus, Paul H.: Latin Tests (Vocabulary, Translation, and Grammar). 1912. Found in Hanus: **School Administration and School Reports** (1920). Houghton, Mifflin Company, Chicago, Illinois.

*Henmon, V. A. C.: **Latin Tests.** 1917 and 1921. World Book Company, Yonkers-on-Hudson, New York.

Inglis, Alexander: **Latin Morphology, Latin Syntax, Latin Vocabulary. 1923. Ginn and Company, 70 Fifth Avenue, New York.

***Lohr-Latshaw Latin Form Test.** School of Education, University of North Carolina, Chapel Hill, North Carolina, 1923.

***New York Latin Achievement Test.** 1928. World Book Company, Yonkers-on-Hudson, New York.

North Carolina High School Senior Examination, Section H. 1927. School of Education, University of North Carolina, Chapel Hill, North Carolina.

***Orleans-Solomon Latin Prognosis Test Form A.** 1926. World Book Company, Yonkers-on-Hudson, New York.

*Pressey, L. W.: **Test In Latin Syntax.** 1922. Public School Publishing Company, Bloomington, Illinois.

Simpson, Elizabeth: **Test on Word Order in Latin.** March, 1928. Service Bureau For Classical Teachers, Columbia University. New York. No. 307.

Simpson, Elizabeth: **A written Lesson For a Review of Rhetorical Figures in Vergil.** March, 1928. No. 306. Service Bureau For Classical Teachers, Columbia University, New York.

***Starch-Watters Latin Test.** 1918. Published by Dr. Daniel Starch, 1374 Massachusetts Avenue, Cambridge, Mass.

***Stevenson Latin Vocabulary Test.** 1923. Public School Publishing Company, Bloomington, Illinois.

***Stevenson-Coxe Latin Derivative Test.** 1923. Public School Publishing Company, Bloomington, Illinois.

***Tyler-Pressey Test in Latin Verb Forms.** 1922. Public School Publishing Company, Bloomington, Illinois.

***Ullman-Kirby Latin Comprehension Test.** 1922. Extension Division, University of Iowa, Iowa City, Iowa.

***White Latin Test.** 1924. World Book Company, Yonkers-on-Hudson, New York.

*Has norms.

**Some of the forms have norms.

23. **The Psychological Processes In Learning History In The Secondary School.** M. E. Ligon, Education Dept., Univ. of Kentucky.

The definitions, conceptions and forms of history are not fixed and therefore the psychology involved in the study of history will be determined by the point of view adopted. Opinions differ as to what the aims of history teaching shall be. This further complicates the psychology of its teaching and study. The author has taken the generally accepted view in the methods and processes and the common methods of teaching. He points out that imagination, memory, judgment, reasoning, and sympathy are involved.

24. **Some Cases of College Vocational Guidance.** G. C. Bassett, Psychology Dept., Univ. of Kentucky

Two cases were reported informally. The paper will be published elsewhere.

25. **Certain Factors Contributing to the Delinquency of Reform School Girls.** Mrs. Juanita Curry Boynton.

The study was made of all girls confined in the Kentucky Houses of Reform at Lexington, within the ages of 12 to 16 years, inclusive. It was not intended to include all factors. Seventy-one per cent of the girls had lived in houses where abnormal parental conditions existed. The median number of children in the families was 8.25. Forty-eight per cent of the girls and twenty-eight per cent of their mothers had held positions outside the home, mostly of a servant nature. The average school grade was the sixth. More than 75 per cent of the girls had one or both of the social diseases.

The conclusion seems justified that these girls reached their delinquent careers thru a more or less natural process when low mentality was forced to react to poor environment.

26. **Kentucky Fluorites.** W. R. Jillson, State Geologist, Frankfort, Kentucky.

