TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

AFFILIATED WITH THE A. A. A. S.

VOLUME FOUR
(1929 - 1930)

Sixteenth and Seventeenth Meetings

LEXINGTON, KY.
1930

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This Volume was Edited by
A. M. PETER and ETHEL V. T. CASWALL

LEXINGTON, KY.
1930

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Kentucky Academy of Science

OFFICERS

1928—1929

President, G. Davis Buckner, Experiment Station, Lexington.
Vice-President, G. D. Smith, Eastern State Normal School, Richmond.
Secretary, Alfred M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., A. R. Middleton, Univ. of Louisville, Louisville.

1929-1930

President, Frank L. Rainey, Centre College, Danville.
Vice-President, C. N. McAllister, Berea College, Berea.
Secretary, Alfred M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A. A. A. S., V. F. Payne, Transylvania College, Lexington.

In Memoriam

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

Clarence Wentworth Mathews,	1861—1928
Arthur McQuiston Miller	1861—1929

COMPLETE MEMBERSHIP OF THE KENTUCKY ACADEMY OF SCIENCE FOR THE YEARS 1928-9 and 1929-30.

"C" indicates Corresponding Member.
"H" " Honorary member.
"L" " Life member.
* " No longer a member.
† " Deceased.

The date denotes the year of election to membership.

	Name and address	Branch of Science
	Allen, W. R., '23, Univ. of Ky., Lexington	Zoology
	Ambrose, Luther M., '29, Berea College, Berea	Physical Sci.
*	Anderson, W. M., '14, Univ. of Louisville, Louisville	Physics
	Anderson, W. S., '15, Univ. of Ky., Lexington	Genetics
	Averitt, S. D., '14, Experiment Station, Lexington	Chemistry
	Baker, Alson, '26, Berea	Anthropology
C.	Bancroft, Geo. R., '19, Univ. of West. Va., Morgantown, W. Va.	Chemistry
	Bandeen, Stanley, '30, 1435 S. 4th Ave., Louisville	Medicine
	Bangson, John S., '26, Berea College, Berea	Biology
*	Barbour, Henry G., '25, Univ. of Louisville, Louisville	Physiology
	Bassett, G. C., '27, University of Ky., Lexington	Psychology
*	Bear, Robt. M., '27, Centre College, Danville	Education
	Beckner, Lucien, '20, 311 W. Chestnut St., Louisville	Geology
	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, 109 Watson Court, Frankfort	Engineering
	Boyd, P. P., '14, Univ. of Ky., Lexington	Mathematics
	Boyden, Ruth, '30, Univ. of Ky., Lexington	Home Ecs.
	Brauer, Alfred, '26, Univ. of Ky., Lexington	Zoology
	Brown, L. A., '15, Experiment Station, Lexington	Chemistry
	Browning, Iley B., '22, Box 126, 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, Lexington	Vet. Sci.
	Bullitt, Wm. Marshall, '28, Inter-Southern Bldg., Louisville	———
	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
	Canon, Ernest H., '29, Registrar, W. State Normal School, Bowling Green	Education
	Capps, Julian H., '28, Berea College, Berea	Chemistry
	Carmichael, H. St.G. T., '24, Ky. Asphalt Co., Kyrock	———
	Caslick, Edward A., '26, Claiborne Stud, Paris	Vet. Science

Chalkley, Lyman, '22, Univ. of Ky., Lexington ....Law
C. Clark, Friend E., '15, Univ. of W. Va., Morgantown, W. Va........Chemistry
Clement, B. E., '28, Holly Fluorspar Co., Marion ....———
Cook, E. Wilbur. '28, Centre College, Danville ....Biology
Cooper, Mrs. Clara C., '26, Wallace Court, Richmond ....Psychology
Cooper, Thomas P., '18, Director Experiment Sta., Lexington....Agriculture
Corley, Grover L., '28, Univ. of Louisville, Louisville ....Chemistry
H. Coulter, Stanley, '14, LaFayette, Ind. ....Botany
C. Cox, Benjamin B., '22 ....Geology
Crooks, C. G., '15, Centre College, Danville ....Mathematics
Crouse, C. S., '21, Univ. of Ky., Lexington ....Mining Eng.
C. Currier, L. W., '22, Syracuse, N. Y. ....Geology
Curry, Gordon L., '28, Louisville College of Pharmacy........Chemistry
Davies, P. A., '26, Univ. of Louisville, Louisville ....Biology
H. Day, Arthur L., '17, Director Geophysical Lab., Washington, D. C...Geology
H. Detlefsen, J. A., '18, The Wistar Inst. of Anatomy, Philadelphia, Pa. ....Genetics
Didlake, Miss Mary, '14, Experiment Sta., Lexington ....Ent. & Bot.
Dimock, W. W., '20, Experiment Station, Lexington........Vet. Sci.
Donovan, H. L., '29, Pres. E. State Normal, Richmond........Education
Edwards, Philip R., '26, Experiment Station, Lexington ....Vet. Sci.
Erikson, Miss Statie, '26, Univ. of Ky., Lexington ....Home Ecs.
Ewell, Miss Esther, '29, Berea College, Berea ....Science
Fehn, Arthur R., '24, Centre College, Danville ....Mathematics
Fenn, Herbert B., '29, Berea College, Berea ....Mechanics
Fergus, E. N., '21, Experiment Station, Lexington ....Agronomy
Flexner, Morris, '26, Heyburn Bldg., 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, Louis, '26, The Heyburn Bldg., Louisville ....Medicine
Funkhouser, W. D., '19, Univ. of Ky., Lexington ....Zoology
C. Gardner, J. B., '15, Exchange Nat. Bank Bldg., Tulsa, Okla........Geology
Garman, H., '14, Experiment Station, Lexington ....Biology
* Giovannoli, Leonard, '26, N. C. State College, Raleigh, N. C. ....Zoology
H. Glenn, L. C., '22, Vanderbilt Univ., Nashville, Tenn. ....Geology
Good, E. S., Experiment Station, Lexington ....Animal Husb.
Graham, Charles C., '25, Berea College, Berea ....Science
Graham, James L., '27, Univ. of Ky., Lexington ....Psychology
Guilliams, John Milton, '25, Berea College, Berea ....Psychology
L. Guthrie, William A., '26, So. Ky. Sanatorium, Franklin ....Med. Sci.
* 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, Oakland, Calif. .... Farm Mcs.
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 .... Physical Sci.
Hoffman, E. M., '29, Berea College, Berea .... Gen. Sci.
Homberger, A. W., '19, Univ. of Louisville, Louisville .... Chemistry
* Hopkins, Miss Mariel, '26, Cleveland, Ohio .... Home Ecs.
* Hudnall, James S., '21, Coleman, Texas .... Geology
Hull, F. E., '26, Experiment Station, Lexington .... Vet. Sci.
Hutchins, Wm. J., '25, President, Berea College, Berea .... ———
Insko, W. M., Jr., '30, Univ. of Ky., Lexington .... Nutrition
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
Kennamer, L. G., '29, E. State Normal, Richmond .... Geology
Kent, R. A. '30, President, Univ. of Louisville, Louisville .... Education
C. Kercher, Otis, '19, Pike Co. Farm Bureau, Pittsfield, Ill. .... Extension
King, Miss Effie, '25, Morehead State Normal, Morehead .... ———
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
Koppius, O. T., '25, Univ. of Ky., Lexington .... Physics
* Kornhauser, S. I., '23, Univ. of Louisville, Louisville .... Anatomy
Lancaster, L. Y., '29, Western State Normal, Bowling Green .... Biol. Sci.
* Lane, R. C., '26, Coleman, Texas .... Geology
Lee, F. S., '23, Middlesboro .... Geology
C. Leigh, Townes R., '19, Univ. of Fla., Gainesville, Fla. .... Chemistry
* Lester, Wm. J., '26, Russellville, Ark. .... Chemistry
* LeStourgeon, Miss Elizabeth, '24, Univ. of Ky., Lexington .... Mathematics
Ligon, M. E., '28, Univ. of Ky., Lexington .... Education
Lovell, Harvey B., '30, Univ. of Louisville, Louisville .... Biology
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 Ky., Lexington .... Geology
McHargue, J. S., '14, Experiment Station, Lexington .... Chemistry
* MacIntyre, Miss Thelma, '26, Springfield .... Zoology
* McNamara, Miss Catherine B., '25, Geol. Survey Office, Frankfort .... Geology
McVey, Frank L., '18, President, Univ. of Ky., Lexington .... Economics
Marshall, Malcolm Y., '27, Henderson, Ky. .... Medicine
Martin, James H., '15, Experiment Station, Lexington .... Chemistry

Martin, J. Holmes, '29, Experiment Station, Lexington ....Poultry
† Mathews, C. W., '16, Univ. of Ky., Lexington ....Horticulture
Mayfield, Samuel M., '23, Berea College, Berea ....Natural Sci.
Meader, A. L., '23, Experiment Station, Lexington ....Chemistry
* Meier, Henry, '15, 1306 N. Van Ness Ave., Fresno, Calif.....Math. & Astron.
Middleton, Austin R., '22, Univ. of Louisville, Louisville ....Biology
† Miller, A. M., '14, 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 Ky., Lexington, or Cecilia, Ky.........Geology
Miller, Richard C., '28, Experiment Station, Lexington ....Animal Husb.
Miller, W. Byron, '22, Wallins Creek, Utilities Coal Corp.........Engineering
H. Millikan, R. A., '20, Calif. Inst. of Tech., Pasadena, Calif. ....Physics
Miner, J. B., '22, Univ. of Ky., Lexington ....Psychology
C. Morgan, Thomas H., '15, Calif. Inst. of Tech., Pasadena, Calif.........Biology
H. Moulton, F. R., '16, Univ. of Chicago, Chicago, Ill. ....Astronomy
* Munroe, Donald James, '28, c|o Sun Oil Co., Jackson, Miss. ....Geology
Nash, Wm. G., '28, Georgetown College, Georgetown........................Physics
Nicholls, W. D., '14, Univ. of Ky., Lexington ....Farm Ecs.
* Nickell, Clarence, '25, Morehead Normal School, Morehead..........Chemistry
Noll, Waldemar, '28, Berea College, Berea ....Physics
C. Nollau, E. H., '15, 14 Norton St., Newburg, N. Y. ....Chemistry
Norton, Mrs. Charles F., '27, Transylvania College, Lexington....Library Sci.
O'Bannon, Lester S., '23, Univ. of Ky., Lexington........................Engineering
Olney, Albert J., '20, Univ. of Ky., Lexington ....Horticulture
Parker, George H., '26, Ky. Actuarial Bureau, Louisville ......Engineering
Payne, Anna L., '30, Berea College, Berea ....Home Ecs.
Payne, Martha, '30, 156 McDowell Road, Lexington ....Science
Payne, V. F., '24, Transylvania College, Lexington ....Chemistry
Pearson, Dr. Norma, '30, Eastern State Normal, Richmond ....Botany
Pelluet, Dixie, '28, Murray Teachers College, Murray ....Biology
Pennebaker, G. B., '29, Murray Teachers College, Murray............Biology
Peter, Alfred M., '14, Experiment Station, Lexington ....Chemistry
Pierce, J. Stanton, '26, Georgetown College, Georgetown ....Chemistry
* Posey, M. E. S., '25, Dept. Roads & Highways, Frankfort..........Engineering
Price, Walter A., '30, Experiment Station, Lexington ....Ent. & Bot.
Pryor, J. W., '14, Univ. of Ky., Lexington ....Physiology
Pugsley, Donald W., '29, Berea College, Berea ....Mathematics
Pyles, Henry M., '26, Wesleyan College, Winchester ....Biology
Rainey, Frank L., '14, Centre College, Danville ....Biol. & Geol.
Rhoads, McHenry, '21, Lexington ....Education
Rhoads. Wayland, '22, Experiment Sta., 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, Geo., '14, Experiment Station, Lexington ....Agronomy
C. Roe, Mabel, '19, 257 Roswell Ave., Long Beach, Calif. ....Plant Path.
Routt, Grover C., '14, County Ag'l Agent, Mayfield ....Biology
Rumold, Dean W., '30, Eastern State Normal, Richmond ....Biology
Rush, R. I., '28, Centre College, Danville ....Chemistry
C. Ryland, Garnett, '14, Richmond College, Richmond, Va. ....Chemistry
* Saunders, J. M., '25, 339 Park Ave., Lexington ....———
Schnieb, Miss Anna A., '26, E. Ky. State Normal, Richmond......Psychology
* Scott, Miss Hattie, '25, Geological Survey Office, Frankfort ....Geology
* Shelton, Wm. A., '25, Vine Grove ....Education
Shepard, Nat L., '28, c|o Franklin Fluorspar Co., Marion ....Chemistry
Shoemaker, Hurst H., '29, Berea College, Berea ....Gen. Sci.
Smith, George D., '20, E. Ky. State Normal, Richmond ....Nat. Sci.
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 ....Sanitation
* South, Lillian H., '20, State Board of Health, Louisville ....Bacteriology
C. Spahr, H. H., '14 ....Physics
Speed, Wm. S., '28, 315 Guthrie St., Louisville ....Engineering
States, M. N., '17, Univ. of Kentucky, Lexington ....Physics
C. Stiles, Charles F., '14, A. & M. College, Stillwater, Okla. ....Entomology
Strandskov, Herluf, '25, Univ. of Louisville, Louisville ....Plant Phy.
Suter, Arthur Lee, '20, 2434 18th St., Washington, D. C. ......Pharmacology
C. Tashof, Ivan P., '14, Victor Bldg., Washington, D. C............Mining & Met'y
* Taylor, L. W., '28, Univ. of Calif., Berkeley, Calif. ....Poultry
Taylor, Chas L., '29, Western State Normal, Bowling Green ......Agriculture
Taylor, William S., '26, Univ. of Ky., Lexington ....Education
Terrell, Glanville, '27, Louisa, Virginia ....Philosophy
Threlkeld, Miss Hilda, '27, Hamilton College, Lexington ....Education
Thruston, R. C. Ballard, '15, 118 W. Breckinridge St., Louisville......Geology
* Todd, E. N., '25, Dept. Roads, Frankfort ....Engineering
Valleau, W. D., '20, Experiment Station, Lexington ....Plant Path.
* 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. & Bot.
Walker, Wm. H., '26, Berea College, Berea ....Psychology
H. Ward, Henry B., '21, Univ. of Illinois, Urbana, Ill. ....Zoology
Weidler, Albert C., '27, Berea College, Berea ....———
Will, R. G., '28, Centre College, Danville ....———
Williams, Charles W., '23, c|o Reed Air Filter Co., Louisville ......Chemistry
Wilson, Gordon, '27, 403 E. Third St., Bloomington, Ind............———
Wilson, Samuel M., '26, 812 Trust Co. Bldg., Lexington ....Law
Womack, E. M., '30, 2021 Grasmere Drive, Louisville ....———
Wurtz, Geo. B., '28, U. S. Weather Bureau, Lexington............Meteorology
Wyckoff, R. Tyson, '26, 1327 College St., Bowling Green............Education

MINUTES OF THE SIXTEENTH ANNUAL MEETING

The sixteenth annual meeting of the Kentucky Academy of Science was called to order by President Buckner at 9 o'clock Saturday morning, April 27, 1929, in room 441, Science Hall, Berea College.

Rev. Earl Zeigler, of Berea, opened the meeting with prayer.

President Buckner reported for the publications committee that Volume 3 of the Transactions, covering the 1927 and 1928 meetings, was ready for publication. He explained that the Academy is in a position to pay for the printing of 300-word digests of papers but that papers to be printed in full and reprints must be paid for by the authors.

Professor Capps, for the membership committee, proposed the following persons for election to membership in the Academy:

Mr. Martin Luther Ambrose, Instructor in Science in the Academy, Berea.

Miss Esther Ewell, Instructor in Science in the Normal School, Berea.

Mr. Herbert Bennett Fenn, Instructor in Electrical and Auto Mechanics, Foundation Junior High School, Berea.

Mr. Edwin Michael Hoffman, Instructor in Bible Science, Foundation Junior High School, Berea. (General Science)

Mr. Donald Wesley Pugsley, Associate Professor of Mathematics, Foundation Junior High School, Berea.

Mr. Hurst Hugh Shoemaker, Instructor in General Science, Foundation Junior High School, Berea.

Dr. Homer Cooper, Dean, Eastern Kentucky State Teachers College, Richmond.

Dr. H. L. Donovan, President, Eastern Kentucky State Teachers College, Richmond.

Dr. J. D. Farris, Professor of Education, Eastern Kentucky State Teachers College, Richmond.

Dr. D. L. Kennamer, Professor of Education, Eastern Kentucky State Teachers College, Richmond.

Mr. Haywood Brown, Instructor in General Agriculture and Biology, Western Kentucky State Normal School, Bowling Green.

Mr. E. H. Cannon, Registrar, Western Kentucky State Normal School, Bowling Green.

Mr. L. Y. Lancaster, Instructor in Biology, Western Kentucky State Normal School, Bowling Green.

Mr. Charles L. Taylor, Instructor in Plant Husbandry, Western Kentucky State Normal School, Bowling Green.

Mr. Charles P. Poole, Dept. of Psychology, Murray State Teachers' College, Murray, Ky.

Upon motion, the report was adopted and these persons were unanimously elected to membership.

The Secretary read his report which was received and ordered incorporated in the minutes.

Mr. A. J. Olney, as a special committee on resolutions, reported the following resolutions on the death of Professor Mathews, which were adopted and ordered spread upon the minutes.

Clarence Wentworth Mathews

Clarence Wentworth Mathews, a member of the Kentucky Academy of Science since 1916, was born in Lawrence, Massachusetts, in 1861. He graduated from Cornell University in 1891, coming to the University of Kentucky in the same year, as Head of the Department of Botany, Horticulture and Agriculture. In 1908 he became Dean of the College of Agriculture and Head of the Department of Botany and Horticulture, in which capacity he served until 1911. The increasing enrollment in Botany and Horticulture caused him to resign the deanship in order to give his whole time to his department. When the department was reorganized in 1913, he became Head of the Department of Horticulture in the College and Experiment Station, and in 1918, Extension work was included in his department. This position he held until he was relieved of teaching in 1928, at his own request, because of ill health. He died as his residence in Lexington, August 26th, 1928.

Professor Mathews was known and loved by the fruit growers and horticulturists of Kentucky and of the United

States. His generous personality and kind disposition endeared him to his associates, and his loss is deplored by his fellow members of the Academy.

Therefore, be it resolved, that this minute be made a part of the record of this meeting as a token of our respect and esteem.

(Signed) A. J. Olney, Committee.

President Buckner appointed the following committees:

To nominate officers: Messrs. Beckner, Capps and Averitt.

To audit the Treasurer's accounts: Messrs. Valleau, Johnson and Fergus.

The general session then adjourned until 1:45 P. M. to allow the divisions to meet separately for reading papers.

After luncheon at the Boone Tavern, the general session re-convened, pursuant to adjournment, at 1:45 P. M.

Treasurer Anderson reported as follows:

Balance May 5, 1928	$263.51	
Receipts May 5, 1928 to April 16, 1929	409.88	
Total	$673.39	
Disbursements from May 5, 1928 to April 27, 1929	$494.75	
Balance on hand	$178.64	
Indebtedness—Printing Vol. II, 1927	$517.25	$517.25
Paid during year		358.50
Balance		$158.75

The report was received and referred to the auditing committee who later reported it correct.

The nominating committee reported as follows:

For President, F. L. Rainey
For Vice-President, C. N. McAllister.
For Secretary, A. M. Peter.
For Treasurer, W. S. Anderson.
For A. A. A. S. Councilor, V. F. Payne.
On Publications committee: W. R. Jillson.

The report was adopted and these persons were elected unanimously.

The questions of declaring a policy with respect to revision of the calendar and the removal of import duty on scientific apparatus and supplies for educational institutions were passed with the suggestion that the new president appoint special committees to consider these matters and report to the council.

Professor Cooper extended to the Academy an invitation to hold its next meeting at the Eastern Kentucky State Teachers' College, at Richmond. Referred to the council.

President Hutchins, of Berea College, then delivered a very able and eloquent address on Science and Religion.

Prof. E. S. Good gave an account of the investigations on infectious abortion in mares which have been made under his direction at the Experiment Station.

The Academy adjourned *sine die*.

MINUTES OF THE COUNCIL

The Council met in Dr. Peter's office, Scovell Hall, on Friday, June 21, 1929. Present, Messrs. Rainey, Buckner, Anderson and Peter. Absent, Dr. McAllister.

It was the sense of all present that a committee on legislation be appointed for the purpose of getting a law enacted by which the Academy will be made a state institution with a suitable provision for publishing its Transactions. President Rainey appointed Sam'l M. Wilson, Chairman, Lucien Beckner and A. M. Peter.

After a discussion of finances, the sense of those present was unanimous that complete papers cannot be published in Volume 3 unless paid for by the authors. Only short summaries will be published of papers not paid for by authors. The Secretary was directed to so inform the authors. Separates will be supplied at cost.

The meeting adjourned without date.

REPORT OF THE SECRETARY FOR 1928-9

The President appointed the following Membership Committee: A. J. Olney, Chairman; M. E. Ligon and Julian H. Capps.

The following 8 persons who were elected at the last meeting have qualified and been added to the roll:

Dixie Pelluet, Teachers' College, Murray, Ky.
George B. Wurtz, Weather Bureau, Lexington.
R. I. Rush, Centre College, Danville.
R. G. Will, Centre College, Danville.
Richard C. Miller, Experiment Station, Lexington.
Grover L. Corley, Univ. of Louisville.
Julian H. Capps, Berea College, Berea.
Waldemar Noll, Berea College, Berea.

The following 4 members of the A. A. A. S. were elected to membership by the Council:

William S. Speed, Louisville.
Gordon L. Curry, Louisville College of Pharmacy.
B. E. Clement, Holly Fluorspar Co., Marion.
William G. Nash, Georgetown College, Georgetown.

We have lost one member by death, namely Prof. Clarence W. Mathews.

Fourteen have been dropped for various reasons, viz:

William J. Lester, Edgar Van Slyke, H. C. Anderson, C. E. Bales, J. C. Branham, Meredith Cox, George A. Irvine, M. L. Pence, John S. Van Winkle, W. M. Anderson, S. I. Kornhauser, Henry Meier, Miss Catherine McNamara, Miss Elizabeth LeStourgeon.

Number of members at time of last meeting (1928)	179
Dropped for all reasons	15
	164
New members added	12
	176

The total membership is now 176, including 85 national and 56 local members, making 141 active members, besides 22 corresponding members and 13 honorary members.

The membership may be classified as follows:

Active members in good standing, including 2 life members	104
Active members in arrears 1 year	24
Active members in arrears 2 years	13
Corresponding members	22
Honorary members	13
	176

The President appointed Dr. Cloyd N. McAllister to succeed Prof. Bear as Secretary of the Division of Psychology and Philosophy as Prof. Bear is to be out of the state for several months.

On January 22, 1929, the Secretary wrote Senators Sackett and Barkley urging them to support the $3,000,000 appropriation for forest land and suggested that some of it be used for Kentucky forests. Favorable replies were received from both.

On February 13, 1929, letters were written to 11 Representatives in Congress in regard to the passage of the Norbeck Bird Conservation Bill, No. S-1271, and replies were received from them. The bill was passed.

Our Representative in the Council of the A. A. A. S., Dr. A. R. Middleton, attended the meeting of the Association in New York, Dec. 27, 1928, and represented our Academy at the Academy Conference.

Two Council meetings were held during the year, on Jan. 18th in Prof. Anderson's office, to fix the date and place of the annual meeting; and on January 23rd, in Dr. Peter's office, with Dr. McAllister, to discuss arrangements for the coming meeting, and to draft the circular letter.

The Kentucky Academy joined in the invitation of Dr. Jillson and Prof, A. C. McFarlan, to the Geological Section of the Ohio Academy of Science for their field excursion in Kentucky on May 31 and June 1

PAPERS PRESENTED AT THE SIXTEENTH MEETING, APRIL 27, 1929

1. **The Kentucky Academy of Science as a State Institution.** G. Davis Buckner, Ky. Agricultural Experiment Station. (President's address.)

The Kentucky Academy of Science as it exists to-day is the result of the appointment of a "committee on organization," by the Kentucky Association of Colleges and Universities. From a simple, unimpressive beginning it has steadily grown until now its membership numbers nearly 200 persons who are interested in practically every phase of science.

In reviewing the history of this Academy, we find in the minutes that on May 8, 1914, Professor P. P. Boyd called the first meeting to order and became the permanent chairman of this organization meeting. At that meeting five scientific addresses were given which were followed by a report of the committee on constitution submitting a constitution and by-laws. These were adopted and in accordance therewith Dr. Jos. H. Kastle was elected the first president of the Kentucky Academy of Science.

The programs offered at the 15 annual meetings of the Academy in the past, presented many brilliant addresses and scientific discussions by members and visiting scientists who enjoy national and international recognition. These programs have been interesting and instructive and the diversity of their nature shows the varied interests of the members.

It seems most appropriate at this time to call attention to the untiring efforts and never-flagging interest of Dr. A. M. Peter who has served continuously as secretary of the Kentucky Academy of Science since the second meeting, held in 1915. All organizations having the character and broad interest of this Academy must pass thru a trying period during their early formation and so it has been with ours. To what degree of interest, excellence and value this Academy has reached to-day, I feel that it is in a large measure due to the efforts and personality of Dr. Peter.

Referring to our constitution, we find that the object of the Kentucky Academy of Science is "to encourage scientific research, to promote the diffusion of useful scientific knowledge, and to unify the scientific interests of the state." We further find that any resident of Kentucky who is interested in any branch of science, either professionally or as an amateur, may be elected a member. It seems to me that the object of this organization and its membership requirements hold up before the people of the State of Kentucky not only a challenge but an opportunity to exert a great influence in properly molding public opinion in the state, to do much to promote safety and efficiency in all industries, and to lend scientific assistance in developing and protecting our natural resources.

The first object of this Academy, "to encourage scientific research" connotes the soul of science and may be termed inspiration. To what extent have we encouraged scientific research and in what ways have we served as an inspiration? The inspired desire to excel and produce are manifested in the programs of our meetings which, I feel, have whetted the appetites of the hearers for further breadth of knowledge.

The second object, "to promote the diffusion of useful scientific knowledge" holds up before us the obligation of presenting at our meetings the results of investigation, accurate observation, logical theories and deductions based on facts. These addresses should be published yearly in accordance with our by-laws and full publicity should be given thru the proper news channels.

The third object, "to unify the scientific interests of the State" proposes to centralize and combine in a common cause, the abilities of our scientists. Viewing such a union as an ideal, it should be free from political influence or any alliance that could warp its purpose. With respect to the organization it should have absolute freedom to investigate issues affecting the welfare and betterment of the citizens of the state.

Since science, knowledge and progress are universal properties, it is the duty of all to enter into a spirit of hearty cooperation in furthering these common causes. The curses of the centuries have been jealously, secretiveness and suspicion, influencing the pursuit of scientific knowledge, and the real and sacred duty of all should be to seek facts and truth instead of the credit for obtaining them. The desire for credit placed above the desire for facts has been one of the great impediments in the development of science as a whole. This is one of the great human weaknesses and one not readily overcome and yet its elimination should be held before us, emblematic of a scientific cross. The man who is capable of having original ideas and thought should be big enough in mental scope to pass on to others less gifted, an idea or inspiration and not demand credit. In most instances, credit will be given by the recipient of the inspiration; in most of the other instances the credit will be recognized by others and if not, the satisfaction one may have in being an inspiration to another should in itself be satisfactory recompense. And if the credit should not be recognized by any one, the fact still remains that the credit existed and will find final expression in inheritance.

If we could unify or confederate properly and securely the scientific talents and interests of this state, we would have a potential scientific power that would be capable of not only seeking out the needs of the state but would have the ability to offer a sound solution and aid in solving them. This we have done in a measure by meeting each year for the presentation of scientific papers, discussion of problems of general interest, the interchange of ideas and the beneficial personal contact that such meetings afford. We have not been able to publish yearly the transactions of the meetings because of limited funds and properly paid clerical assistance for the secretary.

Prof P. P. Boyd as President of this Academy in 1920, discussed in a scholarly and interesting way the possibilities of state academies, stressed the usefulness of a Kentucky Academy of Science and predicted its possible future. Nine years have elapsed since this valuable discussion of Prof. Boyd and we find that we have progressed but little and the things Prof. Boyd said then are just as true to-day and apparently equally distant in the future. What then is the cause of this delay in assuming the obligation of scientific leadership that would keep us abreast with the times and able to rank with the scientific development of our neighboring states? It is true that we have been interested to a degree in scientific progress and control; at least to the extent of writing letters to Senators and Congressmen concerning the preservation of national forests and reserves and in lending such influence as we may have towards the protection of birds. And we have been interested in other things relating to the state and nation.

The meetings of the Kentucky Academy of Science in the past have all been held in Lexington. I personally feel that if this is a state institution the meetings should be held in different locations each year. This gives the visiting scientists the opportunity to become acquainted with the local scientific conditions of the various sections of the state and the people living in these localities will have the opportunity to attend the meetings and above all to feel that the Academy is truly a state institution. But it can never be a state institution until a law has been passed by the legislative bodies of the state, officially creating a Kentucky Academy of Science with fixed duties and powers. In this manner the scientific interests of the state would be officially and securely unified. Besides the moral backing of the State, the Academy should have financial aid in order to insure the yearly publication of the transactions and the proper diffusion of useful scientific knowledge.

And so I venture the hope that the incoming president of this organization will appoint a committee from our membership that is qualified and willing to draft a law creating an official Academy of Science that will be endowed with certain duties, certain powers and with such financial appropriations as the conditions merit. This official recognition would create in the Academy a living, pulsating spirit, its membership would increase rapidly and being separated from politics and divorced from prejudice the Academy would serve in an impersonal fashion the people of the State of Kentucky.

2. **A Case of Apparent Sex Reversal In The Peafowl.** J. S. Bangson, Berea College. (Abstract.)

The creature described was hatched in 1915 on the premises of Mr. S. D. May, of Salyersville, Kentucky. For a number of years after reaching maturity the fowl behaved in the usual manner, laying her quota of eggs each season, hatching her brood, and caring for them according to the orthodox method of her kind. In 1922, after molting, the first evidence of a change appeared, in that she assumed partial male plumage. In two years the drab, subdued, brown plumage of the female was completely replaced by the gorgeous "blue of the beak; green and black of the back and wings; brown, green, violet and gold of the tail." The bird itself seemed to sense the fact of its beauty, and strutted about in the male fashion. The gorgeous typical male train was developed. The bird seemed to take great delight in rattling the shafts of the tail feathers so as to produce the characteristic masculine vibration. The voice equipment reacted male-like. In a word the fowl assumed the complete appearance of the male, and acted his part. In 1927 the bird died. No autopsy was performed and, of course, no histological examination of the gonad. It could not be ascertained whether or not this transformed individual ever became a functional male.

In order to establish this as a genuine instance of sex-reversal the fact of functional male gonad should be established. In many instances recorded in the literature male plumage assumption seemed to be correlated with the acquisition of the male gonad structure. Since the plumage of this bird was so distinctly male it might not be assuming too much to declare that it was a genuine instance of sex-reversal.

3. **Indians of Kentucky.** Lucien Beckner, Winchester, Ky. (Abstract.)

After mentioning the recent work in archaeology by Profs. Funkhouser and Webb of the University of Kentucky, Burroughs, of Berea College, Hon. W. J. Curtis, of Piqua, Kentucky, and others, the author expressed the opinion that a part of the remains and one or more of the cultures being brought to light were of historic Indians, and suggested the possibility of correlating such remains and cultures with known historic tribes. In support of this, the conditions of the native tribes at the coming of the whites was set out, and historical references to the inhabitants of the area afterwards to become Kentucky were given. From these the conclusion was drawn that there were probably in Kentucky, in prehistoric times, only five linguistic stocks, all neighbors or residents of that area in historic times. These were stated to have been the Siouans, Iroquoians, Yuchians, Muskhogeans and, recently, the Algonquians.

The Siouans were traced from their homes on the upper Ohio River, fleeing from the Iroquois armed with European weapons, southeastward, into Virginia and the Carolinas, and southwestward, down the Ohio into the west and southwest. The earliest name of the Ohio was "Akansas," so called from the Akan or Akansas, a Siouan tribe then living on it but, later removing and giving its name to the river and state of Arkansas. The Fort Ancient culture was suggested as Siouan. The Iroquoians, probably of southern origin, may have sojourned for a time in Kentucky; and their southern branch, the Cherokees, lived close to the State's border in historic times. The Yuchians or Chiscans are located in Kentucky on the French maps of the third quarter of the 17th century and are spoken of in the French accounts as having been driven out by the Iroquois. It was suggested that the box-stone graves of the Rockhouse people of the Pennyrile knobs are Yuchian. The Muskhogean Chicasaws occupied the Purchase (west of the Tennessee river) in recent times; and the northern frontier of the southern Muskhogeans was, in historic times, the Tennessee Valley. Traditions tell of their having occupied the Cumberland Valley and possibly farther north. The Algonquian tribe of Shawnees very recently made conquest of part of Kentucky and are definitely located therein from the old French maps and relations of about 1650 to Evans' map of 1755.

Most, or perhaps all, of these stocks left relics in Kentucky, some of which, at least, must be turning up in the recent explorations. With careful attention to details, it may be possible to identify some or all, thus adding interesting and useful chapters to the history of the State and Nation. The paper was offered not as the last word but solely to arouse interest.

4. The Isolation of a Lytic Substance Active Against Bacterium Dysinteriae, Sonne Type, and Tests with Old Filtrates Containing A Lytic Substance Active Against A Thermophylic Organism. E. Wilbur Cook, Jr., Centre College. (Abstract.)

The paper reports experiments which demonstrate the presence in river water of a lytic substance active against *Bact. dysenteriae,* and that filtrates containing a lytic substance remained virulent for two years. A very polluted river water was filtered thru paper and a Maudler earth filter. To 10 cc of this filtrate, mixed with 10 cc of beef infusion broth (pH 7.6) a loopful of a young broth culture of *Bact. dysenteriae* was added. After incubation for 18 hours, the "feeding" tube showed complete clearing, indicating the presence of a lytic substance active against the strain of bacteria used. This was confirmed by other experiments. Filtrates from broth cultures withstood heating to 60° C. without destruction of the lytic substance.

Three tubes of filtrates containing a lytic substance active against a certain thermophylic organism from milk had been sealed in 1926, and 1927. Upon testing the contents 1½ and 2 years later, the potency of the substance was unimpaired, and it was not diminished by heating to 60° C. for 30 minutes.

5. Fecundity In Breeding Ewes. R. C. Miller, College of Agriculture, University of Kentucky.

6. The Effect of Storage on The Vitamin D Content of Eggs. Miss Statie Erikson, Home Economics Dept., University of Kentucky.

7. Potassium Cyanide and Regeneration In Salix Nigra. P. A. Davies, Biology Dept., Univ. of Louisville. (Abstract.)

Recently, Hicks,[1] using willow cuttings, has put forth the theory that polarity in regeneration is due to a C/N ratio, in that a low C/N ratio favors shoot development, while a high C/N ratio favors root regeneration. She believes that the initial growth is due to stimulated respiration (oxidation) yielding energy to expedite translocation of available nitrogen upward and easily oxidizable carbohydrates downward. Root regeneration, according to her theory, depends on the presence of readily oxidizable carbohydrates, and shoot development on available nitrogen. This in a way is contradictory to the findings of Loeb,[2] for he intimates that polarity is due to organ-forming substances (anlagen) and not to the chemical differences in ascending and descending sap.

If root regeneration is dependent upon energy from the oxidation of easily oxidizable carbohydrates, it should be possible to control it by controlling the rate of oxidation. Cyanides, which are powerful reducing agents, have been used for this purpose. Potassium cyanide added to potassium permanganate quickly decolorizes it, the septivalent manganese ion passing into the bivalent condition. Also the spontaneous oxidation of cysteine to cystine is retarded (see, Mathews and Walker[3]). Warburg,[4] and Loeb and Wasteneys[5] found that oxygen consumption of sea urchin eggs was greatly depressed in the presence of a cyanide. Warburg[4] shows results indicating that cyanides lower the oxygen consumption of red corpuscles of geese. Schroeder[6] measured the effect of potassium cyanide upon the rate of oxygen consumption and carbon dioxide output in *Aspergillus* and found a reduction of 50 to 94 per cent, according to the concentration. Meyer[7] states that the circulation of protoplasm in plant cells, for which oxygen is necessary, is

[1] Hicks: Bot. Gaz. *86*: 193, 1928. [2] Loeb: J. Gen. Physiol. *6*: 463, 1924; also, "Regeneration," McGraw-Hill Book Co., 1924.
[3]Mathews and Walker: J. Bio. Chem. *15*: 208, 1909. [4]Warburg: Zeitschr. f. physiol, Chem. *70*: 413, 1910. [5]Loeb and Wasteneys: Biochem. Zeitschr. *70*: 433, 1911. [6]Schroeder: Jahrb. f. wiss. Bot. *64*: 409, 1907. [7]Meyer: Landwirt. Versuchsstat. *23*: 335, 1879.

reversibly stopped by cyanides. Moore and Williams[8] found that cyanides interfered with the consumption of sugar in plants. Hyman[9] and Child[10], from their work with cyanides on *Planaria*, state, "that cyanides depress physiological processes in general and the rate of oxygen consumption in particular." From the literature, it is evident that cyanides retard certain oxidative processes in both living and non-living systems.

The effect of potassium cyanide on root regeneration and oxidative processes in general in willow cuttings (*Salix nigra*) depends upon the concentration. In the concentrations used, the effect was either stimulating or toxic. Concentrations between M/100 and M/5000, inclusive, were toxic and no root regeneration occurred. In concentrations between M/10000 and M/100000, root regeneration occurred and was greater (considering dry weights) than the control. The control was in distilled water. Shoot development occurred in all concentrations used. In M/5000 potassium cyanide, no root regeneration occurred, but shoot development was greater in the solution than out of it, [11]showing that root regeneration (with a high rate of metabolism) was more sensitive to the toxic action of potassium cyanide than shoot development.

The effect of potassium cyanide on root regeneration may be explained in one of two ways or a combination of both: (1) the cyanide being an extremely reactive substance could unite (in non-toxic concentrations) with the system in such a way as to increase, by greater solubility, the oxidative activity of the system, while the toxic effect of the high concentrations is probably one of coagulation; and (2) the effect on the cell membranes primarily with a secondary effect of high concentrations on the interior protoplasmic system. Recent work by Brinley[12] shows that low concentrations of potassium cyanide on the cell-membranes of the amoeba decrease the viscosity of the protoplasm, while toxic concentrations increase the viscosity and cause a rapid disintregration.

[8]Moore and Williams: J. Agri. Research *6*: 319, 1917. [9]Hyman: Amer. J. Physiol. *48*: 340, 1919. [10]Child: Amer. J. Physiol. *48*: 372, 1919. [11]The cutting was so placed that one-half of it was suspended in the solution. [12]Brinley: J. Gen. Physiol. *12*: 201, 1928.

The results seem to favor Brinley's idea that non-toxic concentrations (M/10000 to M/100000) react with the cell-membranes, decreasing the viscosity of the protoplasm and likewise increasing oxidation; while toxic concentrations (M/100 to M/5000) produce an increase in viscosity and a rapid disintegration.

8. The Morels And Some Closely Related Species of Kentucky Fungi. G. D. Smith, Eastern Kentucky State Normal School.

Excellent lantern slides in natural colors, made by the author, were shown and explained. The morels of Kentucky are as follows: Morchella esculenta, Morchella semilibera, Morchella bispora, Morchella deliciosa, and Morchella crassipes. Related species are: Gyromitra esculenta, Gyromitra brunnea; Peziza scutellata, Peziza coccinea, Peziza aurantia, Verpa digitaliformis, Peziza repanda, Peziza badia, and Hydnum imbricatum.

9. A Simple Classroom Demonstration of Electro-Magnetic Waves. Waldemar Noll, Physics Dept., Berea College. (Abstract.)

The apparatus described was given to Berea College by a friend* who had used it in lectures. It can be constructed easily by a high-school physics teacher. The transmitter consists of a small induction coil, a condenser and a spark gap, in a copper-covered box. The spark gap is in a round hole in the wall of the box, and a copper tube extends from it. The receiver consists of a coherer connected with a telegraphic relay and battery. The other end of the relay is connected to an ordinary lamp and 110-volt outlet. The coherer is a narrow glass tube filled with nickel and silver filings (19 parts nickel to 1 part silver), with a copper wire in each end, adjustable so as to get the right compression. The filings become conducting when acted on by electro-magnetic waves from the spark, thus allowing the current from the battery to pass, turning on the light. Reflection, refraction and polarization of the rays can be shown.

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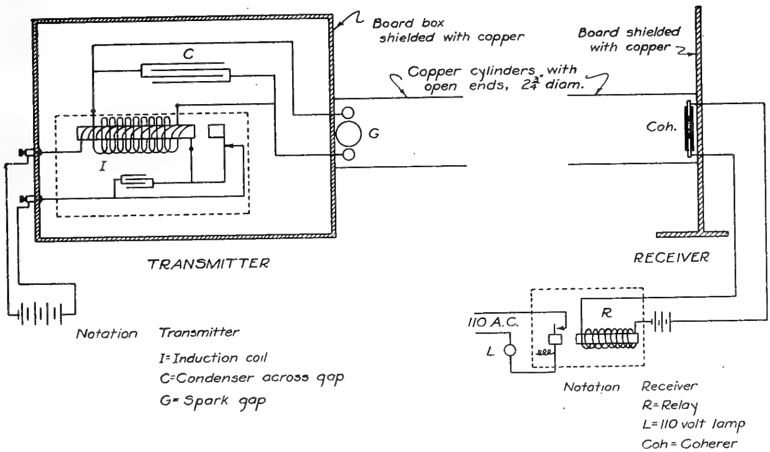
*The late Charles L. Harrington of New York City.



10. Some Structural Geology of Western Kentucky. Lucien Beckner, Winchester, Ky. (Abstract.)

On a diagrammatic cross-section of western Kentucky along the parallel of north latitude, 37° 45′, from about Colesburg, in Hardin county, on the Rolling Fork of Salt River and the Louisville & Nashville Railroad, westwardly to about Shawneetown, Illinois, the various wells were shown that have been drilled close enough to the line to be available for displaying the subsurface position of strata along that line, in a general way. The wells were drawn to the scale of three hundred feet to the inch and placed upon a horizontal line representing actual sea level, at their approximate distances apart, on a scale of four miles to the inch. This exaggerated scale brought out in small space the amount of the dip to the west. The New Albany (Devonian) black shale was the lowest stratum displayed. It was followed from its outcrop near Colesburg, over four hundred feet above sea level, to its appearance in the Sol. Blue well in Union county, at 3,770 feet below sea level. Below that the junction of the Ordovician and Silurian was estimated, and in the Sol. Blue well, which reached the total depth of 5,955 feet, the Utica shale was shown. The top of the New Providence shale was shown; then the three sands that are producing the oil at present in the Owensboro and Ohio county field, the "Barlow" (Bethel-Sample), the "Jackson" (Cypress), and the "Jett" (Hardinsburg). The junction of the Mississippian and Pennsylvanian was shown.

The diagram contained thirteen wells and several surface outcrop readings. Three of these wells went to the Ordovician: at Victoria in Breckinridge county, at Maceo in Daviess, and the Sol. Blue well in Union. Five of them went into the Devonian: the three above mentioned, and the Garfield and Hardinsburg wells in Breckinridge county. Five others went to the Barlow sand; the Stuart well at Pellville, the Cooper well near Knottsville, the Deer Farm well south of Owensboro, and the Hebbardsville and Zion wells. One other, the Southland well in Henderson city, went only to the Jett sand, and two did not reach so deep; the well in the Bon Harbor hills near Owensboro and the Onan well on the Union-Henderson county line.

Ten miles west of where the top of the Mississippian is showing in the Sol. Blue well at 1340 feet below sea level, it has popped to the surface in Illinois at 450 feet above sea level, indicating a fault of 1790 feet throw, down to the east. The surface geology of Union county has been worked out by the United States Geological Survey in conjunction with the Kentucky State Geological Survey, and published in 1916; but the published structural contours do not seem to imply such conditions as the well records show. The surface would make the Mississippian-Pennsylvanian contact about 600 feet below sea level, whereas the Sol. Blue well shows it to be at 1340 feet. This discrepancy can be accounted for only by a thrust fault, the Sol. Blue well being located where the overlap occurs only in the Pennsyllvanian.