Within the last few years the mineral fluorite (CaF_2), commonly referred to as fluorspar, has become of much economic significance in Kentucky. Occurring in commercial quantities in two general localities, the North-Central Ordovician outcrop and the western tip of the Mississippian pleateau its production has steadily increased until at the present time Kentucky stands first in the United States and the world. In 1926 Kentucky produced 62,459 tons of commercial fluorite valued at $1,167,129.00.

Altho the volume indicated is considerable it is certain that much more fluorite could have been produced in Kentucky had it not been for the rather considerable foreign importations. In fact, during recent years, post war industrial and shipping conditions abroad have so materially aided the importation of foreign fluorite as to elevate it to the point of a rather serious menace to the domestic fluorite mining industry. This is particularly true in Kentucky.

With this fact in mind the Director of the Kentucky Geological Survey while in Spain during May and June, 1926 attending the meetings of the 14th International Geological Congress, entered into relations of mineral exchange with many of the National Geological Surveys for the purpose of securing representative specimens of cabinet size from all commercial and smaller deposits of fluorite. At the same time and later, one or two important fluorite collections were purchased to which many recently obtained specimens from points widely distributed thruout the world have been added.

As a result of these endeavors it is thought that the fluorite collections of the Kentucky Geological Survey are probably of the first order in point of geographic representation and variability of mineral occurrence. All known commercially producing and scientific localities are represented by one or more specimens, duplicates, triplicates and quadruplets of some areas being a part of the collection's reserve. In this unique and beautiful cabinet displayed in the office of the suite of the Survey at Frankfort, the Kentucky fluorite is well represented by over 125 specimens. The entire fluorite cabinet contains over two hundred separate trays. Thirty-five other states and foreign countries are represented, the complete list being as follows: Albuquerque (New Mexico), Arizona, Baden, Bavaria, Bohemia, Butte (Montana), California, Cayote Springs (New Mexico), China, Colorada, Connecticut, Cornwall (England), Crystal Peak (Colorado), Derbyshire (England), Durham (England), France, Freiburg (Germany), Germany, Greenland, Hastings County (Ontario), Pennsylvania, Rhodesia, Rochester (New York), Salzburg (Germany), Saxony, Siberia, South Africa, Sydney, St. Gothard (Switzerland), St. Lawrence County (New York), Spain, Switzerland, Tennessee, Valoes (Switzerland), Weisseck (Germany) and Windhoek (South Africa).

27. **Racial Specialization of Parasitic Fungi.** E. C. Stakman, Univ. of Minnesota and U. S. Dept. of Agriculture.

Many species of fungi which cause plant disease comprise distinct physiologic races or parasitic strains, usually known as physiologic forms. The phenomenon of physiologic specialization has been known for many years, first having been demonstrated clearly by Eriksson, a Swedish investigator, in 1894. However, the extent of the phenomenon and its far-reaching consequences in mycology and plant pathology have not been appreciated until recently, and probably are only imperfectly appreciated now.

Physiologic specialization is common in many groups of very destructive plant pathogenes: the rusts, the smuts, the powdery mildews, the fungi which cause root rots of cereals, the organism causing flax wilt, and a great many others. In order really to understand the course of development of a plant disease, and especially the development of epidemics, it is essential to know the number, geographical distribution, pathogenic capabilities, and ecological peculiarities of the different physiologic forms of the causal organism. An investigation of physiologic specialization must become regular procedure in the investigation of plant diseases.

Physiologic forms can be recognized in several different ways: (1) By their effect on host plants; (2) sometimes by slight morphologic differences between the different forms, altho these differences are not sufficiently great to justify calling the forms species or varieties; (3) by differences in cultural characters; (4) by their reaction to physico-chemical environment, such as temperature and hydrogen-ion concentration.