Another cross-section was exhibited running north and south along 86° 45′ west longitude, from Herschell, in Butler county, to Tell City, Indiana. Seventeen wells were located by the system already explained. The main features displayed were the faulting about Hartford in Ohio county, with the Kentucky anticline just north of it and the deep syncline just south of it. The high exaggeration used brought out the Kentucky, or Rough Creek anticline conspicuously. Its existence explains the large production of oil in Ohio county.

11. **The Status of Geologic and Topographic Mapping in Kentucky.** W. R. Jillson, State Geologist.

An informal account was given, illustrated by maps.

12. **Gravitation.** Daniel J. Healy, Ky. Agricultural Experiment Station. (Abstract.)

A floating body in a sealed vessel was observed on 26 days. The temperature at which the original position of equilibrium was attained was found to vary considerably, and it decreased rather regularly during the last 15 days.

13. **Economic Geography of the Mississippian Plateau in Kentucky.*** Wilbur Greeley Burroughs, Berea College. (Abstract.)

This region touches every physiographic division of Kentucky except the Bluegrass from which it is separated by the Knobs. Thirty-eight counties are wholly or partly within the plateau. The relief is varied, from level to rolling and hilly. In the middle Green River district a karst topography is developed. Here are Mammoth Cave and other caverns with many miles of underground passages.

The climate is humid, of continental type. The mean annual temperature in 56.8° F. and mean annual precipitation 44.7 inches. The practically sure length of the growing season, 4 years out of 5, is 149 to 169 days. Snow remains on the ground only a few days.

Mineral products, listed alphabetically, are abrasives, bituminous coal, cannel coal, clay, fluorspar, iron ore, lime and cement material, limestone, marl, mineral paint, natural-gas-gasolene, oil and gas, oil shale, onyx, rock asphalt, salt, sand and gravel, glass sand, molding sand, sandstone. The fluorspar

*Summary of an investigation for the Kentucky Geological Survey. Read by permission of Director Jillson.

field is one of the two most important areas producing this mineral in the United States. The rock asphalt is known thru-out the nation. Road materials occur in inexhaustible quantity.

Natural forest growth consists of oaks, hickory, black walnut, cedar, poplar, chestnut, dogwood, locust, elm, sweet gum, black gum, maple, ash, hemlock and many other kinds of trees. Most of the virgin timber has been cut away, but some parts of the area have a dense second growth. Wild animal life consists of birds, rabbits, raccoons, opossums, minks, skunks, squirrels, foxes and an occasional wildcat. Deer and wild turkey are seen between the Tennessee and Cumberland rivers. In the streams are at least 146 species of fish.

Grain crops are corn, tobacco, wheat, oats, buckwheat, rye and barley, the first three being the most important. Forage crops are grown in all the counties. Sorghum for molasses is grown mainly in the rougher parts. Apples, peaches, grapes, strawberries and blackberries are grown. Irish potatoes, sweet potatoes and other truck crops are grown, mostly near the cities.

Large numbers of beef cattle are fed, mainly in the more level country, and dairying is followed near the cities.

Towns, cities and manufacturing industries are influenced by the geographic conditions.

14. Humidity and Its Meaning. Geo. B. Wurtz, Meteorologist, U. S. Weather Bureau, Lexington. (Abstract.)

The author explained the practical significance of the common expressions for atmospheric humidity. Three ways of stating the measure of humidity are common.

1. As weight of water in a stated volume of air; e. g. grains per cubic foot or grams per cubic meter.

2. As degree of saturation. This is the "relative humidity" of the weather reports. It states, on a percentage scale, how near the air is to containing all the water it can take up, under the conditions of the observation. Thus, relative humidity 75 per cent means that the air is three-fourths saturated. If the temperature is not stated, this gives no idea of the actual

quantity of water in a given quantity of air, because the capacity of air for taking up water varies greatly with the temperature.

3. As pressure. This is the pressure exerted by the vapor in the air, exprest in terms of the barometric scale. It is the most convenient expression, tho unfamiliar to the layman.

The author has observed that when the moisture content of the air was sufficient to saturate at 60° F, people would remark "It begins to feel like summer". Saturation at 60° means 5.8 grains of water to the cubic foot, a relative humidity of 100 per cent and a vapor pressure of 0.516 inch. Raise the temperature to 75° F and keep the moisture content per unit volume unchanged, the relative humidity drops to 61 per cent while the vapor pressure remains the same. And so does the human temperament; it still "feels like summer." But with the temperature at 75° and the moisture raised to 100 per cent of saturation, which means about 9.5 grains to the cubic foot and a pressure of 0.866 inch, the weather would be pronounced sultry. The difference depends upon the increase in vapor pressure. The normal temperature of the body is about 98° F, and the body consists largely of water. The pressure of the vapor above water at 98° is slightly more than 1.8 inches of mercury. When vapor is driven back into the body under a pressure not greater than 0.5 inch, it is not much of a burden on the body to absorb this water and the load of heat of condensation that accompanies it. Under those conditions, the factor of reabsorption becomes 0.5 to 1.8; but whenever it gets past a factor of about 1 to 3, the nerves begin to feel the load. The human body will reabsorb thru the skin about one-third of the vapor it gives off. When this margin is exceeded, discomfort arises.

15. A Comparative Study of Delinquents and Non-Delinquents (II).* Clara Chassell Cooper, Eastern Ky. State Normal School, Richmond. (Abstract.)

*See The Relation between Morality and Intellect: a Tabular Review and Synthesis of Previous Studies in Delinquent and Non-delinquent Groups, and Two Original Investigations among College Students and Elementary School Pupils.

The study reported at the 1928 meeting has been continued. The principal findings are concerned with the relation between delinquency and mental deficiency. They are presented below, and include, in order, data, number of countries, number of coefficients, and crude median:

1. Reports of the prevalence of delinquency, 3, 8, .55.
2. Estimates of the prevalence of mental deficiency, 8, 11, .75.
3. Reports of educational status:
   a. Prevalence of illiteracy, 6, 10, .135.
   b. Amount of schooling, 4, 9, .18.
   c. School progress, 2, 7, .45.
   d. School achievement, 2, 1, .48.
4. Results of intelligence tests:
   a. Verbal abstract, 4, 39, .52.
   b. Army, 1, 4, .065.
   c. Non-verbal concrete, 2, 2, .485.
   d. Mechanical, 1, 5, .01.

Altho the crude median of the coefficient reported above is .52, the assembled results for all parts of the research point to a correlation between morality and intellect in restricted groups slightly under .40.

16. Implications and Problems of Recent Physics. Wm. H. Walker, Berea College. (Abstract.)

By confession of the physicists, the science of physics is in a state of confusion and doubt. Old principles have been proved inadequate and new ones have not yet been developed. The business of philosophy is to interpret science as well as all other phases of experience. As the interpreter, it must wait upon the discoveries of science. In spite of the present confusion, recent physics has reached enough assured results to admit of some interpretation.

Recent physics has banished the last remnant of a static universe. The atom was the last stronghold of a static conception, and the atom is resolved into moving centers of energy. Even these centers are not constant, but are phases in the existence of energy. In one quarter of the universe energy is being concentrated around movable centers, and in another it is being dissipated.

Energy is one. The former distinction into gravitational, light, thermal, electrical and chemical energy has vanished as an ultimate distinction, and all forms of energy have been proved ultimately one, and acting under one law. A spiritualistic interpretation of nature finds this good. Formerly the static atom, as the ultimate element of matter, formed an irreducible surd, uninterpretable in terms of spirit. Energy is distinctly within the realm of spirit. We experience energy, and the entire interpretation of the universe in terms of energy is an interpretation in terms of experience. Just now the physicists seem to be travelling toward a yet more radical spiritualism, in that they admit that they have no laws to determine the actions of electrons. Electrons seem to be governed by a caprice wilder than any which the most radical defender of free will would apply to the human will. This however can hardly be more than a temporary confusion.

Relativity, by reducing space and time to space-time, seems to confirm Kant's doctrine of the subjectivity of space and time. Both are relations to conscious experience. But in reducing gravitation to a peculiar conformation of space-time, space-time would be made as objective as energy. Indeed it seems to subject energy to a new static. The call is for a new criticism of the space-time concept.

17. **Some Present-Day Philosophical Tendencies.** Glanville Terrell, Philosophy Dept., University of Kentucky.

18. **What Text Shall I Use?** Paul L. Boynton, Psychology Dept., University of Kentucky.

19. Some Educational Tendencies as Revealed in Foreign Language Teaching. R. Tyson Wyckoff, Western Ky. State Normal School.

20. The Present Status of Phrenology As A Science. C. P. Poole, Psychology Dept., Murray State Teachers' College, (Abstract.)

The author makes no claim for phrenology as a science but points out that it greatly stimulated thought during the latter part of the 19th century and thus opened the way to much of the present-day knowledge of cerebral organology and psychology. The study of the contours of the brain, as brought about by phrenology, resulted in much that we have to-day that is tangible and definite, in the field of mental science.

21. Science and Religion. William J. Hutchins, President of Berea College.

You have already been welcomed to our Campus and to our hearts. The keys of both are yours. I think it very good for us all to get together in this way. Sometimes a man working all alone reminds himself of the old soldier beggar who had emblazoned upon his chest the words, "Have pity on me, been in five battles, wounded twice, children four, total eleven." We meet in conclave, and we realize that we are workers together in one great and fruitful field of human endeavor. And we go back to our individual tasks, strengthened.

Ever since we were children we have heard of the conflict between Science and Religion. Occasionally we hear of the indifference of Scientists to Religion. More frequently in recent years we have heard of the contributions of Science to Religion. This afternoon I wish to speak of certain familiar aspects of a great Alliance, the Alliance between Science and Religion. And I speak of those which happen to be of special interest to me.

I note first that the ethical monotheism of the prophets, glorified and transfigured in the religion of Jesus, has helped largely to furnish the atmosphere in which modern science can live and breathe freely and progress. Let me read you a letter received this week from a medical friend in India. She writes, "One leper in the town of Arni was told that he would be cured if he let a cobra bite him. He roused the cobra to bite twice, but the third time the knife killed the cobra. A half hour later he was dead." In Benares I have seen hordes of pilgrims go to make their offerings in the shrine of the smallpox goddess. At Ahmednager I have seen the representative of the cholera goddess, dressed after the manner of a woman, armed with a great whip. He threatened the villagers with the cholera, if he did not receive baksheesh. A wild dark world of chaos and of fear, a world filled with demons and warring gods and goddesses, ready to take their toll of blood from the poor people.

Go back to the middle of the 8th century before Christ and to the land of Palestine. Pass from the fumes of your laboratory to smell the incense of the flaming altars of Bethel. The Israelite of 750 B. C. had passed somewhat beyond a wild and ghastly polytheism. He still believed that his God Jehovah was the god of the little territory of Israel, but he also was sure that just beyond, in Egypt, in Assyria, were powerful gods, hostile to the plans of Jehovah. From his sheep and sycamore trees, comes Amos, and with words which are half battles, he cries in Jehovah's name, "You only have I known of all the families of the earth, therefore upon you will I visit all of your iniquities. You think God lives in a tent, whose floor is 150 by seventy miles in area. I tell you that Jehovah lives in a tent, whose floor is the wide earth and whose covering is the blue vault of heaven." There in the world of Amos you have an atmosphere in which Science can live, breathe freely, progress.

In the latter part of the same century, Hosea looks out from the threshold of his ruined home, and into a national life ruined by lust, and he cries in God's name, "How can I give thee up, Ephraim, How shall I cast thee off, Israel?" "I desire goodness and not sacrifice, and the knowledge of God more than burnt offerings." And there comes into the foreground of the thought of earth's noblemen the conception that at the heart of the universe there is *one,* yes, one creative good will. The later prophecies ring with the laughter of Jehovah who sees a man with infinite care and stupidity take one part of a tree, put it in the fire to keep warm, and another part of the tree to make a god of it and worship it.

Then comes the late, great, unrelated prophecy, which reads: "In that day shall Israel be the third with Egypt and with Assyria, a blessing in the midst of the earth; for that Jehovah of hosts hath blessed them, saying, "Blessed be Egypt my people, and Assyria the work of my hands, and Israel, mine inheritance." The ancient, non-moral, immoral deities, killed by the laughter of Jehovah, Jehovah the God of world-wide sway and age-long purpose, who plays no favorites, who requires of Assyria, Egypt and of Israel justice, lovingkindness and humility. There you have the dawning of a great day in the history of the world in which thought can be unified, in which Science can live and breathe freely, and progress. The ethical monotheism of the Old Testament burgeons in the Religion of Jesus. And the Religion of Jesus, which assures the atmosphere in which Science can live and breathe furnishes as well new motives to its progress.

The motives are two, the desire to know the Truth of the Heavenly Father's world, and the desire to respond to the fascinating kindness of God in Christ. Men have always been the victims of insatiable curiosity, but in the light of Christianity this curiosity has gained the dignity of a desire to know about our Father's world, to decipher the hieroglyphics of the Heavenly Father in the stones and trees and flowers and stars.

And along with the desire to discover the truth of our Father's world, there has also come into the foreground of life the desire to respond to the grace or the fascinating kindness of God in Christ. The little child, his eyes all covered with flies, the Master receives into his arms and blesses. The paralytic who has no man when the water is troubled to put him into the pool; the publican, turncoat and traitor to his race;

the robber, his hands and feet torn by the nails of the cross, the fisherman, the ordinary man, the least interesting of all men, each of these is the recipient of the lavish love and golden promises of his Lord. The Western world has never learned of Christ very perfectly, but the homes of Christians and the monasteries were the refuges and the hospitals for the sick and distressed of earth. Francis of Assisi repelled by the leprous beggar repents and returns and washes the sores of the leper. In the act you see portrayed the influence of Christianity upon the thought of men. The ethical monotheism of the prophets, blossoming in the lovingkindness of Jesus, the Word become flesh, has sent men into the forests and into the laboratories, to seek out cures for the ills of men.

On the borders of the city of Allahabad I found Sam Higginbottom, working among his more than four hundred lepers, with a Science inspired by self-giving love. And in recent weeks we have watched Dr. Gladys Dick, who after some twelve years of arduous toil with her husband devised the Dick Test and the inoculations, which seem certain to drive scarlet fever as far from our homes as earlier campaigns have driven smallpox. I have watched her with patient skill puncturing with her needle the arms of some twenty-five hundred boys and girls, men and women; then I have seen her with careful measuring rule, noting the diameters of the scarlet marks upon the arms of the non-immune. Was she getting any money for her work? Not a cent. Was she getting any *kudos?* None, save the reward of the gratitude of the needy. Behind all the natural curiosity, which has led to high adventure in science, there was in the woman a self-dedication, directly traceable to Him who, according to the ancient book, bore our sicknesses and carried our diseases.

Ever since the apostle Paul wrote his letter to Philemon, sending back the runaway slave and thief Onesimus to his Master, not as a slave but as a brother, while the word "emancipation" trembled on the apostle's lips, liberation has been the goal, whether conscious or unconscious, of the science of the western world.

While the religion of the ancient prophets and of Jesus has helped to furnish an atmosphere in which Science may live and breathe and progress, while this religion has added new and potent motives to the search of the scientist; this religion has inculcated as well a spirit, without which Science would lapse into arrogant dogmatism, the spirit of Humility.

The ancient seer saw the Divine, dwelling in the high and holy place, with him also that is of a humble and a contrite spirit. He saw Jehovah, who counts the number of the stars, and heals the broken in heart. And the Master, as he takes a child in his arms, tells the Pharisees: "Except ye turn and become as little children ye shall in no wise enter into the kingdom of heaven;" and the sovereign discoveries of science have been made by those, who held in their hearts the treasure of the humble.

We think

"Of those who conquered inch by difficult inch
The freedom of this realm of law for men;
Dreamers of dreams, the builders of our hope,
Who while the dynasts drenched the world with blood,
Would in the still small circle of a lamp,
Wrestle with death like Hercules of old
To save one stricken child."

Almost everyone of them, I believe everyone of them, directly or indirectly, owed much of the atmosphere which he breathed, the motives which stirred his heart, and the spirit of his search, to the religion which came to fruition in Jesus Christ. I do not forget the influence of the Greek culture in the Renaissance; nor do I forget the fateful warfare of science with ecclesiastics. But no ecclesiastics have ever been able to bury Jesus or to slay his God. And Jesus has led the men, who longed to know.

And now may I speak for a moment of the share which Science has had in the partnership of the Great Alliance.

Science has given to our Religion a new universe, under law; that goes without the saying; a new home and workshop for Jehovah, who works by definite and, in part, discoverable methods. Noyes wishes that old Copernicus could see

> "How through his truth that once dispelled a dream,
> Broke the false axle-trees of heaven, destroyed
> All central certainty in the universe,
> And seemed to dwarf mankind, the spirit of man
> Laid hold on law, that Jacob's ladder of light,
> And mounting slowly, surely, step by step,
> Entered into its kingdom and its power."

Science has torn from his throne the ancient man-God of our childhood, easily angered, writing down our naughty deeds in his day book, and has compelled us either to go without a God, or to find a God big enough, strong enough, wise enough, good enough, to be the creative good will at the heart of a world of immeasurable vastness, ruling the universe by LAW.

A while ago I met a man, and asked him whether he thought his peaches might freeze that night. I told him how a friend of mine got some cans from behind Ladies Hall, filled them partly with crude oil, telephoned to Lexington for the latest weather reports; sent some boys to start the smudges in his peach orchard and saved his trees. The old man replied, "That does seem as if it was goin' agin' the Lord's Will."

In the early days Dr. McCormack's father was starting to operate on a woman for tumor, and an ancient preacher told him to stop, that the Lord had put the tumor there; but old Dr. McCormack replied: "You are mistaken, my friend; the devil put the tumor there, and the Lord told me to cut it out." A shrewd answer, and one which perhaps the Lord will forgive, in view of the fact that the woman's life was saved; but how different from the world of these countrymen is the world, given to the religious man by the scientist, a world, which yields its secrets to the humble, and gives its mastery to those who yield obeisance to its law.

Again, Science has offered to Religion its sovereign method of vindication, namely the method of science itself; the observance of phenomena, the hypothesis, the trial of case after case, to check, to verify, to modify the original hypothesis, until for practical purposes the hypothesis is counted true. We as religious men have always known the method, but are cheered by the support of science. From the facts of history, experience and reason, we fashion our hypothesis that there is a creative good will at the heart of the universe, one who knows and loves and cares and is strong. We walk out upon that hypothesis, and try it again, and yet again; the facts which seem to belie the hypothesis we find subordinating themselves to the hypothesis; or we let them rest, daring to hope that time will "chew" our questions for us; we come at last to believe and hold with a conviction that ignores no facts, that the universe is on the side of the hero. We come to accept that "sane wholesome practical working faith" which George MacDonald in Robert Falconer describes, "first that it is a man's business to do the will of God, second that God takes on himself the special care of that man, and third that therefore that man ought never to be afraid of anything." We gladly acknowledge that the hypothesis is an hypothesis, a working faith, like the working faith of the scientist in electrons and ions. And we thank the Scientist.

One word, and I am done. I believe that the scientists of our state, like the scientists of Tennessee, have a mission at once more perilous and more important than some would have us believe. Our students come to us, taught by fathers and mothers and preachers, whose faith is knit in with cosmological and Biblical conceptions, which make them feel that their loss would mean the death of true religion. Moreover these fathers and mothers see their children coming home from college, very uppish, very careless, very indifferent or condescending, their early faith lost, and no new faith acquired, save faith in Mencken. They now feel fully assured that the early chapters of Genesis contain divergent accounts of Creation, and that none of them are correct; but they have gained no valid conception of a creative good will which has worked eternally and still works, and with which we can work, as Jesus worked. They feel certain that Moses did not receive the Ten Commandments written by the hand of God on tables of stone, but they have acquired no reverence for any new laws of God or man, whether written on the fleshly tablets of the heart or on parchment, or on the paper of state legislatures. And it is not strange if the parents of our students, wise with the wisdom of experience, are fearful and dismayed.

I believe the burden resting upon the scientist cannot be evaded. I have thought it might be stated in three avowals.

> I will freely, gladly, acknowledge the fact that the ethical monotheism of the prophets, glorified and assured by the life and teaching of Jesus, has done much to furnish the western world with the atmosphere in which Science can live and breathe and progress.
>
> Again, I will gladly, freely, acknowledge that this same monotheism has given to the Scientists of the West motives to research elsewhere unknown to men.
>
> Again, I will gladly, freely, acknowledge that the ethical monotheism of the prophets, that of Jesus, has helped to inculcate a spirit of humility, of awe and reverence, before the mysteries of the world, apart from which Science stands forever outside the doors of the treasurehouse of truth.

It may be that these frank and free avowals will calm the fears of parents, and lead them to acknowledge with gratitude our debt to Science, whose telescope reveals a world of unimagined vastness, whose microscope penetrates mysteries which give hint of other mysteries; whose instruments permit the explorer of the Antarctic to send his voice traveling over bridges whose arches are more elusive than the arches of the rainbow, in order that he may whisper his love to his household in Virginia; our debt to Science, with its new universe, its eternal law, and its method of ascending to the mount of vision.

It may be that we shall avoid the disgrace that has come to a sister state, and help the state of Kentucky toward a religion, which can fight, naked, untrammeled, unencumbered, unafraid, victorious in the Wars of God.

22. **The Immunization of Mares Against Infectious Abortion.** E. S. Good, Ky. Agricultural Experiment Station.

An account of the work of the Animal Husbandry Department in studying the disease and devising a successful method for protection against it.

MINUTES OF THE SEVENTEENTH ANNUAL MEETING.

The 17th annual meeting of the Kentucky Academy of Science was called to order by President Rainey at 9:15 o'clock in Room 33, Young Hall, Centre College, Danville, May 3, 1930. About 30 members and several visitors were present.

The Secretary read his report, which was received and ordered filed.

The Treasurer presented his report showing a balance of $225.07. The report was referred to the auditing committee.

The Council had no formal report but the Secretary reported that one meeting had been held to determine the time and place of the annual meeting and make arrangements for it. A number of members had been elected unanimously by letter vote. The report of the committee on Calendar Reform had been adopted unanimously by letter vote, and the National Committee had been informed of this action. The report of the committee on duty-free importation was received and filed, the opinion of the council being divided as to its disposition.

The Membership Committee recommended the following named persons for election to membership in the Academy:

Ellis Freeman, Univ. of Louisville, Asst. Professor of Psychology.
W. M. Insko, Jr., Univ. of Kentucky, Asst. Animal Nutrition.
Harvey B. Lovell, Univ. of Louisville, Asst. Prof. Biology.
Anna L. Payne, Berea College, Asst. Prof. Home Economics.
Martha Payne, 156 McDowell Road., Lexington, Ky.
Norma Pearson, Eastern State Normal, Biology Department.
R. E. Stouder, Owensboro, Ky., Geologist.
Eugene Simpson, Univ. of Kentucky, Member Entom. Dept.
Roy Smith, Winchester High School, Instr. Chem. & Physics.
A. M. Wolfson, Murray State Teachers College, Prof. of Biology.
Chas. Hatfield, Georgetown College, Mathematics.
James Boswell, Georgetown College, Instr. in Mathematics.
G. Moseley, Georgetown College, Asst. Prof. Chemistry.
Barney Watson, Georgetown College, Instructor in Biology.
Ruth Boyden, University of Kentucky, Asst. Home Economics.
H. L. Hull, Berea, Ky., Instr. in Biology, Berea College.

On motion, the report was adopted and the nominees were elected unanimously.

Dr. Peter, for the Publications Committee, reported that payment for Volume 2 of the Transactions had been completed and that Volume 3 is still in manuscript form awaiting the abstracting of the papers. This because the Council has decided that our finances will not permit publication of the papers in full.

Dr. Buckner reported informally for the Legislation Committee substantially as is recorded in the Secretary's report. Reports of the committees on calendar reform and on duty-free importation were made by Dr. Peter substantially as recorded in the Secretary's report.

Prof. M. N. States who represented the Academy in the Council of the A. A. A. S. as proxy for Prof. Payne, read his report which, on motion, was accepted and made part of the minutes.

President Turck very gracefully welcomed the Academy and extended the hospitality of Centre College.

The President appointed the following committees:

Auditing: J. Stanton Pierce, Chairman; V. F. Payne, E. W. Cook, Jr.
Nominating: T. A. Hendricks, Chairman; Lucien Beckner, E. S. Good.
Resolutions: Cloyd N. McAllister, Chairman; G. D. Buckner, M. N. States.

President Rainey delivered his address on "The teaching of science in Colleges of Liberal Arts."

At 10 o'clock the general session adjourned until 2. P. M. and the divisions assembled in their respective rooms.

The Divisional meetings were well attended and enthusiastic.

At one o'clock the members and their friends were the guests of Centre College at an elegant lunch in the dining hall of the Woman's Department.

The general session reassembled at 2 o'clock in the auditorium of the Woman's Department.

Dr. Buckner, for the committee on resolutions, presented a Memorial to Prof. A. M. Miller which was unanimously adopted.

Mr. Beckner, for the nominating Committee reported the following nominations for officers:

For President: V. F. Payne, Transylvania College, Lexington.
For Vice-President: Mrs. Clara C. Cooper, Richmond.
For Secretary: A. M. Peter, Lexington.
For Treasurer: W. S. Anderson, Lexington.
For member of Committee on Publications: W. R. Jillson.
For councilor: Austin R. Middleton.

The Committee also recommended that the Academy accept the invitation extended by Prof. Payne to hold the 18th meeting of the Academy at Transylvania College. The report was adopted unanimously and the Secretary was instructed to cast one ballot for the Academy. This having been done, the nominees were declared elected unanimously.

Mr. Pierce, for the Auditing Committee, reported that the Treasurer's accounts had been examined and found correct.

Dr. A. M. Reese then delivered a very able and instructive address on "The Habits of the American Alligator." An interesting discussion followed.

Dr. Buckner, for the Committee, offered the following resolutions which, upon motion, duly seconded, were adopted unanimously.

RESOLVED, that the Kentucky Academy of Science expresses its appreciation and thanks to President Turck and to Centre College, for their delightful hospitality and that the memory of the occasion will persist for years in the minds of the members, as one of the most pleasant events in their scientific careers.

There being no other business, the meeting adjourned.

A. M. Peter, Secretary.

ARTHUR McQUISTON MILLER, 1861-1929

ARTHUR McQUISTON MILLER

Arthur McQuiston Miller was born at Eton, Ohio, August 6, 1861, the son of Robert and Margaret McQuiston Miller. He received his A. B. and A. M. degrees at Princeton in 1884 and 1887 and studied geology at the University of Munich in 1891-2. He came to Kentucky in 1892 as Professor of Geology in the State University. He was Dean of the College of Arts and Sciences until 1917 and retired as Professor Emeritus of Geology in 1925. He died in Florida, October 28, 1929, of heart failure.

Professor Miller was an authority on Kentucky geology, including the geology of petroleum and natural gas. He was the author of the "Geology of Kentucky" and of various reports for the Kentucky Geological Survey, of which he was one of the geologists. He was a member of the Geological Society of America and a Fellow of the A. A. A. S.

Professor Miller was a charter member of the Kentucky Academy of Science, its second President, and always took active part in its proceedings. In his death the Academy has lost a valued member and the state a useful and progressive citizen.

THEREFORE, be it resolved, that this notice be made a part of the minutes of this meeting and a copy be sent to Dr. Marion Mills Miller.

G. Davis Buckner,
M. N. States,
Cloyd N. McAllister,
Committee.

COUNCIL MINUTES.

The Council met Wednesday, March 5, 1930, at 2 P. M. in Dr. Peter's office in Scovell Hall. Present: Drs. Rainey, McAllister, Buckner and Peter.

Dr. Rainey, on behalf of the College, invited the Academy to hold its annual meeting at Centre College. Accepted unanimously.

Dr. Rainey, on behalf of the College, invited the Academy to be the guests of Centre College at luncheon on the day of the meeting. Accepted unanimously.

By unanimous vote, it was determined to hold the annual meeting on Saturday, May 3, 1930, beginning at 9 o'clock A. M., at Centre College.

After some discussion, Dr. Rainey was asked to invite President Turck to address the general session in the afternoon and was given the names of several alternates, in case President Turck should not accept.

SECRETARY'S REPORT, 1929-30.

President Rainey appointed the following committees:

Membership: W. R. Allen, Chairman; M. N. States, Robert T. Hinton.

Legislation: Samuel M. Wilson, Chairman; Lucien Beckner, A. M. Peter.

On duty-free importation for scientific institutions: Robert T. Hinton, Chairman; A. W. Homberger, M. N. States.

On the reform of the calendar: P. P. Boyd, Chairman; R. G. Will, A. R. Middleton.

The following 12 persons who were elected at the last meeting have qualified and been added to the roll as active members:

J. Holmes Martin, Experiment Station, Lexington.
Herbert B. Fenn, Berea College, Berea.
Donald W. Pugsley, Berea College, Berea.
E. M. Hoffman, Berea College, Berea.
Luther M. Ambrose, Berea College, Berea.
Hurst H. Shoemaker, Berea College, Berea.
D. L. Kennamer, Eastern State Normal School, Richmond.
H. L. Donovan, President Eastern State Normal School, Richmond.
L. Y. Lancaster, Western State Normal School, Bowling Green.
Chas. L. Taylor, Western State Normal School, Bowling Green.
E. H. Cannon, Registrar, Western State Normal School, Bowling Green.
Miss Esther Ewell, Berea College, Berea.

The following 6 members of the A. A. A. S. were elected to membership by the Council and have been enrolled as national members:

Stanley G. Bandeen, Bandeen Hospital, 1435 S. 4th St., Louisville.
G. E. Pennebaker, Teachers College, Murray.
Dean W. Rumold, Eastern State Normal School, Richmond.
E. M. Womack, 2021 Grasmere Drive, Louisville.
W. A. Price, Experiment Station, Lexington.
R. A. Kent, President Univ. of Louisville, Louisville.

We have lost one member by death, namely, Prof, A. M. Miller, Professor Emeritus of Geology and former Dean of the Arts and Science College, of the University of Kentucky.

Twenty-one have been dropped for various reasons.

Number of members at time of last meeting (1929)	176
Added since that date	18
	194
Lost since that date	22
Total to date	172

The total membership is now 172, including 83 national and 54 local members—making 137 active members besides 22 corresponding members and 13 honorary members.

Active members in good standing, including 2 life members	110
Active members in arrears 1 year	16
Active members in good standing including 2 life members	110
Corresponding members	22
Honorary members	13
	172

Our active members are distributed among the educational institutions of the state as follows:

University of Kentucky	49
Berea College	18
University of Louisville	7
Centre College	6
Eastern State Normal	5
Western State Normal	4
Murray State Normal	3
Georgetown College	3
Transylvania College	2
Wesleyan College	1
Morehead State Normal	1
Hamilton College	1
Louisville College of Pharmacy	1
	101

On July 31, 1929, a meeting of the Legislation Committee was held in Judge S. M. Wilson's office. After some discussion, Chairman Wilson expressed the opinion that the Academy's influence for good and opportunity to accomplish its proper objects would be greater as a voluntary organization than as a state institution. He thought, however, that the Academy should be incorporated and suggested that we get more information about the organization of other Academies and scientific societies and assemble all material that we think should go into the articles of incorporation. When this has been done, Mr. Wilson will put it into legal form, without charge. After incorporation, the Academy should ask the Legislature for an appropriation for publishing Transactions. All present agreed to this program.

On November 9, 1929, the Secretary received a report from the Chairman of the Committee on Change of Calendar which he submitted to the Council for action, which was as follows: "Our recommendation is to the effect that the Kentucky Academy of Science support the movement for revision of the calendar and also bring what influence it has to the support of the thirteen month year." This was voted on by the Council in the affirmative. The resolution was transmitted to the National Committee on Calendar Simplification, George Eastman, Chairman, and was acknowledged by his Secretary as follows: "This is to thank you in behalf of Mr. Eastman for your letter of December 5 advising us that the Council of the Kentucky Academy of Science had passed a resolution endorsing calendar simplification and the thirteen month calendar. It will be our pleasure to add the name of this society to our list of endorsers."

December 6, 1929, the Secretary received a report from the Committee on the Tariff and submitted same to the Council on the same day, to be voted upon. The resolution was as follows: "Your committee, after reading the material which was furnished to it and on the basis of a somewhat limited experience feels that the scientific industries of this country should have the benefit of a reasonable tariff. The committee feels that in many cases the tariff at present may be quite satisfactory. However, it will be quite impossible for it to definitely state what is a reasonable tariff. The committee is willing, therefore, to leave that to the judgment of those who are more intimately acquainted with the situation. It does, however, favor a reasonable tariff for the protection and for the development of scientific industries in America."

In December, some 50 or more individual letters were written to members of the A. A. A. S. residing in Kentucky who are not members of the Kentucky Academy, inviting them to join—the list having been furnished by Dr. Burton E. Livingston, Permanent Secretary of the A. A. A. S., Washington, D. C. So far, six have accepted: Dr. Stanley Bandeen, Louisville; Dr. Dean W. Rumold, Richmond; Mr. E. M. Womack, Louisville; Prof, G. B. Pennebaker, Murray; Dr. W. A. Price, Lexington; and Dr. R. A. Kent, Louisville, and they have been duly elected by the council.

On January 30, 1930, the Secretary received a communication from the Mammoth Cave National Park Association (Mr. Huston Quin, Chairman) asking the Academy to support a bill in the Legislature for the purchase of the Mammoth Cave and vicinity as a national park. Accordingly the Secretary wrote Hon. J. J. McBrayer, of the Senate, and Messrs. J. L. Vallandingham and J. G. Brown, of the House, asking them to support this bill, and sent Judge Quin a copy of our membership list.

A meeting of the Council was held on March 5th, in Dr. Peter's office, Scovell Hall, at which the date and place of the annual meeting was determined upon. Other business during the year was transacted by letter.

A. M. Peter, Secretary.

PAPERS PRESENTED AT THE 17TH ANNUAL MEETING, May 3, 1930.

1. The Teaching of Science in Colleges of Liberal Arts. (President's Address.) Frank L. Rainey, Centre College. (See Centre College Magazine).

2. Iodine in Kentucky. J. S. McHargue and W. R. Roy, Agricultural Experiment Station. (Abstract.)

Kentucky is about 500 miles inland from the nearest point on the sea. The transportation of iodine thru vapor from the sea over this distance does not appear plausible. However, iodine was found in a sample of rain water collected at the Kentucky Agricultural Experiment Station but no trace was found when air was aspirated thru a solution of caustic soda. Iodine has been found in small quantities in the water used for domestic purposes in more than half of the counties of the state. Recent investigations indicate that forage crops and vegetables grown on Kentucky soils contain appreciable amounts of iodine. Limestone rocks are the principal source of iodine in Kentucky. No areas are known in Kentucky where goiter is more prevalent than in other parts. Apparently the iodine content of natural waters and foods produced in Kentucky is adequate for the normal growth and metabolism of animals.

3. Some Abnormalities in Rats. J. S. McHargue and W. R. Roy, Kentucky Agricultural Experiment Station. (Abstract.)

Stock rats fed a satisfactorily balanced grain ration show occasional abnormalities. Two rats, one littered in 1928 and one in 1930, have developed unusually long, brittle teeth, during the six years a colony has been kept at the Kentucky Agricultural Experiment Station. The teeth continued to grow after being clipped and it was necessary to keep them clipped to permit the rat to feed. Analyses of the teeth of these rats showed, in both cases, abnormally low calcium content and extremely high phosphorus and magnesium content in comparison with average analyses of normal rat teeth.

Another striking observation was the appearance of rings on the tails of three rat pups which were of a litter of six, the other three being normal in every respect. Analyses of the carcasses of two of the "ring-tailed" rats gave no clue as to the cause of the abnormality. The third abnormal rat was kept under observation and segments of the tail dropped off at intervals, until only a stub remained. Otherwise he seemed normal and attained normal growth.

4. The Effect of Manganese, Copper and Zinc on the Growth and Metabolism of Aspergillus flavus and Rhizopus nigricans. J. S. McHargue and R. K. Calfee, Kentucky Agricultural Experiment Station. (Abstract.)

The effects of known amounts of manganese, copper and zinc were investigated in pure cultures of *A. flavus*. Each constituent of the basal medium and control culture was known by chemical tests to be free from the elements studied. Factors other than the quantity of these elements in the medium were kept constant. Optimum concentrations of manganese, 2.5 ppm, copper, 5 ppm, and zinc, 1 ppm, were established. Slight growth occurred in the absence of these elements. Their presence in excessive amounts proved toxic and reduced growth. Combinations of two produced more growth than the presence of single elements, and the maximum growth was obtained in the presence of the three. The presence of manganese, copper and zinc influenced the rate of absorption of other elements such as calcium, phosphorus and magnesium, and increased the synthesis of ether soluble products. No differences in structure could be detected microscopically.

5. The Heritability of the Effects of Ultra-violet and Infra-red radiations on the Fission Rate of Paramecium caudatum. A. R. Middleton, Biology Dept., University of Louisville. (Abstract.)

The paper reports experiments designed to throw light on the question of the possibility of modifying living systems by environmental factors so that the modifications persist in later

generations in the absence of the factor which called them forth. Twenty lines of a single clone of *P. caudatum* were given 30 seconds daily exposure at 30 inches from a Burdick-Cooper-Hewitt mercury anode, tungsden cathode, quartz lamp, for 15 days. A control was carried on the the same way, without irradiation. The fission rate was determined by "balanced selection." The irradiated animals averaged 8.35 ± .07 fissions per line, for the 15-day period, with a range of 4 to 11. The controls averaged 23 ± .06 fissions, with a range of 20 to 27. For a test period of 15 days the animals were continued under balanced selection, without irradiation. During this period the average for the progeny of the radiated animals was 11.05 ± .09, with a range of 4 to 14, and for the controls, 14.28 ± .03, with a range of 10 to 18. The standard deviation of the irradiated set was 1.96 ± .03 and for the controls, 1.08 ± .03; for the ex-irradiated animals this was 2.73 ± .04, and for the controls, 1.92 ± .03. The coefficient of variability for the irradiated set was 21., and for the control, 7.82; for the ex-irradiated animals the corresponding figure was 24.7 and it was 13.4, for the controls.

A second experiment gave a similar result. The conclusion is that exposure to radiations of wave lengths 1849 to 3900 A caused a decrease in the fission rate which persisted in the descendants of the irradiated animals, thru as many generations as had been irradiated. Apparently, the question is answered affirmatively.

6. An Investigation of the Origin and Differentiation of the Hind Limb of Amblystoma by Means of Grafting Experiments. H. B. Lovell, Biology Dept., University of Louisville. (Abstract.)

The hind limb rudiment of *Amblystoma punctatum* was transplanted several segments anterior to its normal position. By this method it was found possible to locate the anlage of the limb from a week to ten days before its visible appearance. Such limbs developed in their new positions all the structural characteristics of normal limbs. By placing the limb bud in various orientations, it was found that both the dorso-ventral

and antero-posterior axes were polarized at the time the grafts were made. The dorso-ventral axis is not established in the forelimb until after the limb bud appears (Swett).

The limb reduplicated in a high percentage of cases. Altho reduplication was usually from the hip region, it also occurred in the thigh, shank, ankle, and foot. The extra limbs were mirror images of the original limbs. Histological examination revealed the presence of mesonephric tubules and gut tissue at the base of many of the grafts. The branching of the nerves in the grafts was exactly like that in normal limbs.

7. **X-Rays and Evolution.** John S. Bangson, Biology Department, Berea College.

A review of the literature of the efforts of men to artificially induce mutations in plants and animals, using darkness, variations of temperature, chemicals, drugs, radium and X-rays.

8. **The Isolation and Identification of Some Mastitis Streptococci and Notes on the Diagnosis of the Disease.** L. Y. Lancaster, Western Ky. State Normal School. (Abstract.)

Infectious mastitis is a common disease among dairy cows and is known to affect other farm animals also. There is little disagreement about the causative organism and its transmission but the degree of pathogenicity of the organism for humans is much disputed.

Diagnostic tests were made at intervals from October the first, 1929, to January 1, 1930, on a herd of twenty cows. Routine bacteriological technique was employed in taking the samples and three tests were made each, namely; centrifuge and smear, methylene blue reductase and plate. Several isolations were made from typical streptococcus colonies. Their growth was observed upon blood agar and then typed by the Holman, Brown, Blake method. The predominant form was a green ring type of streptococcus.

It was concluded that the causative organism in this outbreak was a non-hemolytic green zone streptococcus and that segregation of infected animals, and disinfection of infected stalls would check the spread of the disease.

9. Distribution of Total Nitrogen in Relation to Regeneration in Salix nigra. P. A. Davies, University of Louisville. (Abstract.)

A correlation has been found between growth and the amount of available carbohydrate and nitrogen in the plant. Regeneration is a growth process, so the carbohydrate-nitrogen relationship should hold equally well for regeneration as for growth. Studies in regeneration in cuttings of *Salix nigra* indicate that shoots develop in the area of highest total nitrogen per gram dry weight of the cutting and roots regenerate in the area of lowest total nitrogen per gram dry weight, in cuttings with well developed polarity. Analyses of material in the early stages seem to indicate that the initial changes prior to regeneration and development are not dependent on the translocation of nitrogen.

10. Abnormal Branching in Ailanthus. P. A. Davies, University of Louisville. (Abstract.)

The normal method of branching in *Ailanthus glandulosa,* Desf. is forked and divided. The large pithy area in the center is not continuous between stem and branch, and the intervening area is occupied by wood. The abnormal branching is not forked and irregular, but fan-shaped, flattened, and regular. Progressing from the base upward, the abnormal structure flattened more and more until, at the apex, seven distinct stems could be observed. Transverse sections of the abnormal branch show clearly that the pith is continuous thruout the flattened structure, differing in this respect from the normal condition. The leaf scars which appear abundantly and close together on the flattened surfaces, indicate beyond doubt that this condition is not simply a flattened stem, but an abnormal method in branching. This abnormal method differs so greatly from the normal that, occurring as they do, both normal and abnormal on the same plant, it is safe to consider the abnormal branch not simply a flattened stem, but a true vegetative mutation (bud sport).

11. The Growth of Chicks as Influenced by Vitamin D Supplements Given The Mother Hen. W. M. Insko, Jr., Ky. Agricultural Experiment Station. (Abstract.)

Reports the growth of chicks whose mothers were given the following treatments in addition to a basal ration. (1) confined in a house; (2) like (1) but irradiated 30 min. daily with a quartz mercury arc lamp; (3) like (1) but given cod liver oil equal to 2 percent of their feed; (4) wire screened, wire floored sun porch; (5) bluegrass range and sunshine (all-mash); and (6) bluegrass range and sunshine (grain and mash). In the first hatch, there were only very slight differences in the average percentage of calcium oxide in the chicks from the different pens. In the second hatch, there was very little difference in the average percentage of ash in the femurs of the pure-bred or cross-bred chicks from the different pens, and very little difference in the inorganic phosphorus content of the blood. There was a difference in body weight in favor of the chicks whose mothers received bluegrass range and sunshine. The chicks of the third hatch gave results like those of the second hatch. The inorganic phosphorus content of the blood was smaller than in those of the second hatch, since these chicks were continued on the ration longer. The chicks of pens 5 and 6 were heavy in comparison with the other lots, except those of pen 2, whose mothers received irradiation. It seems that chicks from hens receiving an adequate supply of vitamin D, supplemented by green feed, grow more rapidly than chicks from hens not adequately supplied with this vitamin.

(A full report will be published in Poultry Science.)

12. The Control of Error in Scientific Experimentation. G. D. Buckner, Ky. Agricultural Experiment Station. (By title.)

13. The Use of Trinitrobenzene in the Determination of Magnesium. J. Stanton Pierce, Chemistry Dept., Georgetown College. (Abstract.)

For almost every insoluble magnesium compound, there is a corresponding insoluble calcium compound. Determination of magnesium as one of these insoluble salts, or separation of it from solution as one of these salts, in order that it may be determined volumetrically, can be done only in the absence of calcium salts.

Magnesium hydroxide is one of the few compounds of this metal which is less soluble than the corresponding calcium compound. Trinitrobenzene, in ten per cent alcohol solution, gives a dark brick red color with saturated calcium hydroxide solution but does not with saturated magnesium hydroxide solution. Trinitrobenzene, therefore, makes a satisfactory indicator for the determination of magnesium in the presence of calcium. The determination may be made by direct titration, by precipitation of magnesium hydroxide, filtration of the precipitate, solution in standard acid, and titration of the excess, or by precipitation with excess alkali, dilution of the solution to a definite volume, filtration of part of the solution, and titration of the excess alkali in an aliquot. (See Indus. & Eng. Chem., Vol 20, p. 436, April, 1928, and Ibid. Anal. Ed., Vol. 1, p. 25 and Vol. 2, p. 193.)