Certain obligate parasites, like the rust fungi and the powdery mildews, can be recognized best by their effect on certain selected varieties of crop plants. The morphologic species *Puccinia graminis,* the fungus causing the black stem rust of cereals and grasses, is a good example. *P. graminis tritici* causes infection on wheat and barley, but not on oats and rye. *Puccinia graminis secalis* causes infection on rye and barley, but not on wheat and oats, while *P. graminis avenae* causes infection on oats, but not on wheat, barley, and rye. But *P. graminis tritici* in itself comprises more than 40 parasitic strains which can be recognized by their effect on certain varieties of wheat; *P. graminis secalis* consists of at least a dozen forms which can be recognized by their action on certain varieties of rye, and *P. graminis avenae* consists of parasitic strains which can be recognized by their effect on certain varieties of oats.

Physiologic forms of facultative saprophytes often can be distinguished by their appearance in artificial culture. The cultural characteristics of a given form are remarkably constant on the same medium and under the same conditions. But on different media the same form may behave entirely differently. Furthermore, different forms may look almost exactly alike on certain media, but may be entirely different in appearance on certain other media. This means, of course, that in order to differentiate forms it is necessary to grow them under proper conditions.

Forms may differ also in their physico-chemical reactions. Some of them may have a low optimum temperature, while that of others may be very much higher. Obviously, this has an important application in controlling diseases by regulating the time of planting of certain crops. Many of the forms differ also in their reaction to hydrogen-ion concentration and in their fermentative abilities.

The question naturally arises as to how these physiologic forms originated, whether they still are originating, and whether they are stable. Several theories have been advanced regarding the origin of forms: (1) Ecological adaptation; (2) hybridization; (3) mutation.

Many of the earlier investigators, and even some at the present time, asserted that forms might arise as a result of association with certain host plants, a sort of ecological adaptation. These investigators were of the opinion that physiologic forms were very unstable and that their parasitic capabilities could be changed at will by keeping them on certain host plants. This idea probably is erroneous. Physiologic forms of many fungi are just as stable as morphologic species. This has been demonstrated clearly in experiments made at Minnesota. Furthermore, we have collected the same physiologic form of *P. graminis tritici* in India, Hungary, France, the British Isles, and on the North American continent. Another form was collected in Japan, France, Norway, the British Isles, United States, and Canada. The parasitic behavior of each of the forms was the same regardless of the place in which it was collected.

There is a strong probability that forms may originate thru hybridization of previously existing forms, but this has not been demonstrated for plant pathogenic fungi.

Many fungi apparently mutate abundantly. The so-called mutants probably are similar to bud mutations in higher plants. They often appear as pie-shaped sectors in colonies growing on artificial media. The frequency of mutation can be influenced by environmental conditions, such as amount and kind of nutrients and temperature. The mutants may also be different pathogenically: some of them are less virulent than their parents, some of them more so, and some of them about equally virulent.

Physiologic specialization is important in plant quarantines. In epidemiology studies, forms may be important as biological reagents, and in attempts to breed disease-resistant crop plants.

It is essential to attempt to prevent the introduction into any country of parasitic strains more virulent than those now there. It is known that the parasitic strains of certain pathogenes in foreign countries are much more virulent than any which now occur in the United States. Obviously, therefore, they should be excluded by quarantines. And certain other countries have good reason to exclude some of our parasitic strains.

It has been shown conclusively that certain varieties of crop plants are resistant in some regions and susceptible in others because of the existence of different physiologic forms in different regions. Futhermore, the distribution of physiologic forms can be used as a criterion of the source of inoculum in certain areas.

Physiologic forms have been used to identify certain varieties of crop plants. In order to make sure of the varietal identity of some wheats, it often is necessary to inoculate them with the proper physiologic form of rust.

It is obvious that it is essential to take into consideration physiologic forms in the production of disease-resistant varieties of crop plants, because varieties and hybrids may be immune from or resistant to certain forms of a pathogene and completely susceptible to others. Therefore, the parasitic capabilities of all physiologic forms of the pathogene must be known and attempts must be made to combine in one variety resistance to all of them.

INDEX