14. **Air Adsorption in Water Vessels.** Charles Hire, Murray State Teachers' College. (By title.)

15. **Observations on the Concretions of the Champlainian Clays of the Connecticut Valley.** F. E. Tuttle, Chemistry Department, University of Kentucky.

Some curiously shaped concretions were exhibited and discust.

16. **X-Rays In Industry.** T. M. Hahn, Physics Dept., U. of Ky. (Abstract.)

A brief review of some of the more recent developments in the use of X-rays industrially. The application of X-ray methods in the examination of castings, particularly to determine correct gating and pouring methods on intricate castings, and for the location of flaws in castings unusually valuable for various reasons. The value of radiographic and fluoroscopic examination in miscellaneous industries; X-ray examinations and advertising; ionization and photographic methods of determining the amounts of heavy elements or compounds present in lighter materials. A brief non-technical explanation of X-ray diffraction phenomena, and a description of a few of the commercial applications of diffraction methods.

17. **An Ultra-Violet Photometer.** J. J. Coop, Physics Dept. Univ. of Kentucky. (Abstract.)

Describes an instrument for measuring the distribution of ultra-violet radiation from a given source, and for comparing the relative intensities of various sources. A quartz photoelectric cell was connected in series with a battery and a sensitive galvanometer. The cell was found to give a current which was directly proportional to the intensity of the incident light. By means of glass filters successive portions of the ultra-violet spectrum may be eliminated and the intensity of these regions measured by the deflection of the galvanometer. A method for determining the intensities of the mercury lines was developed and the results of measurements made of a quartz and a glass mercury arc were given.

18. **A Determination of the Coefficient of Viscosity of Air by Means of a Torsion Pendulum.** Jarvis Todd, Physics Dept., Univ. of Kentucky. (Abstract.)

If a cylindrical torsion pendulum of radius, R; length, L; and moment of inertia, I, be made coaxial with a very long tube of radius S and then be permitted to oscillate, it may be shown that:

$$\eta = \frac{Y\ N\ I\ (S^2-R^2)}{\pi\ L\ S^2\ R^2},$$

where η is the coefficient of viscosity of air, N is the frequency of the damped oscillatory S. H. M. and Y is the logarithmic decrement of the motion. Ideally η may be determined by simply evaluating the quantities in the right hand member of this equation since the mathematics predicates that the S. H. M.

is damped solely by the viscous medium in which the pendulum oscillates. However, in the physical experiment the suspension helps to damp the motion. Thus $Y = Y_a + Y_s$. Now Y_a may be determined by measuring Y which is the decrement when the pendulum swings inside the encasing tube and then measuring Y_s, the decrement when the pendulum oscillates outside the tube. The Y_a thus determined showed a consistent variation with the amplitude. This variation was traced to the elastic after working and plasticity of the suspension. Determination of the absolute Y_a was made from the difference of the curve of variation of Y with the amplitude and the curve of variations of Y_s with the amplitude. These curves were representative curves obtained by averaging the ordinates over equal ranges of abscissae arbitrarily chosen. Such averaging was made necessary because the points plotted were logarithms of the amplitudes and a slight error in observation produced an error in opposite direction when the logarithms of successive observations were plotted. The value of Y_a determined from these curves was .01123. This value was too small because the above elimination of the effect of the suspension unavoidably deducted too great an amount, since it included the influence which the entire air exerted upon the pendulum when the encasing tube was removed. Computation of this last effect was made by considering the pendulum to oscillate in a tube of infinite radius. This computation added .00052 to Y_a making the absolute value of the logarithmic decrement .00175. With this absolute value of Y the coefficient of viscosity of air at room temperature (22° C) was found to be 182-7 x 10^{-6}. This value is .24% greater than that used by Millikan in his determination of the electronic charge.

19. The Triode As A Photo-electric Cell. J. Richard Haynes, Physics Dept., Univ. of Kentucky. (Abstract.)

The process of adaptation of the triode for use as a photoelectric cell is extremely simple. A burnt out or discarded vacuum tube is selected. It seems to make little difference what type or make of tube is used, with the exception of WD 11 and UV 199 which are unsuitable for this purpose. The first step consists in volatilizing a portion of the 'getter' which consists of magnesium metal placed in the tube by the manufacturer to absorb the gases remaining in the tube after evacuation. To do this the tube is placed over a Bunsen flame with the projection on the base down so that the flame touches the tube directly below the plate, and it is held in this position until a clear window about one and a half inches in diameter is formed. This vaporized metal condenses all over the inside surface of the tube giving a 'fresh' photo-active surface on the plate and usually at the same time shorting the lead-in wires, which, of course, would render the tube useless. In order to remedy this the tube prongs are brought separately in contact with a source of high potential such as an induction coil. This causes a spark to jump across the lead-in wires, the heat from which is sufficient to vaporize the "getter" at this point. The cell is then ready for use. The plate is connected to the positive terminal of the 'B' batteries. The negative terminal is connected to the filament, and the galvanometer is placed anywhere in the circuit. With such a cell, using a galvanometer whose constant K is equal to 8×10^{-6} and a 200 watt lamp as a source of light, a deflection of 3.5 cm. at a distance of 15 cms. was obtained. This is about one-ninth as sensitive as a commercial photoelectric cell. This cell does not fatigue quickly. It gives a current which is proportional to the amount of light which is incident upon it.

20. A Vacuum Tube Impedance Bridge. G. A. Stone, Physics Dept., Univ. of Kentucky. (Abstract.)

An arrangement of two vacuum tube circuits for the comparison of impedance is described. The absolute magnitude of any combination of impedances may be determined in terms of the square root of the product of two pure resistances. Operation on the characteristic curves of the tubes takes place in the vicinity of the intersection of the two alternating current characteristics. This intersection is accomplished by inserting additional resistance in the output circuit of one of the tubes. The operation involved in balancing the instrument is a null method, employing a galvanometer whose sensitivity is controlled by a 5000-ohm potentiometer used as a universal shunt. It is possible to measure impedances of any nature over a range from 10 ohms, to 100,000 ohms, with an accuracy of one half of one per cent.

21. The Origin of Sial*. Lucien Beckner, Louisville, Ky. (Abstract.)

The author argues that the current explanations of Sial's origin are outgrowths of discarded dogmas concerning earth's interior and growth, of which the nebular hypothesis is one, and that acceptance of the planetesimal hypothesis renders these no longer tenable. He suggests that Sial is the relic of a planetoid, or great planetesimal, which crashed into the sima-surfaced earth. He states that many observed phenomena can not be accounted for by supposing Sial to be an evolutional growth from a rotational spheroid with central gravity, gradational density, and symmetrically arranged material, such as the sima-surfaced earth must have been; but that most of these can be accounted for by considering them due to forces and materials of celestial origin.

Of these phenomena cited are the erosional and organic evolutions, or the procedures of all earthly things subsequent to Sial's appearance, which are so sharply different from the evolution or procedure precedent thereto that they show that Sial could not have been an evolutional growth from Sima. This sharp break in earth's history indicates that Sial was possibly the origin or cause of life; but, be this as it may, it certainly was the cause of its rapid development. The paper states that Sial's presence was not only the beginning but the cause of earth's diastrophic, orogenic, volcanic, and erosional history; all being but efforts of earth to distribute the excess foreign material—Sial—evenly over its surface, as rotational and gravitational laws demand; and that when this is finally done, isostatic evolution will have ended and there will again be a lifeless world covered with a Sial crust and water mantle,

*From Si, silicon, and Al, aluminum, referring to the great mass of granitic rocks on which the northern continents appear to rest.

which will so remain until a new celestial visitor arrives, large enough to cause another worldwide disturbance, a new evolution.

22. The Relation Between Recidivism and Mental Deficiency*. Clara Chassel Cooper, Richmond, Ky. (Abstract.)

The paper presents one aspect of a study of the criminal propensity of the feeble-minded included in a research on the relation between morality and intellect. Attention is called to the seriousness of the problem presented by recidivism, both in this country and abroad; first, quite apart from its relation to mental deficiency, and, secondly, complicated by mental deficiency in the offender. The findings of a number of investigations, representing several different countries, which bear upon the relation between recidivism and mental deficiency, are analyzed. The following questions are discussed:

Are repeaters in crime more likely to be feeble-minded than people in general?

Are repeaters in crime more likely to be feeble-minded than first offenders or criminals in general?

Three studies of repeated offenders agree in reporting a larger percentage of feeble-mindedness among recidivists than the most extreme estimates would posit for the general population, and justify an affirmative answer to the first question. The divergent findings of a large number of studies of delinquents in which recidivists are compared with first offenders and with groups of criminals as a whole preclude the formulation of a final answer to the second question. These divergent findings may be explained in part by the method of obtaining information as to the previous offenses of a delinquent, the method of evaluating the intelligence of the offender, the artificial restraint of the feeble-minded, and the ability of the more intelligent offenders to profit by a court experience.

*The paper consisted of selections from a longer study of this subject to be included in a forthcoming book, entitled *The Relation Between Morality and Intellect: a Compendium of Evidence Contributed by Psychology, Criminology, and Sociology.* (Address Bureau of Publications, Teachers' College, Columbia University.)

23. How We Come to be What We Are or, How We Acquire New Forms of Behavior—Especially a Young Child Acquiring Motor Control for Walking. Miss Anna L. Payne, Home Economics Dept., Berea College, (Abstract.)

An observational study of a 12-months-old child during the period when he was learning to walk. By observing the child in his play during the hour immediately following his afternoon nap, about 3 to 4 p. m., three afternoons each week, from the time he was 12 months old to the time he was 16 months and 11 days old, 35 hours of behavior were recorded. All the child did and said or attempted to say, and all that was done or said to the child during observation was immediately recorded. A graphic representation of the forms of behavior observed showed some 24 minor forms, recorded in their chronological order of appearance and as to their frequency of occurrence in each of the 35 observations. Out of the 24 forms of behavior, *creeping, hitching, sitting, standing with support* and *walking with support,* were constant from the beginning of the study, or forms which had been acquired. *Standing with support* was diminishing in use about the time the child learned full motor control for *walking alone,* at 14 months and 9 days, or at the 19th observation. *Pulling body to standing position, sitting down from standing position, climbing stairs,* with its reverse performance of coming down stairs, *sitting down in chairs,* and standing up again all seem important factors in ultimate motor control for walking. Raising the body to a standing position as distinguished from pulling the body to a standing position appeared about the time the child began taking a few steps alone. Other minor forms of behavior which were analyzed from the records did not stand out as important, but seemed to be a part of the orientation of the body for walking alone.

Some conclusions drawn from this study were:

1. New forms of behavior appear to be acquired by building up on forms already acquired; as, motor control for sitting was a basic acquired form of behavior without which element of balance the child could not make new connections which culminated in walking alone.

2. Maturation plus multiple response, plus the law of exercise gives the orientation which Franck (L. K.—Problem of Learning, Psych. Rev. 33, 340, 1926.) says gives insight, as sitting plus the many minor forms of behavior observed, exercised by both frequency and repetition, integrates in the insight for the major problem of walking.

3. Motivation, as encouragement by adult saying, "Stand up B..................", when child was in state of readiness on hands and knees, led to a series of performances, (minor forms of behavior already used singly) which culminated in walking 3 steps.

4. Motivation plus insight as, child left by himself downstairs climbed whole flight of stairs to get to mother and sister whom he heard talking up-stairs; again as, child left by himself in one room, in order to get to person in the next room, stood up from sitting position, in his small chair, turned around, and with a verbal expression of explanation walked alone a distance of 15 feet to the person in the next room, the first time he had taken more than 3 steps alone, and from that time on walked everywhere.

24. The Variations of the Same Students Thru A Series of Tests and Scholarship Records. Keh-ching Chen, University of Kentucky. (Abstract.)

The purpose of the study was to determine the extent to which one may expect college freshmen to vary from one scholarship record or from a score in a placement test to a scholarship grade or test in another subject. One hundred and twenty University of Kentucky freshmen were given, at entrance, seven so-called placement tests and scored on each of them. The scholarship grades to be compared with these scores were those made by the freshmen during their first and second semesters in English and Mathematics, and also their total scholarship standing for the two semesters.

From the comparison the author concludes,, so far as his data indicate, that the tendency is for the same student to vary as much from the record in one of these kinds of activity to another as the difference between the average of the freshmen

above the middle and the average of the freshmen below the middle in a single kind of record. This variation of the same person from one activity to another is of great social significance. Mr. Chen's master's thesis, setting forth this research, is on file in the library of the University of Kentucky.

25. A Critique of Humanism. John Kuiper, Philosophy Dept., Univ. of Kentucky. (Abstract.)

Contemporary Humanisms find themselves divided from within. The passing away of an old, well-established order has bred instability of belief, discontent and a desperate need for some firm faith in the ability of the human animal to achieve a new orientation. The Humanists disagree on the "distinctly human" qualities of man in contrast with the biological; on the value of scientific knowledge and its offspring, technology; and on the need of more or less humanitarianism. In view of these wide divergences of opinion, there is at present no indication that Humanism has anything vital to offer in the way of clarification of thought or "revaluation of values."

26. The Habits of the American Alligator. A. M. Reese, Univ. of W. Va. Delegate of the A. A. A. S. (Abstract.)

Only two species of the genus Alligator are known, one found in China, the other in the United States, from southern North Carolina to southern Texas. The American alligator, *Alligator mississippiensis,* has been hunted for its hide and for mere wanton sport until its numbers have been greatly reduced. It is probable that the alligator seldom, if ever, attacks man. Its food consists of practically any kind of animal matter, and even a certain amount of vegetable matter may at times be eaten. It is at times cannibalistic. Since it is especially fond of crayfish and gars, Kellogg thinks its feeding habits are beneficial to man in spite of the birds and mammals which it eats.

The alligator builds a nest of flags, grass or other vegetable matter on the banks of the "hole" in which it lives and near its "cave." In the nest, which may contain a cubic yard, more or less, of vegetation, it lays from one to four or five dozen eggs, about thirty being an average number. The nest seems to be for the protection of the eggs against drying and against extremes of temperature, rather than to produce heat. The eggs hatch in eight to ten weeks, the baby alligator being about eight inches long. Since the egg has a thick, calcareous shell and is buried in a compact mass of vegetation it is likely that the female alligator aids her just-hatched young to escape by digging them out of the nest. At the time of hatching the young alligator makes a squeaking call that may be heard for several yards.

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A. M. PETER and ETHEL V. T. CASWALL

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OFFICERS

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President, V. F. Payne, Transylvania College, Lexington.
Vice-President, Clara C. Cooper, Eastern Kentucky State Teachers' College, Richmond.
Secretary, Alfred M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A.A.A.S., A R. Middleton, University of Louisville, Louisville.

1931—1932

President, Anna A. Schnieb, Eastern Kentucky State Teachers' College, Richmond.
Vice-President, Charles Hire, Murray State Teachers' College, Murray.
Secretary, Alfred M. Peter, Experiment Station, Lexington.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Councilor to A.A.A.S., A. R. Middleton, University of Louisville, Louisville.

In Memoriam

He has crossed the river and is resting
in the shade of the trees:

Charles G. Crooks, 1860—1931

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.

MEMBERSHIP FOR THE YEARS 1930-1 AND 1931-2

C indicates corresponding member; H, honorary member; L, life member; N, national member; *, no longer a member; ‡, deceased.

	Name and address	Branch of science
H.	Abell, Irvin, Louisville	Medicine
	Adams, Kerney M., Eastern Ky. Teachers Col., Richmond	Social Sci.
	Allen, R. S., Univ. of Kentucky, Lexington	Anat. & Physiology
N.	Allen, W. R., Univ. of Kentucky, Lexington	Zoology
	Ambrose, Luther M., Berea College, Berea	Physical Science
N.	Anderson, W. S., Univ. of Ky., Lexington	Genetics
N.	Averitt, S. D., Experiment Station, Lexington	Chemistry
N.	Baker, Alson, Berea	Anthropology
C.	Bancroft, Geo. R., 255 Roslyn Ave., Glenside, Pa.	Chemistry
N.	Bandeen, Dr. Stanley, 1456 S. 4th Ave., Louisville	Med. Sci.
N.	Bangson, John S., Berea College, Berea, Ky.	Biology
	Banks, Edgar, Eastern Ky. Teachers Col., Richmond	Chemistry
*	Bassett, G. C., Gettysburg College, Gettysburg, Pa.	Psychology
N.	Beckner, Lucien, 311 W. Chestnut St., Louisville	Geology
N.	Birckhead, E. F., Supt. City Schools, Winchester	Education
	Bishop, Harlow, Univ. of Louisville	Biology
	Blackburn, Walter E., Murray State Teachers Col.	Chemistry
C.	Blumenthal, P. L., 316 Parker Ave., Buffalo, N. Y.	Chemistry
N.	Boggs, Jos. S., 109 Watson Court, Frankfort	Engineering
	Bottom, Curtis H., Centre College, Danville	Biology
N.	Boyd, Paul P., Univ. of Ky., Lexington	Mathematics
	Boyden, Ruth, Univ. of Ky., Lexington	Home Ecs.
N.	Brauer, Alfred, Univ. of Ky., Lexington	Zoology
N.	Brown, L. A., Experiment Station, Lexington	Chemistry
N.	Browning, Iley B., Ashland (Box 129)	Geology
C.	Bucher, Walter, U. of Cincinnati, Cincinnati, Ohio	Geology
N.	Buckner, G. Davis, Experiment Station, Lexington	Chemistry
N.	Bullitt, Wm. Marshall, Inter-Southern Bldg., Louisville	Math., Astron.
	Burroughs, W. G., Berea College, Berea	Geology
H.	Butts, Charles, U. S. Geological Survey, Washington, D.C.	Geology
	Caldwell, C. E., Eastern Ky. Teachers Col., Richmond	Mathematics
N.	Caldwell, Morley A., Univ. of Louisville, Louisville	Psychology
*	Canon, Ernest H., Western St. T. C., Bowling Green	Education
	Capps, Julian H., Berea College, Berea	Chemistry
N.	Carmichael, H. St.G. T., Ky. Rock Asphalt Co., Kyrock	Civil Eng.
	Carter, Ashby B., Eastern Ky. T. C., Richmond	Agriculture
N.	Caslick, Edward A., Claiborne Stud, Paris	Vet. Sci.
*	Chalkley, Lyman, Univ. of Ky., Lexington	Law
	Chinn, Harriette L., Eastern Ky. T. C., Richmond	Biology

C. Clark, Friend E., Univ. of W. Va., Morgantown, W. Va. .... Chemistry
Clashman, W. H., 1400 S. Brook St., Louisville .... Biology
Clay, Thelma, 430 Breck Ave., Richmond .... Zoology
N. Clement, B. E., Holly Fluorspar Co., Marion .... Geology
Coates, J. D., Eastern Ky. Teachers Col., Richmond .... Education
N. Cook, E. Wilbur, Centre College, Danville .... Biology
* Cooper, Mrs. Clara C., 50 Morningside Dr., New York ..... Psychology
N. Cooper, Thomas P., Director, Experiment Sta., Lexington........Agri.
* Corley, Grover L., Univ. of Louisville, Louisville .... Chemistry
H. Coulter, Stanley, Lafayette, Ind. .... Botany
C. Cox, Benjamin B., 26 Broadway, New York, N. Y. .... Geology
Cox, Meredith J., Eastern Ky. Teachers Col., Richmond .... Chemistry
‡ Crooks, C. G., Centre College, Danville .... Mathematics
* Crouse, C. S., Univ. of Ky., Lexington .... Mining Eng.
N. Cuff, Noel B., Eastern Ky. Teachers Col., Richmond ...... Psychology
C. Currier, L. W., U. S. Geol. Survey, Washington, D. C. .... Geology
N. Curry, Gordon L., Louisville Col. of Pharmacy, Louisville...Chemistry
N. Davis, P. A., Univ. of Louisville, Louisville .... Biology
H. Day, Arthur L., Director, Geophysical Lab., Washington ..... Geology
Desjardins, Louis, 125 W. St. Clair St., Cincinnati, O. .... Geology
H. Detlefsen, J. A., The Wistar Inst. of Anatomy, Phila, Pa. .... Genetics
N. Didlake, Miss Mary L., Experiment Sta., Lexington ...... Ent. & Bot.
N. Dimock, W. W., Experiment Station, Lexington .... Vet. Sci.
N. Donovan, H. L., Pres. Eastern Ky. T. C., Richmond .... Education
N. Eddy, C. O., Experiment Station, Lexington .... Entomology
* Edwards, Philip R., Experiment Station, Lexington .... Vet. Sci.
N. Erikson, Miss Statie, Univ. of Ky., Lexington .... Home Ecs.
* Ewell, Miss Esther, 5757 Woodlawn Ave., Chicago .... Science
* Fehn, Arthur R., Centre College, Danville .... Mathematics
Fenn, Herbert B., Berea College, Berea .... Mechanics
N. Fergus, E. N., Experiment Station, Lexington .... Agriculture
Ferguson, Dorcas Louise, Berea College, Berea .... Chemistry
N. Flexner, Morris, Heyburn Bldg., Louisville .... Med. Sci.
C. Fohs, F. Julius, 60 Broadway, New York, N. Y. .... Geology
Ford, M. C., Western Ky. T. .C., Bowling Green .... Agriculture
N. Fortney, B. B., Louisville Lighting Laboratory, Louisville ......Physics
N. Frank, Louis, 614 Heyburn Bldg., Louisville .... Med. Sci.
* Freeman, Ellis, Univ. of Louisville, Louisville .... Psychology
N. Fremd, Lydia K., Eminence, Ky. .... Education
N. Funkhouser, W. D., Univ. of Ky., Lexington .... Zoology
C. Gardner, J. H., Exchange Nat. Bank Bldg., Tulsa, Okla. ..... Geology
N. Garman, H., 638 South Limestone St., Lexington .... Biology
N. Gillis, Ezra L., Univ. of Ky., Lexington .... Education
H. Glenn, L. C., Vanderbilt Univ., Nashville, Tenn. .... Geology
N. Good, E. S., Experiment Station, Lexington........ Animal Husbandry

	Graham, Charles C., Berea College, Berea	Science
*	Graham, James L., Lehigh University	Psychology
N.	Guilliams, John Milton, Berea College, Berea	Psychology
LN	Guthrie, William A., Southern Ky. Sanitorium, Franklin	Med. Sci.
	Harms, Amanda, Experiment Station, Lexington	Biology
H.	Hart, E. B., Univ. of Wisconsin, Madison, Wis.	Nutrition
*	Hatfield, Chas., Georgetown College, Georgetown	Mathematics
C.	Havenhill, Mark	Farm Economics
	Healy, Daniel J., Experiment Station, Lexington	Bacteriology
C.	Hendrick, H. D.,	Agriculture
	Hendricks, T. A., Berea College, Berea	Education
	Herndon, Thos. C., Eastern Ky. T. C., Richmond	Chemistry
N.	Hinton, Robert T., Georgetown College, Georgetown	Biology
N.	Hire, Charles, Murray State T. C., Murray	Physics & Math.
	Hoffman, E M., Berea College, Berea	Gen. Sci.
	Hoke, R. S., Morehead Teachers Col., Morehead	Gen. Sci.
N.	Homberger, A. W., Univ. of Louisville, Louisville	Chemistry
	Hull, F. E., Experiment Station, Lexington	Vet. Sci.
	Hume, O. F., (M. D.), Richmond	Medicine
N.	Hummell, A. D., Eastern Ky. Teachers Col., Richmond	Physics
	Hutchins. Wm. J., President Berea College, Berea	Education
N.	Insko, W. M., Jr., Univ. of Ky., Lexington	Nutrition
N.	Jensen, Milton B., Bowling Green	Psychol. & Edu.
N.	Jewett, H. H., Experiment Station, Lexington	Entomology
LN	Jillson, W. R., Frankfort	Geology
N.	Johnson, E. M., Experiment Station, Lexington	Plant Pathology
	Jones, S. C., Experiment Station, Lexington	Agriculture
	Jones, W. C., Eastern Ky. T. C., Richmond	Physicial Sci.
N.	Karraker, P. E., Experiment Station, Lexington	Agriculture
N.	Keffer, J. L., U. of Ky. Teachers College, Lexington	Chemistry
	Keith, Mrs. Chas. A., Eastern Ky. T. C., Richmond	Biology
	Kemper, D. C., Univ. of Ky. Teachers Col., Lexington	Education
N.	Kennamer, L. G., Eastern Ky. Teachers Col., Richmond	Geology
N.	Kent, R. A., President, Univ. of Louisville, Louisville	Education
C.	Kercher, Otis, Pike Co. Farm Bureau, Pittsfield, Ill.	Agriculture
	King, Miss Effie, Randolph College, Cisco, Texas	Biology
N.	Kinney, E. J., Experiment Station, Lexington	Agriculture
C.	Kiplinger, C. C., West Liberty St. T. Col., W. Va.	Chemistry
C.	Knapp, R. E.	Bacteriology
N.	Koppius, O. T., Univ. of Ky., Lexington	Physics
	Krick, Harriette V., Eastern Ky. Teachers Col., Richmond	Biology
	Kunkel, Mabel, 113 E. Walnut St., Richmond	Geog. & Geol.
	Lancaster, L. Y., Western Ky. T. C., Bowling Green	Biol. Sci.
	Lands, A. M., Univ. of Ky., Lexington	Physiology
*	Lee, F. S., Middlesboro	Geology

N. Leggett, J. L., Transylvania College, Lexington .... Psychology
C. Leigh, Townes R., Univ. of Florida, Gainesville, Fla. .... Chemistry
* Ligon, M. E., Univ. of Ky., Lexington .... Education
Lovell, Harvey B., Univ. of Louisville, Louisville .... Biology
N. Lutz, Florence, 2006 Grasmere Drive, Louisville .... Biology
Lynch, John R., Road Engineering Dept., Frankfort.......Engineering
N. McAllister, Cloyd N., Berea College, Berea .... Psychology
McCormack, A. T., State Board of Health, Louisville ...... Sanitation
N. McFarlan, Arthur C., Univ. of Ky., Lexington .... Geology
McGlosson, Georgiana, 347 High St., Richmond .... Geography
N. McHargue, J. S., Experiment Station, Lexington........... Chemistry
N. McInteer, B. B., Univ. of Ky., Lexington .... Botany
McVey, Frank L., President Univ. of Ky., Lexington........ Economics
* Marshall, Malcolm Y., (M.D.) .... Medicine
Martin, James H., Experiment Station, Lexington .... Chemistry
N. Martin, J. Holmes, Experiment Station, Lexington ...... Poultry Sci.
Mayes, Mildred Ann, College P. O., Richmond .... Geography
N. Mayfield, Samuel M., Berea College, Berea .... Geology
* Meader, A. L., Experiment Station, Lexington .... Chemistry
N. Middleton, Austin R., Univ. of Louisville, Louisville .... Biology
H. Miller, Dayton C., Case School of Applied Sci., Cleveland .... Physics
* Miller, Raymond, Cecilia .... Geology
* Miller, Richard C., Experiment Station, Lexington ...... Animal Husb.
N. Miller, W. Byron, Wallins Creek (Utilities Coal Corp.).....Engineering
H. Millikan, R. A., Calif. Inst. of Tech., Pasadena, Calif. .... Physics
N. Miner, J. B., Univ. of Ky., Lexington .... Psychology
N. Moore, William J., Richmond .... Education
C. Morgan, Thomas H., Calif. Inst. of Tech., Pasadena, Calif.....Biology
H. Moulton, F. R., Univ. of Chicago, Chicago, Ill. .... Astronomy
N. Muncy, V. E., 246 Sixteenth St., Ashland, Ky. .... Physics
N. Nash, William G., Georgetown College, Georgetown........... Physics
Nicholls, W. D., Univ. of Ky., Lexington .... Farm Ecs.
Noll, Waldemar, Berea College, Berea .... Physics
C. Nollau, E. H., 14 Norton St., Newburg, N. Y................. Chemistry
N. Norton, Mrs. Chas. F., Transylvania Col., Lexington...... Library Sci.
O'Bannon, Lester S., Univ. of Ky., Lexington .... Engineering
O'Donnell, W. F., Supt. of Schools, Richmond.......Philos. & Psychol.
Ogg, Earl F., Union College, Barbourville .... Chemistry
N. Olney, Albert J., Univ. of Ky., Lexington .... Horticulture
Osborn, John S., Clarence, Ky. .... Biology
N. Owen, O. Edwin, Berea College, Berea ....Zoology
N. Parker, George H., Ky. Actuarial Bureau, Louisville ..... Engineering
N. Payne, Anna L., Berea College, Berea...................... Home Ecs.
N. Payne, Martha, 156 McDowell Road, Lexington .... Zoology
N. Payne, V. F., Transylvania College, Lexington .... Chemistry

Pearson, Norma, 300 Linworth Pl., S. W., Washington, D.C......Botany
Pelluet, Dixie, Rockford College, Rockford, Ill. .... Biology
N. Pence, M. L., 635 Maxwelton Court, Lexington .... Physics
N. Pennebaker, G. B., Murray St. Teachers' Col., Murray .... Biology
N. Peter, Alfred M., Experiment Station, Lexington .... Chemistry
Pierce, J. Stanton, Georgetown College, Georgetown .... Chemistry
N. Pindar, L. Otley, Versailles .... Med. Science
N. Pohl, Erwin R., Mammoth Onyx Cave, Horse Cave .... Geology
N. Price, Walter A., Experiment Station, Lexington .... Ent. & Bot.
* Pryor, J. W., 417 West 2nd St., Lexington .... Physiology
Pugsley, Donald W., Berea College, Berea .... Mathematics
Pyles, Henry M., Wesleyan College, Winchester .... Biology
N. Rainey, Frank L., Centre College, Danville .... Biol. & Geol.
Ray, Mrs. Willie C., Supt. City Schools, Shelbyville ...... Education
Rhoads, McHenry, 1435 S. Limestone St., Lexington .... Education
Rhoads, Wayland, Experiment Station, Lexington .... Animal Husb.
H. Richardson, Charles H., Syracuse Univ., Syracuse, N. Y. ......Geology
H. Ries, H., Cornell Univ., Ithaca, N. Y. .... Geology
Robbins, Floy, Murray St. Teachers Col., Murray .... Geography
N. Roberts, George, Experiment Station, Lexington .... Agronomy
C. Roe, Mabel, 257 Roswell Ave., Long Beach, Calif. .... Plant Path.
Routt, Grover C., County Ag'l Agent, Mayfield .... Biology
N. Rumbold, Dean W., E. Ky. Teachers' Col., Richmond .... Biology
* Rush, R. I., Centre College, Danville .... Chemistry
C. Ryland, Garnett, Richmond College, Richmond, Va. .... Chemistry
N. Schnieb, Anna A., E. Ky. Teachers' College, Richmond.....Psychology
N. Seay, Maurice F., Union College, Barbourville .... Education
N. Semans, F. M., W. Ky. Teachers Col., Bowling Green.... Med. & Biol.
* Shepard, Nat L., Franklin Fluorspar Co., Marion .... Chemistry
Sherwood, T. C., Univ. of Ky., Lexington .... Zoology
Shoemaker, Hurst H., ... Gen. Sci.
Shutt, Chas. Noble, Berea College, Berea
Simpson, Eugene, 203 E. Fourth St., Lexington .... Ent. & Bot.
Smith, George D., Eastern Ky. T. C., Richmond .... Nat. Sci.
C. Smith, N. F., Citadel College, Charleston, S. C. .... Physics
H. Smith, William Benjamin, 9 Price Ave., Columbia, Mo. .... Philosophy
Snoddy, E. E., Transylvania College, Lexington .... Philosophy
N. Solomon, Leon L., The Solomon Clinic, Louisville .... Med. Sci.
C. Spahr, R. H. .... Physics
H. Spearman, C. S., Univ. of London, London, England ...... Psychology
N. Speed, Wm. S., 315 Guthrie St., Louisville .... Engineering
Spillman, C. O., City High School, Berea .... Agriculture
Starnes, Clarence, Science Hill .... Biology
Starnes, W. Gayle, Wellington Court, Richmond .... Physics
* States, M. N., Chicago, Ill. .... Physics

C. Stiles, Charles F., A. & M. Col., Stillwater, Okla. .... Entomology
* Strandskov, Herluf .... Plant Psysiology
Stouder, R. E., 2161 Eastview Ave , Louisville .... Geology
Suter, Arthur Lee, 1841 Col. Road, N. W., Washington, ...
D. C. .... Pharmacology
C. Tashof, Ivan P., Victor Bldg., Washington, D. C......Mining & Met'gy
Taylor, Charles L., Western St. T. C , Bowling Green .... Agriculture
N. Taylor, William S., Univ. of Ky., Lexington .... Education
* Terrell, Glanville, Louisa, Virginia .... Philosophy
Theiss, Emory W., 305 Ohio Ave., Jeffersonville, Ind. .... Biology
* Threlkeld, Miss Hilda, Hamilton College, Lexington .... Education
N. Thruston, R. C. Ballard, 118 W. Breckenridge, Louisville ..... Geology
Todd, Russell I., Richmond .... Dental Science
N. Valleau, W. D., Experiment Station, Lexington .... Plant Path.
N. Walker, Wm. H., Berea College, Berea .... Psychology
N. Warburton, Fred W., Univ. of Ky., Lexington .... Physics
H. Ward, Henry B., Univ. of Illinois, Urbana, Ill. .... Zoology
Watson, Barney, Milton College, Milton, Wis. .... Biology
Watts, Nola C., Waddy High School, Waddy .... Mathematics
N. Weidler, Albert G., Berea College, Berea .... Social Sci.
N. Wells, Carroll, 421 Fulton St., Jeffersonville, Ind. .... Biol. Sci.
White, J. Taylor, Eastern Ky. Teachers Col., Richmond ...... Geology
Whitehouse, Elmer Clay, Eastern Ky. T. C., Richmond....Agr. & Biol.
* Will, R. G., Centre College, Danville
N. Willey, W. M., West. Ky. Teachers Col., Bowling Green .... Education
N. Williams, Charles W., Reed Air Filter Co., Louisville ...... Chemistry
Wilson, Gordon, West. Ky. Teachers Col., Bowling Green, Ky.
N. Wilson, Latimer J., Franklin .... Astronomy
Wilson, Samuel M , 812 Trust Co. Bldg., Lexington .... Law
N. Wolfson, Alfred M., Murray St. Teachers Col., Murray .... Biology
Wolfson, Mrs. Marcelle, Murray St. Teachers Col., Murray.... Botany
N. Womack, E. M., 2021 Grasmere Drive, Louisville .... Zool. & Bot.
Wurtz, Geo. B., U. S. Weather Bureau, Lexington .... Meteorology
N. Wyatt, Grace, Murray State Teachers Col., Murray .... Biology
* Wyckoff, R. Tyson .... Education
N. Zarbell, Iver H., 1041 Cherokee Road, Louisville .... Biology

MINUTES OF THE EIGHTEENTH ANNUAL MEETING

President Payne called the Academy to order at 9 a. m., May 2, 1931, in Morrison Chapel of Transylvania College, Lexington. Present, about 40 members.

The Secretary's report was received and ordered filed.

The Treasurer's report, showing a bank balance of $94.82 was referred to the auditing committee.

The Secretary reported that the council had elected 24 persons to membership by letter ballot, namely:

R. S. Allen, University of Kentucky; W. E. Blackburn, Murray Teachers' College; C. E. Bottom, Centre College; N. A. Braden, Transylvania College; W. M. Caudill, Murray Teachers' College; N. B. Cuff, Eastern Teachers' College; C. O. Eddy, Experiment Station; Miss L. K. Fremd, Lees Junior College; E. L. Gillis, University of Kentucky; A. D. Hummell, Eastern Teachers' College; Miss H. V. Krick, Eastern Teachers' College; J. L. Leggett, Transylvania College; R. P. Meacham, University of Kentucky; W. J. Moore, Richmond; E. F. Ogg, Union College; L. O. Pindar, Versailles; Miss F. Robbins, Murray Teachers' College; C. C. Ross, University of Kentucky; M. F. Seay, Union College; F. M. Semans, Western Teachers' College; T. C. Sherwood, University of Kentucky; Roy Smith, Murray Teachers' College; W. M. Willey, Western Teachers' College, and Mrs. A. M. Wolfson, Murray Teachers' College.

On recommendation of the membership Committee, the following persons were elected unanimously to membership:

W. H. Clashman, Louisville; W. M. Clay, Transylvania College; L. Desjardins, Dayton Ky. High School and University of Cincinnati; Miss Olive Douglas, Transylvania and Hamilton Colleges; A. M. Lands, University of Kentucky; D. M. Polot, University of Louisville; E. E. Snoddy, Transylvania College; A. F. Stoner, Jeffersonville, Ind.; E. W. Theiss, Jeffersonville, Ind.; C. C. Wells, Jeffersonville, Ind.; Miss Grace Wyatt, Murray Teachers' College, and I. H. Zarbell, Louisville.

The Councilor to the A. A. A. S., Dr. A. R. Middleton, presented a full report, dealing mainly with junior academies and academy libraries. The report was received and made part of the record. *

The President appointed the following committees: Auditing, Messrs. Averitt, Hire and Pierce; Nominating, Messrs.

* The account in Science of Feb. 6, 1931 (Vol. 73, No. 1884, pp. 137-168) covers most of the material.

Beckner, McAllister and Buckner; Resolutions, Messrs. Middleton, Anderson and Seay.

The Academy accepted unanimously the invitation of President Donovan, extended by Dr. Cuff, to meet next year at the Eastern Kentucky State Teachers' College.

Dr. Arthur Braden, President of Transylvania College, welcomed the Academy, in an appropriate address, after which Dr. V. F. Payne delivered the presidential address entitled "A chemist views the social sciences."

At 10 o'clock the general session recessed until 2 p. m. and the divisional meetings were called by the respective secretaries, namely: G. D. Buckner, Biological Sciences; O. T. Koppius, Physical Sciences and Mathematics, and Cloyd N. McAllister, Psychology and Philosophy. The general session reassembled at 2 o'clock.

Mr. Beckner, for the nominating committee, reported the following nominations for officers: President, Anna A. Schnieb; Vice-President, Charles Hire; Secretary, A. M. Peter; Treasurer, W. S. Anderson; Committee on Publications, W. R. Jillson; A.A.A.S. Council, A. R. Middleton. The report was adopted and the nominees were elected unanimously.

The resolutions committee reported the following resolutions which were adopted unanimously:

Resolved: 1. That the officers of the Academy be instructed to take whatever steps are necessary to make the Academy eligible for an appropriation by the State to publish annually the Proceedings of the Academy.

2. That a committee be appointed at this meeting to study the possibility of securing the affiliation of the scientific and engineering clubs of the state with the Academy.

3. That a committee be appointed at this meeting to have prepared, for each branch of science, a list of books for a progressive course of reading on the part of laymen; that these lists be sent to the various libraries of the State, with the request that they place the books upon their shelves.

4. That the sincere thanks of the Academy be tendered President Braden and Transylvania College for the gracious

welcome given the Academy by Dr. Braden and the entertainment given the Academy by the College.

President Payne appointed the following committees under these resolutions: Resolution 2, Messrs. Pierce, Buckner and Leggett; Resolution 3, Messrs. Beckner, Capps and Pyles.

The President appointed as a committee on Academy library, Messrs. Healy, Valleau and Wurtz.

Mr. George B. Wurtz read a humorous poem entitled "Resourcefulness of the Irish People."

The Vice-President, Mrs. Clara Chassell Cooper, took the chair and introduced the guest speaker, Dr. Edmund M. Baehr, University of Cincinnati Medical School, whose subject was "The Uses of Adversity."

The members and guests were invited to visit the Transylvania Medical Library, with Mrs. Charles F. Norton, Librarian, as hostess.

The Academy adjourned *sine die*.

EXTRACTS FROM THE SECRETARY'S REPORT, 1930-31

Twelve persons elected at the 1930 meeting qualified and have been enrolled as active members, namely:

Ellis Freeman, Charles Hatfield, Harvey Lovell, Anna L. Payne, Martha Payne, Norma Pearson, Eugene Simpson, R. E. Stouder, Barney Watson, A. M. Wolfson, W. M. Insko, and Ruth Boyden. Dr. M. L. Pence was reinstated as a national member after being out of the Academy for several years.

Nineteen persons elected by the Council have qualified and been enrolled. Nine of these are national members.

The number of members at the time of the 1930 meeting was 172. Since then, 31 have been added and 8 have been lost, for various reasons, making the present total 195. These may be classified as follows:

Active, in good standing, including 2 life members	130
Active, in arrears 1 year	17
Active, in arrears 2 years	13
Corresponding	22
Honorary	13
	195

Volumes 3 and 4 of the Transactions have been printed and distributed. This brings the series up to date. The edition was 500 copies of each.

An invitation was received from the Ohio Academy to join them and the Indiana Academy in a joint meeting at Miami University on April 2, 3 and 4, 1931. The invitation was accepted and transmitted to our members in a circular letter. President Payne represented the Kentucky Academy at the joint meeting.

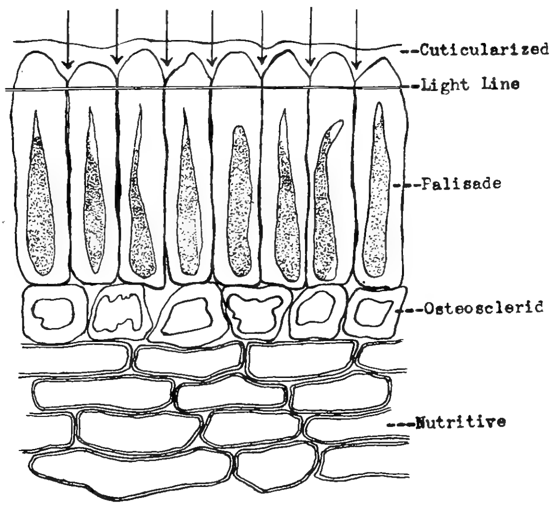
By appointment of Secretary Livingston, your Secretary represented the A.A.A.S. at the Sesquicentennial celebration of Transylvania and the installation of President Braden, in June.

ABSTRACTS OF PAPERS PRESENTED AT THE EIGHTEENTH MEETING

1. **A Chemist Views the Social Sciences.** (President's address) V. F. Payne, Transylvania College. (Published in Science, May 29, 1931, Vol. 73, No. 1900, pp. 577-79, under the title "An optimistic view of the evolution of the sciences.")

2. **The Effect of High Pressure on the Seed Coat of Hard Seeds.** P. A. Davies, University of Louisville.

The failure of seeds of *Medicago sativa* (alfalfa) and *Melilotus alba* (sweet clover) to germinate is caused by two conditions: (1) the loss of vitality of the young embryo (resulting in soft seeds), and (2) the impermeable nature of the seed coat (resulting in hard seeds). That the impermeable seed coat is the cause of the low percentage germination of seeds of these plants has been confirmed by all workers on hard seeds. They find that when impermeability has been destroyed, either by hydraulic pressure or by other mechanical means, the seeds germinate readily. The writer,[1] by applying a hydraulic pressure of 2000 atmospheres, increased the germination of seeds of *Medicago sativa* over 50 per cent, and seeds of *Melilotus alba* over 200 per cent. This increase must be because the pressure in some way destroys the impermeable nature of the seed coat. Pammel[2], and Coe and Martin[3] found that the seed-coat of *Melilotus alba* is made up of three distinct layers: the Malpighian layer; the middle, or osteosclerid; and an inner, or nutritive layer. According to Coe and Martin, the Malpighian layer consists of three layers: the outer layer, cuticularized material and cones; the middle layer, known as the light line; and an inner layer of Malpighian, or palisade cells.



Section of the impermeable seed coat of Melilotus aiba. The arrows indicate the path of penetration under hydraulic pressure.

The writer, using cresyl blue, haematoxylin, eosin, and gentian violet, observed that in impermeable seeds the stains

[1]Davies, P. A. Jour. Gen. Physiol. 9: 805-809. 1926; Amer. Jour. Bot. 15: 149-156. 1928; Amer. Jour. Bot. 15: 433-436. 1928.

[2]Pammell, L. H. Trans. Acad. Sci. (St. Louis) 9: 91-275. 1899.

[3]Coe, H. S., and Martin, J. N. U. S. Dept. Agri. Bull. 844: 26-35. 1920.

penetrate only as far as the light line. In permeable seeds, they pass readily thru the light line into the palisade cells and the underlying tissues. The path of penetration was occasionally between the palisade cells. The impermeable structure must lie either in the light line, the palisade cells, or in both. In seeds made permeable by high pressure, the path of penetration was not thru the palisade cells but between them (see figure). These results seem to indicate that, under hydraulic pressure, water is forced thru the cuticularized material until it comes to the light line, and then into the light line, causing it to swell and rupture, particularly in the region where the palisade cells join, for in this regiou they are not guarded by the cones. As soon as the impermeable nature of the light line is destroyed, the palisade cells are pushed apart (by the swelling of the cementing material between them) allowing the water to pass into the underlying tissues. Once the light line is destroyed and the palisade cells pushed apart, a permanent passageway thru the previously impermeable structure is produced. These seeds can be dried and will germinate when placed under proper conditions.

3. Progress Report of a Study of Strains of Bact. abortus Bang each Obtained from an Individual Organism. E. S. Good and Amanda Helen Harms, Kentucky Agricultural Experiment Station.

Considerable interest has been aroused recently among investigators concerning the relationship of the organisms that cause Malta fever in man, and infectious abortion in cattle and in swine. Alice B. Evans, of the U. S. Public Health Service, pointed out that certain relationships exist among these three organisms. The authors have found some differences by culture and agglutination tests. They have not succeeded in growing the organism from cows aerobically until it has first been cultured under diminished pressure of oxygen. The organism from sows, however, grows aerobically, even in the first generation. No report was found in the literature, of the oxygen requirement of the melitensis organism, when first isolated.

Inasmuch as occasional variations were observed, in conducting routine agglutination tests for infectious abortion in cows, the present investigation was undertaken to compare the characteristics of cultures derived from single cells of the organism. About 40 of these "strains" have been prepared, by the method described by Avery and Leland in the Journal of Experimental Medicine for June, 1927. Two original cultures, C_1 and C_2, from different cows, were used. Little difference was found in the morphological, physiological and serological characterstics of the 40 strains. Four of the 15 strains from C_1 had a scant amount of flaky sediment and no pellicle; the remaining 11 formed pellicles and abundant flaky sediment, as in the original C_1. All the 25 strains from C_2 formed a small amount of mucoid sediment after 8 days, but only 2 formed a slight pellicle. The original culture produced a mucoid sediment but no pellicle. Agglutination tests of antigens made from strains produced from individual cells of C_1 and C_2 differed little, if at all, from antigen made from the original cultures.

4 **The Effect of a Diet of Polished Rice on the Mineral Content of the Carcases of Pigeons.** J. S. McHargue and W. R. Roy, Ky. Agri. Expt. Station.

Analyses of polished and unpolished rice show that a considerable portion of the mineral matter contained in whole rice is removed in the process of polishing. Polished rice was fed as the sole diet to pigeons until experimental polyneuritis was produced. Individual pigeons required considerably different times to develop this condition. Brown rice and other cereals were then fed to ascertain which ones would bring about recovery and a normal gain in body weight. Analyses of the carcases show marked losses in potassium, phosphorus and calcium in the polyneuritic pigeons in comparison with normal pigeons. The authors are of the opinion that loss in body weight and a diminution in important major mineral constituents, including potassium, phosphorus and calcium, are factors in producing experimental polyneuritis.

5. Growth of Watercress in a Solution Free from the Less Common Elements. J. S. McHargue and R. K. Calfee, Ky. Agri. Expt. Station.

Cuttings from watercress growing under natural conditions were grown in water cultures of known chemical composition. All chemicals composing the nutrient solution were known to be free from Mn, Cu, Zn, Co, Ni, Ba, Sr, B, I, and As. The cuttings contained originally .286% manganese. When the cuttings had attained a length of 7-8 inches, the top 2 inches were removed and started in a similar solution. It was found that the manganese content had been reduced to .05%. Growth was slower in the second cultures. The manganese content was .017%. The third transfer required a longer time to grow large enuf to transfer. The leaves were lighter in color than normal leaves, and contained .0069% manganese. The tops when transferred made very slow growth, and became speckled and a pale blue-green color; .00024% manganese was present. In the final transfer, the tops made very little growth and became cream colored. No manganese could be detected.

6. Functions in Grafted Limbs in Amblystoma Larvae. Harvey B. Lovell, U. of Louisville.

Two very different types of function occurred when the hind limb anlagen were grafted to new locations. First, coordinate function was present in those limbs which developed in or near their normal locations. Homologous muscle groups in such grafts flexed and extended synchronously with those of the normal limb, if it were present, and alternately with those of the contralateral limb. The lumbosacral plexus is composed normally of the 15th, 16th, and 17th spinal nerves. Graphical reconstructions of the nerve paths show that those limbs with well-developed coordinate function were always innervated by at least one of the normal plexus nerves. In addition, nerves anterior to the plexus, such as the 14th and 13th, frequently entered the graft. While limbs not innervated by at least one of the normal plexus nerves occasionally exhibited movements, the coordination of such movements was either imperfect or lacking. Second, the foot and digits of the graft in a few larvae were observed to flex synchronously with swallowing movements of the mouth and throat. Such movements occurred only in those grafts which did not exhibit coordinate function, and such grafts were found to be innervated by nerves anterior to the lumbo-sacral plexus, as the 14th, 13th, and 12th. In a few cases a small twig from the 15th was contributed, but this was not sufficient to produce coordinate function.

7. **Condemned Before Birth.** W. S. Anderson, Professor of Genetics, U. of Ky.

The paper deals with the transmission from generation to generation of syphilis which was carried to a remote mountain section by a United States soldier at the close of the war between the States. This soldier married a vigorous young woman who contracted the disease from him. Before she recovered her health under the treatment of a country doctor the husband died of the disease without leaving children. When the wife recovered she married and bore sixteen children, six of whom, because of the spirocheta pallida in her blood, were stillborn. Of the ten living children six married and had rather large families. Almost all the grandchildren and many of the great grandchildren were born with the blood stream contaminated with the syphilitic germ.

In recent years health workers have given these unfortunate people medical attention and after the plague has wrought its ravages for over sixty years it is about to be conquered. The havoc it has wrought in the community in stillbirths, in suffering children and adults, in paresis, and in loss of energy by four generations can never be adequately described. All this human suffering and economic loss could have been avoided had the soldier received the right medical care before marriage.

8. **The Chemical Control of Battery-Brooder-Raised Chicks.** G. Davis Buckner, J. Holmes Martin and W. M. Insko, Jr., Ky. Agri. Expt. Station.

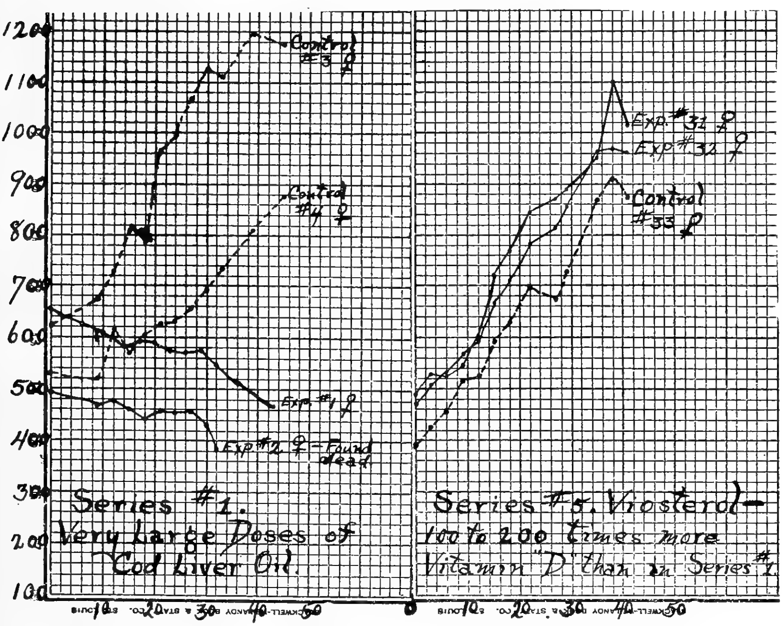
Battery brooders confine chicks unnaturally. This restricts activity, increases consumption of feed and hastens early growth. Experiments have shown that under these conditions greater care is required in the selection of rations used. A mash which has given excellent results consists of wheat bran 25, wheat middlings 25, ground yellow corn 25, meat scrap (50% protein) 12, dried buttermilk 10, sodium chloride 1 and steamed bone meal 5 parts, and .125% fortified cod liver oil (super D). This mash supplemented a grain mixture of equal parts of yellow corn and wheat. Chemical analysis showed that this mash contained protein 19.8, fat 6.5, fiber 5.5, water 8.7, nitrogen-free extract 47.4, calcium 3.3, phosphorous 2.0, other components of the ash 6.8 percent. The ratio of calcium to phosphorous is 1.65 to 1. It has been found advisable to prepare a ration which contains approximately 1.2% calcium, having a ratio of calcium to phosphorous not materially exceeding 2 to 1.

9. Seed Transmission of Ring-spot in Tobacco. W. D. Valleau and E. M. Johnson, Ky. Agri. Expt. Station.

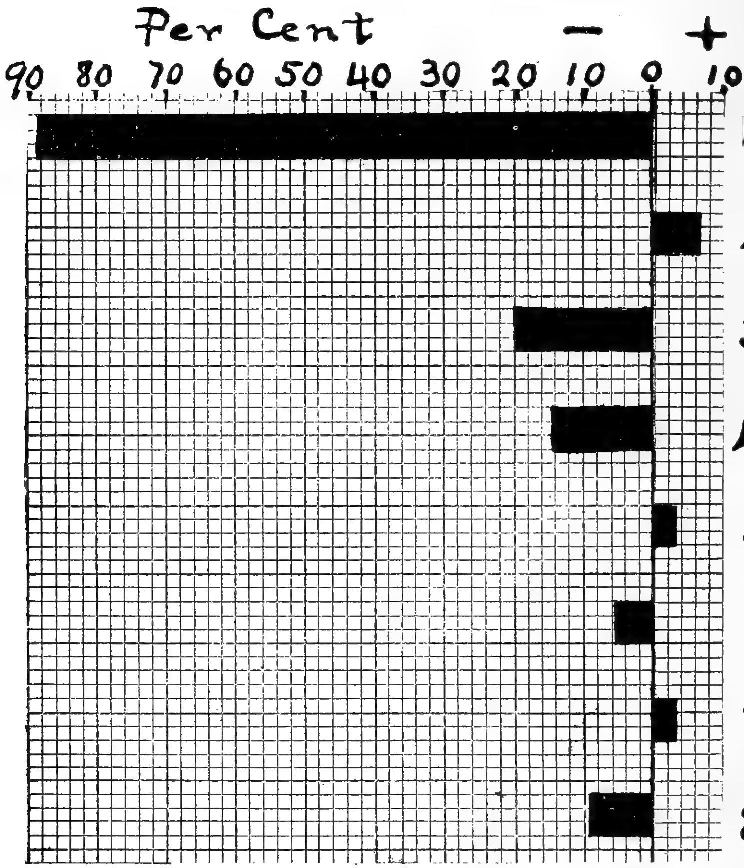
Altho seed transmission of viruses is recognized, ring-spot appears to be the only tobacco virus in which seed transmission has been demonstrated. Two types of tobacco ring-spot occur, one in which the chlorotic patterns are made up of various shades of green (green ring-spot) and one in which they may be yellow (yellow ring-spot). In the latter, leaves produced following the period of pattern formation are inclined to be a yellowish green, in contrast with the normal color of the former. Seed transmission of green ring-spot occurs, but as the plants are normal in color and produce no patterns, detection is difficult. Plants exposed to relatively low temperatures (50 to 65°F), if affected, develop a leaf-edge chlorosis and necrosis by which the presence of the disease may be recognized. Seed transmission of yellow ring-spot is readily demonstrated, as the seedlings become light green to yellow within a few days after germination. Failure of ring-spot tobacco plants to set a normal quota of seed appears to be due to partial pollen sterility, varying proportions of pollen grains being smaller than grains from healthy plants or plants affected with certain other viruses.

10. Rate of Bone Growth and Body Weight in Kittens Given Large Doses of Cod Liver Oil and Irradiated Ergosterol. R. S. Allen and A. M. Lands, Dept. of Anatomy and Physiology, U. of Ky.

Irradiated ergosterol (Viosterol), in doses containing approximately 100 to 200 times as much of the antirachitic substance as doses of cod liver oil which were extremely toxic and fatal, had no injurious effect but, on the contrary, showed some improvement. Cod liver oil with vitamin A destroyed gave similar results altho less marked. Cod liver oil to which irradiated ergosterol had been added was toxic but not so toxic as cod liver oil alone. The administration of an excess of vitamin B along with the toxic dose of cod liver oil seemed to modify the toxic symptoms to some extent. A brief review of the literature bearing upon the subject was presented.



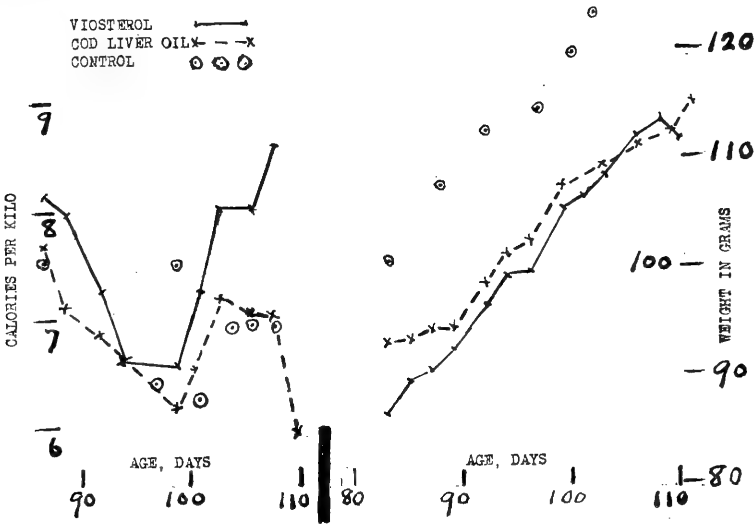
Weight Curves of Kittens



Percentage differences in diaphyseal length of the tibia of kittens. 1. Cod liver oil, large doses, 45 days, females. 2. Viosterol, 100-200 times as much Vitamin D as in 1, 55 days, females. 3. C.l.o., .40 the quantity given in 1, 75 days, females. 4. C.l.o., with D added, quantity same as in 3, 75 days, females. 5. C.l.o., vitamin A removed, same quantity as in 3 and 4, 75 days, females. 6. C.l.o., vitamin A removed, quantity same as in 3-5, 59 days, female, control male. 7. Viosterol, quantity same as in 2, 59 days, males. 8. C.l.o., with excess of vitamin B, quantity same as in 3-6, 59 days, males.

11. The Effect of Large Doses of Cod Liver Oil and Irradiated Ergosterol on the Basic Metabolism of Young Rats. T. C. Sherwood, Dept. of Zoology, U. of Ky

Basal metabolism tests showed a slight decrease in calories when large doses of cod liver oil were given. A very marked increase in calories was noticed when irradiated ergosterol was given. The thyroid picture is being studied and the anterior lobe of the pituitary gland. Results are very significant.



Metabolism and Weight Curves of Kittens

12. The Effect of Tri-orthocresyl Phosphate on the Cat, and a Comparison with so-called Ginger Paralysis in the Human. A. M. Lands and W. T. Forman, Dept. of Anatomy and Physiology, U. of Ky.

At present considerable interest is manifested in a "1930 type of multiple neuritis" resulting from drinking an adulterated fluid extract of ginger. Evidence points to tri-orthocresyl phosphate as the causative factor. A comparison of two cases of "ginger paralysis" in the human with paralysis induced in cats by oral, subcutaneous and intravenous administration of C. P. tri-orthocresyl phosphate (Eastman) shows a marked similarity. The intravenous injection of this compound caused immediate onset of symptoms. Depression and dyspnea set in within an hour or two, with motor symptoms (stimulation and spastic incoordinated walking) within 24 to 36 hours. Subcutaneous injection showed a latent period of two or three weeks in which the only symptom was slight depression with loss of weight. This long period no doubt represents the time necessary for the absorption of a toxic amount. We believe that tri-orthocresyl phosphate is a quite stable compound, is very slowly broken down and excreted, and is toxic as the whole molecule. The toxic picture is as follows: 1. Depression and dyspnea. 2. Gastro-intestinal disturbance. 3. A general fine muscle tremor follows oral or intravenous administration in about 24 to 30 hours. 4. Motor impairment in the lower extremity. 5. Slight foot drop may develop in the upper extremity. 6 Severe poisoning involves neck and respiratory musculature. 7. Increased susceptibility to infection. A study is being made of the pathology after tri-orthocresyl phosphate poisoning.

13. A New Method for the Determination of Iodine in Rocks and Soils. J. S. McHargue and W. R. Roy, Dept. of Chemistry, Experiment Station.

A satisfactory method for the determination of iodine in rocks and soils is highly desirable because it would afford a ready means of ascertaining whether or not an iodine deficiency is likely to occur in the foods and drinking water of any particular region. Fusion with sodium carbonate or solution by means of hydrochloric acid have been the methods heretofore used. It is generally admitted that each of these methods is subject to considerable error. Failure to find iodine in well-burned lime suggested the idea that this element could be distilled from its combination in rocks and soils. Accordingly, samples of limestone, sandstone, rock phosphate and soil were subjected to distillation in an electric tube furnace giving a maximum temperature of about 1,100°C. The volatile products were absorbed in a 10% solution of sodium carbonate contained in gas washing bottles. The residue from evaporation of the sodium carbonate solution was ignited gently and the iodine extracted with 95% alcohol and determined by the colorimetric carbon disulfide method in a microcolorimeter. Fairly concordant results were obtained for the iodine contained in limestones, sandstones, rock phosphate and soils thus far analyzed.

14. The Estimation of Potassium and Sodium in Mixed Chlorides by Indirect Analysis. S. D. Averitt, Ky. Agr. Expt. Station.

To determine chlorine in such a mixture and compute the quantities of potassium and sodium is much quicker and easier than to determine the potassium as chloroplatinate. Nevertheless, the indirect method has not found favor with analysts, probably because of the common teaching that results are accurate only when the quantities of the two chlorides are about equal. However, in 1864, P. Collier reported good results on mixtures of a wide range of composition. * The author's experience is that results are accurate even when the quantity of NaCl is relatively small, as shown by the following comparative tests. The solution of the mixed chlorides was halved for analysis by the two procedures.

Solution	Indirect Method		Chloroplatinate	
	NaCl	KCl	NaCl	KCl
1	.0039	.0236	.0038	.0237
2	.0015	.0260	.0013	.0262
3	.0016	.0404	.0016	.0404
4	.0018	.0362	.0020	.0360
5	.0018	.0116	.0017	.0117
6	.0025	.0431	.0026	.0430

Solution 1 was 50 cc of a solution of 0.250g KCl and 0.025g NaCl in 500 cc of water. No. 2 was 50 cc of a solution of 0.275g of the same lot of KCl, in 500 cc of water. Nos. 3 and 4 were from the ash of redtop, and Nos. 5 and 6 from the ashes of wheat grain and alfalfa, respectively. The findings by the two procedures are equally good.

For analyses like the foregoing, the silver solution should not be stronger than 1 cc = .001g Cl (4.7914g $AgNO_3$ in 1 liter), the volume titrated should be 35-50 cc, and the weight of Cl should be stated to 5 decimals. Chromate and dichlorofluorescein were equally good as the indicator. The quantity of NaCl present is equal to 3.63 times the difference between the KCl equivalent of the Cl found and the weight of the mixed chlorides.

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* Amer. Jour. Sci., Series 1, Vol. 37, p 344. Chemical News, Vol. 10, p. 182.

15. New Oil and Gas Map of Kentucky. W. R. Jillson, Kentucky Geological Survey. By title.

16. The Pre-Illinoian Glaciation of the Cincinnati Region. Louis Desjardins, Geology Department, U. of Cincinnati, and Dayton, Ky., High School.

Scattered areas of decomposed drift near Cincinnati, glacial boulders in Kentucky far south of the Illinoian drift border, and recent drainage studies by Leverett indicate a pre-Illinoian ice sheet of great antiquity in this region. The author's studies indicate that the old surface possessed three major northward drainage lines profoundly different from all hitherto recognized pre-glacial lines. The course of the central and largest, the ancestral Licking, lay east of its present and its pre-Illinoian courses as far south as Pendleton and Bracken counties and to a point north of Cincinnati. About a dozen drainage changes on this old surface have been worked out. The inference as to a glacial epoch is clear. The ice came from an easterly direction, and must have been approximately contemporaneous with the first uplift after the peneplain stage, because all down-cutting due to the later cycles is along the newer drainage lines.

A second pre-Illinoian glacial stage that gave birth to the present large Ohio River, which occurred at a time much later than the first, is indicated with almost certainty in a second series of drainage changes along the Ohio and Licking valleys. This occurred when the valleys had been cut down about 200 feet below the old age surface, but still about 250 feet above the level reached just before Illinoian time.

The best evidence to date shows that both the old till found near Cincinnati and the old boulders found in Kentucky belong with the first of these glacial stages. No drift has been found attributable to the second, suggesting that this ice never extended beyond the later Illinoian limits. A study of all known data concerning Jerseyan, Nebraskan, and Kansan glaciation shows the strong likelihood that the two older events in this region were Jerseyan or Nebraskan, and Kansan, respectively.

16½. A Simple Form of Boyles Law Apparatus. A. D. Hummell, Eastern State Teachers' College.

A simple apparatus has been designed which proves the law for a range of pressures from 15 to 150 cm. of mercury. Settings are adjusted by pumping air into or out of a reservoir which supplies the open and closed tubes with mercury. It has the advantages of commercial forms that retail for more than twenty dollars and costs less than half as much. The apparatus is entirely of glass and may be easily made in the laboratory.

17. The Structure of Seeds Found in Coal Balls from Harrisburg, Illinois. Harriette V. Krick, Eastern State Teachers' College.

18. The Preparation of the 1, 4-Dithienes and Related Compounds.* Charles Barkenbus and R. H. Baker, U. of Ky.

Attempts to prepare the 1,4-dithienes by a more satisfactory method than that described by Johnson** led to the discovery that 2,5-diphenyl-1,4-dithiene could be produced in good yields by the hydrolysis of phenacylsodiumthiosulfate in the presence of strong hydrochloric acid. By a similar hydrolysis, 2,5-di-metanitrophenyl-1,4-dithiene was prepared, but attempts to apply this method to the preparation of the theoretically possible dimethyl and dibetanaphthyl derivitives did not succeed. In the course of the study several compounds not mentioned in the literature were prepared and described, namely: phenacylsodiumthiosulfate, acetonylsodiumthiosulfate, metanitrophenacylsodiumthiosulfate, and 2,5-dimetanitrophenyl-1,4-dithiene.

19. The Rectification of Current for Laboratory Uses. Charles Hire, Murray State Teachers' College.

A rectifier mechanically operated and of unlimited current capacity is demonstrated and briefly discussed.

20. A Convenient Force Table. Charles Hire.

A simple, convenient and accurate apparatus for demon-

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* Thesis submitted by R. H. Baker to the Graduate School of the University of Kentucky, May, 1931.

**Jour. Amer. Chem. Soc., 35, 447.

strating and teaching the composition and resolution of forces is discussed and shown.

21. The Nature of Sun Spots. Charles Hire.

It is assumed that chemical reactions taking place within the sun may be either endothermic or exothermic. The temperature would be reduced where endothermic reactions occur, and temperature differences would result within the atmosphere, possibly within sub-photospheric layers of the sun. Measurements in spot umbras have shown a temperature considerably below that of the remaining areas of the sun. The assumption is made that these temperatures are low enough to cause the condensation and solidification of metals in the solar gasses, including iron, and that the temperatures are below 786°C., at which solidified iron would become magnetic. The magnetic properties of this iron accentuate any magnetic force about the sun, and the influence of the strengthened field within the spot region produces magnetic and electrical disturbances on the earth. The temperature differences within the solar gasses necessarily cause storm regions in the reversing layer and chromosphere. It is concluded that the spot is a storms center, where metallic vapors are being condensed and solidified, or that the spot is a storm center with a solid metallic core.

22. Dielectric Constant of Liquids by Vacuum Tube Oscillator Method. W. L. Rast, U. of Ky.

23. A Study of Thermionic Emission from a Tungsten Filament. F. L. Yost, U. of Ky.

24. Temperature Variation of Young's Modulus in Copper. E. L. Kirk, U. of Ky.

25. The Thomsen Effect in Alloys of Bismuth and Tin. C. H. Bernard, U. of Ky.

26. A Study of Thermionic Volt Meters. C. B. Crawley, U. of Ky.

27. Contributions to Child Psychology by The University of Vienna. Anna A. Schnieb, Eastern State Teachers' College.

The University of Vienna has made three outstanding contributions to child psychology: First, in devising accomplishment baby tests for the first two years of life. Second, in making a detailed study of the successive steps in the development of the human being from birth to maturity. Third, in maintaining a psychological laboratory with unlimited subject-matter. The sources of these contributions were: 1. Detailed inventory of every action of sixty-nine children ranging in age from one day to twelve months. 2. Large number of diaries. 3. Council work. 4. Observations of a large number of children of various ages both in Europe and in the United States. 5. Cooperation of the City of Vienna.

First contribution. The detailed inventory furnished the basis for the baby tests. Forty per cent of the children were from private homes and sixty per cent were "institution" children. In all, sixty-nine children, representing a varied social environment and ranging in age from less than a month to twelve months, were observed. Five complete observations were made for each age group. The method employed was uninterrupted systematic observation of the same child under conditions which were normal in his everyday life. Each child was observed during twenty-four hours, both waking and sleeping. The observer kept himself completely passive in relation to the child, and in no way disturbed the normal daily plan. Protocols were kept of all that was observed. Most of the protocols were made by the same two observers. Only healthy babies were observed. Frequently the same children were observed at different age levels so that monthly progress in development could be seen in the same child.

The purpose in making the exact observations was: 1. To obtain a complete picture of the child's behavior during the first year of life. 2. By means of an exhaustive inventory of every item of observable behavior, to obtain an inventory that would serve as a standard for normal development within this period.

The material stated in the detailed protocols has been treated in three ways: First, a qualitative and quantitative analysis of the behavior was made. This describes and determines the separate behaviors at the different age levels. Second, the time analysis of the day and the time measurement of the behavior. This is concerned with those types of behavior which can be observed within one day, and with separating and determining those groups of reactions which follow one upon the other. Third, the meaning of the facts—that is establishing the levels of development in the course of the first year of life.

Thru the interpretation of the detailed inventory and thru other research studies, the first accomplishment baby tests for the first two years of life were devised. The tests were drawn up after making ten preliminary trials for each month and were then given to more than thirty children in each month.

The tests, according to Buhler, do much more than show whether the child is normal or subnormal. They enable one to say something rather positive concerning the productivity of the individual. According to Buhler, productivity can never be measured by a definite, limited task with a prescribed goal. If talents are to be measured, mental freedom must be assured. Tests must show the individual's level positively rather than merely its relative deviation. The tests must actually test the level, not simple intellectual dexterity, maturity or ability. Test items must be so arranged as to measure the individual in all the varied aspects of his life. They must be based upon an exact knowledge of the necessity and possibility of performances in the stage of development to be considered. They must measure exactly that which is characteristic of one stage of development and maturation.

The tests were not restricted to the child's intelligence, but were directed to his personality as a whole. They were devised in order to determine the stage of the child's development in the mastery of life. The total system of action was considered, not single intellectual function. Three questions were considered: How does the child develop; 1, in physical and mental control of himself; 2, in social relationships; 3, in the manipulation of materials?

Second contribution. According to Buhler, the development of childhood and youth consists of five phases. The principal problems of each phase are: mastery of body and self, social reactions, manipulation of materials, and intellectual development. One of these problems predominates each phase. The phases may be characterized as: First, from birth to one year of age—largely bodily control and functional handling of materials. Second, from two to four years—largely subjective interests; child becomes conscious of self and asserts his will. Third, from five to eight years—largely objective interests, which are shown by the things the child makes and by his understanding of duty and work. Fourth, from nine to thirteen years—continued curiosity and interest in learning. Interests cease to be subjective. Fifth, from fourteen to nineteen years—physiological changes—puberty and adolescence; psychological changes—feels need for a special friend; active interests in a philosophy of life.

Third contribution. The psychological laboratory is in one of the municipal temporary homes for children ranging in age from one day to fourteen years. The children come from a varied environment. Several thousand are received each year. Major students in child psychology and guest students of the University may do research work at the laboratory provided it is done under the supervision of the University.

28. **The Relation between College Marks and Extra-Curricular Activities.*** Clara Chassell Cooper, Richmond, Ky.

The data for this study were collected in connection with an investigation of the relation between moral and intellectual traits among college students. The institutions represented were Cornell College, Heidelberg University, the University of Nevada, Washburn College, and William Woods College. These institutions differed significantly in respect

* A fuller account of this study will appear in a book, entitled The Relation between Morality and Intellect: a Compendium of Evidence Contributed by Psychology, Criminology, and Sociology. (Bureau of Publication, Teachers College, Columbia University, New York.)

to location, type, and affiliation or control. All were four-year coeducational institutions except the fifth, which was a junior college for women. Members of the senior class served as subjects.

The data on college marks consisted of a transcript or a compilation of the scholastic records for the full college course, in each institution. The data on extra-curricular activities consisted of the information as to activities given in the college annual or in the senior edition of the college paper, covering a period of two to four years, according to the institution. The two types of data were statistically reduced in order to provide two series of measures for each type. Thereupon, reliability coefficients and paired coefficients of correlation were obtained by the rank-difference method, in routine fashion, between the appropriate halves of the data, and a suitable correction for attenuation formula was applied.

The results showed a practically zero correlation between college marks and extra-curricular activities in four institutions, in contrast with a high degree of correlation, represented by a corrected coefficient of .59, in the fifth. An explanation of the divergent result was possibly found in the supervision of student affairs afforded by a cooperative government association including both faculty and student members. The conclusion appears to be justified that, as a rule, practically no correlation exists between college marks and extra-curricular activities, but that under certain conditions superior scholastic achievement and active participation in student affairs, or their opposites, may be associated.

In the presentation of this study, a tabular method of report advocated by the writer for various types of investigation in psychology and the allied sciences was utilized; and two point system used in the evaluation of extra-curricular activities, covering all activities reported for the subjects in the five institutions, were exhibited.

29. An Analysis of Factors in Motor Learning. R. L. Hoke, Morehead Teachers' College.

A study in tossing balls at a target, under controlled conditions, is reported. The condition most conducive to efficiency was to keep the individual fully aware of the degree of success attained. The study has been published as a Doctor's Dissertation, Univ. of Cincinnati, College of Education, June, 1929.

30. What Freshmen Read in a Teachers' College. Noel B. Cuff and H. L. Donovan, Eastern State Teachers' College.

The study was conducted by means of a questionnaire covering three main points: first, the amount of voluntary reading of newspapers, and what appeals to the student; second, the quantity of independent reading of magazines and what appeals to the student; third, the amount of reading of books not directly connected with college work. Answers from 330 freshmen in Eastern Ky. State Teachers' College seem to justify the following conclusions: 1. More than 80 per cent of the freshmen read newspapers and magazines regularly. 2. The average number of newspapers read daily is 2.5, and of magazines read regularly is 2.5. 3. The students devoted an average of about 12 hours per week to voluntary reading. 4. The wide variation in the amount of time spent on independent reading is striking and significant. The range of hours per week spent on reading daily papers was from 0 to 18; on magazines, from 0 to 20; on books, from 0 to 30. 5. Students were most interested in the front page of newspapers and in short stories. 6. Students read reasonably substantial types of magazines. 7. The average number of books read voluntarily, per student, during one semester was 4.3. 8. The averages for the independent reading of freshmen in Eastern Ky. State Teachers' College were higher than the averages reported for freshmen in other institutions.

31. A Genetic Study of Cheating Among Elementary School Groups. Graham B. Dimmick, U. of Ky.

The purpose of this study was to determine the incidence of cheating in schoolroom situations and the relation of such behavior to age, sex, type of school, intelligence, achievement, retardation, and social status. Seven hundred and fifty-five subjects ranging in age from nine to sixteen years, from grades four to seven, inclusive, were selected as representative of: (1) a rural school; (2) an urban school, and (3) a mill-village school. Two equivalent forms of a standardized arithmetic problem test were administered upon separate occasions. A key sheet containing the correct answer was passed out with Form I, with explicit instructions that it was not to be used except to score the papers at the conclusion of the test. Retest of the same subjects was made two days later with Form II, with no answers available. Previous administration of both forms of the test to a comparable group, under conditions precluding cheating, made possible the establishment of norms of 'expected' differences. The mean and the standard deviation of these 'honest' differences were used as points of reference and the raw difference score of each subject of the experimental group was converted, by dividing it by the standard deviation of the honest differences, into a multiple of this standard deviation. This procedure made possible the translation of the raw difference scores into a statement of the probability of the honest occurrence of such a deviation. A subject was considered as having cheated when the probability of the honest occurrence of the difference was six in ten thousand.

Tabulation of the data showed: (1) increase in the incidence of cheating with age; (2) no reliable sex differences; (3) no significant differences in respect to type of school; (4) a marked inverse relation between intelligence and cheating; (5) a marked inverse relation between cheating and school achievement; (6) the incidence of cheating among retarded pupils was three times as great as among those at age for their grade; (7) no relation between cheating and social status as indicated by parental vocation.

32. **The Inadequacy of Current Intelligence Tests for Testing Kentucky Mountain Children.** Eston J. Asher, U. of Ky.

33. **Must We Give Up God?** Wm. H. Walker, Berea College.

Atheism, even ignoring Russia, is exploited at the present time as never before. It assumes that science and philosophy have made a belief in God impossible. But the many schools of philosophy and their various wings are by no means a unit in their attitude toward belief in God. Furthermore, recent changes in the concepts of space, time, and matter, and the abandonment of the mechanistic theory are favorable to the theistic idea, while the leading scientists of the world are emphatic in their expression of belief in God. Far from assuming that this results from an "emotional inheritance", it is more just to recognize it as an attitude growing out of a sense of the order of the world. Wherever order is recognized and its source is known, that source is mind. Where a higher order emerges out of a lower order, and the moving force is known, it is mind. The world generally is under the operation of the principle of entropy, or of increasing disorder; but entropy is reversed in living organisms. To say that "purpose presupposes order, not order purpose," ignores the fact that the higher order is latent in the lower. In man order comes to itself in man's conscious purpose. Hence purpose is latent in the whole process—unless it be introduced from without, which few would accept today. It is in this latent purpose that the theist sees God. Such a God is immanent, not transcendent or anthropomorphic. It is vain for Lippmann to insist that nothing but an anthropomorphic God is the God of ancient faith. In Hebrew history the anthropomorphic idea began to be abandoned almost as soon as it was formulated in literature, and Christianity's early literature provided for divine immanence.

Recognizing that man himself, in the entirety of his being, must be embraced in the World-Purpose, we must give to that Purpose the capacity to give rise to man in all his emotional and volitional life. Hence that Purpose must have an emotional and volitional life like unto man's. This sets no limit to God, nor does it assert that we can fathom the depths of his being. It merely asserts that God must be at least as much as man, and that beyond that limit God must reach immeasurably farther.

34. The Seen Occasional, The Unseen Eternal. William Benjamin Smith. (By title.)

35. The Uses of Adversity. Edmund M. Baehr, M.D., College of Medicine, Univ. of Cincinnati.

The paper showed that pain and fatigue are protective agencies without which we would fare badly. "It may not be known to all of you that just as we possess special nerve structures as the eyes and ears whereby we may see and hear, so we possess special nerve structures in the surface skin that can be excited only by noxious or destructive external agents. These are as specific in their function of appreciating such stimuli and transmitting their information to the brain as are the visual nerves in responding to "light" waves and, what is more important, they are very much older. Perhaps our first nervous contact with the world, it is permissable to suppose, was a painful one.

"It seems to me our physiological chemists have not made much of a case of the idea that fatigue was the consequence of the accumulation in the tissues of metabolism products. My own belief is that fatigue is defensive physiological inhibition of function working in conjunction with the pain sensibility; that it is psychical rather than chemical, and that without its purposeful functioning we should never know when our otherwise uncomplaining organs were in desperate need of rest and recuperation.

"I maintain my right to contemplate life that I am expected to live as the relation of myself to a perpetually severe and brutal physical environment every element of which is at work to destroy me. I survive only because I am well equipped to meet this environment—or avoid it—and I realize I have strange equipment wherewith to accomplish these ends." For the complete paper see The Journal of Medicine, Cincinnati, Ohio, October, 1931.

MINUTES OF THE NINETEENTH MEETING

President Schnieb called the Academy to order at 9:35 a. m. in the auditorium of Eastern Kentucky State Teachers' College. Present about 70 members and 120 visitors.

The report of the Secretary was received and ordered filed.

The Treasurer reported a bank balance of $75.50, unpaid bills, $90.50, and $75 in Lexington Building and Loan Association stock to cover life memberships. The report was referred to the auditing committee who later reported it correct.

Dr. Middleton reported on the meeting of the council of the A.A.A.S. and the Academy Conference in New Orleans. See Science, February 5, 1932.

Mr. Gayle Starnes, Dr. V. F. Payne and Mr. John Osborn reported for the committee on Junior Academy.

The membership committee recommended 56 persons for membership. The report was adopted and these persons were elected unanimously. Dr. Irvin Abell and Dr. Charles E. Spearman were elected honorary members, unanimously.

Mr. Beckner, for the committee on list of books on science for popular reading reported that the committee had not been able to prepare such a list, largely because the best scientific books are too technical for the general reader.

Prof. J. S. Pierce, for the committee on affiliation of scientific societies in the state, reported the recommendation that the secretary of the Academy write to the secretary of each society asking the appointment of a representative to meet at some future date with a committee of the Academy, for the purpose of considering affiliation, this committee to report to the Academy in 1933.

Mr. Wurtz, for the library committee, reported that President McVey had consented to allot the Academy space in the University library, provided that our books and papers were bound suitably. He exhibited and recommended a binder for manuscripts and pamphlets.

The President appointed the following committees: Membership, W. R. Allen, Julian Capps, Robert T. Hinton. Legislation: S. M. Wilson, G. D. Buckner, Lucien Beckner. Junior Academy, Gayle Starnes, John Osborn, V. F. Payne, A. R. Middleton. Auditing, A. D. Hummell, S. D. Averitt, W. G. Burroughs. Nominating, Noel B. Cuff, G. D. Buckner, V. F. Payne. Resolutions, Lucien Beckner, W. R. Roy, J. L. Leggett. Scientific books for laymen, Lucien Beckner, Julian Capps, H. M. Pyles.

Upon motion, it was ordered that the committees on membership, legislation and junior academy be made permanent.

Following announcements from the Chair, Dr. H. L. Donovan addressed the Academy (paper No. 1), after which Dr. Schnieb delivered the President's address (paper No. 2). The general session adjourned until 2 p. m. and the Divisions met for their respective programs.

At 12:30 the members and guests were entertained by the college at a delightful luncheon, at the close of which Mr. Geo. B. Wurtz read a humorous poem entitled "Evolution."

The general session reconvened at 2 p. m., President Schnieb in the chair. Dr. Donovan introduced Dr. Irvin Abell, who addressed the Academy on "Some recent contributions of science to the field of medicine" (paper No. 23). Dr. Miner then introduced Dr. Charles E. Spearman who spoke on "The Nature of Intelligence" (paper No. 24).

The committee on nominations reported as follows:

For President, George Roberts, University of Kentucky; for Vice-President, Robert T. Hinton, Georgetown College; for Secretary, A. M. Peter, Experiment Station; for Treasurer, W. S. Anderson, Experiment Station; for Member of Publications Committee, J. B. Miner, University of Kentucky.

Upon motion, the report was adopted and these were elected unanimously.

The Academy adjourned to meet next year at the University of Kentucky. After adjournment, members and visitors were taken on a tour of inspection of the campus.

Divisional secretaries reported the meetings well attended and all papers read.

A. M. PETER, Secretary

EXTRACTS FROM THE SECRETARY'S REPORT FOR 1931 - 32

Nine persons elected at the 1931 meeting qualified and have been enrolled as active members, namely: W. H. Clashman, Louis Desjardins, Harriette V. Krick, A. M. Lands, E. E. Snoddy, E. W. Theiss, C. C. Wells, Grace Wyatt, I. H. Zarbell. Thirty-four persons elected by the Council qualified and have been enrolled. We have lost one member by the death on September 2, 1931, of Dr. Charles G. Crooks, retired Dean of Centre College.

The number of members at the time of the 1931 meeting was 195. Since then 43 have been added and 14 dropped, for various reasons, making the present number 224. This is the first time that the number of members has exceeded 200, and credit for the increase should be given to the indefatigable work of our president.

Dr. W. R. Jillson was authorized to represent the Academy in the International Geographical Congress in Paris, France, September 16-24, 1931, he having been appointed by the Governor to represent Kentucky. Unfortunately, he could not attend.

The Academy was invited to send a representative to the International Congress of Mathematics in Zurich, September 4-12, 1932.

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1. **The Scientist and the Social Order.** H. L. Donovan, President, Eastern State Teachers' College.

My first thesis is that the masses do not comprehend the discoveries of men of science and are, therefore, indifferent to scientific revelations. In times of prosperity, they may tolerate scientists with their play houses; but in periods of depression, they either abolish them or leave them with resources that render them impotent. The masses do not believe in men of science, but pin their faith to a political order. They do not turn to the scientist to assist them in the solution of the hard problems of life, but to the politician. They possess no knowledge of the scientific approach to social, economic, educational, or governmental problems. They thoroly understand the political approach and usually attack all problems by this method.

My second thesis is that men of science are so enamored with their work in the laboratories that they assume an attitude of indifference toward the masses, believing them incapable of understanding and appreciating their discoveries. These men, like the proverbial lover, receive their pleasure in the pursuit of the unknown rather than in the possession of the object of their affections. As soon as they have discovered a new truth, they turn in search of another. After having discovered some new thing, they usually display but little interest in the dissemination of the results of their labors. If they do attempt to explain their research, all too frequently they talk or write in an unknown tongue, as far as the general public is concerned. The masses do not understand technical terms and probably have but little interest in mastering a vocabulary that would enable them to appreciate a scientific vernacular.

My third thesis is that there is now available scientific knowledge on social, economic, educational and political problems, which, if intelligently applied to their solution, would advance civilization a century in a single decade. Business has used scientific research to promote its ends—profits. It has built up the machine until the machine has almost destroyed business. Much study has been given to the construction of the machine for production, but little thought has been given to how to control the machine in the interest of a better industrial order. Except for the uses made of research by industry, scientific discoveries have not been utilized to any great degree. The discoveries of the scientists are not always used to promote the general welfare of mankind to the end that the masses may enjoy a better social order. The masses do not appear to be aware that they have missed anything. The politician will attempt to make you believe that if the human race is left to its own devices, it will automatically make the right decisions and do what is best for itself. The scientist knows that the human race is lazy and if left to itself, it will do nothing but continue its course by the trial and error method, which ultimately leads it into oblivion.

As evidence in support of my theses, let me give some concrete illustrations. Take, for example, the work of our last General Assembly. In using this illustration, no reflection is meant on either of the parties or upon any individual or group of individuals involved. The actions of practically any State Legislature would serve equally well. I use our own General Assembly because we are familiar with its actions. I use it as an illustration of a system in which we find ourselves rather than in criticism of its methods and procedures. The members of this Assembly alone are not to blame. We must all accept our share of the responsibility.

Do the constitutionally-elected representatives of the masses respect the man of science? Do they call upon him when drafting revenue bills to share with them his investigations on matters of revenue and taxation? We have in our State as President of our University, a man who is an economist of national reputation, and professors in our various colleges who have given the best of their lives to a study of economics. Was their judgment sought in the last General Assembly in helping to solve the financial tangle in which the State found itself? Or rather were not the laws which were drafted written without adequate information with respect to their effect upon the economic order? I believe that a study will reveal that no well-trained economist has ever written a revenue law for our State which finally has been adopted. There is not the slightest doubt that there are a number of men in the colleges, who have worked in this field, who could render valuable service in working out an equitable system of taxation for the Commonwealth.

Let us turn to another field. What position does the educator occupy in the minds of the masses of our citizens? Do they respect his judgment? Do they regard his technical and professional training? Do our citizens say: "In view of the excellent opportunities you have enjoyed to study the problems of education in a scientific manner and because of the wealth of experience you have had in administering and supervising schools, we, therefore, concur in your judgment relative to the direction of our schools?" Or is their sentiment more likely to be something like this: "He is just another school teacher and doesn't know much about practical affairs."

Again I cite the results of the last General Assembly that you may study the actions of the duly elected representatives of the people, and conclude which of these sentiments actually expresses the attitude of the general public. Against the advice and best judgment of every educator in the State, laws were enacted that were detrimental to the children of the Commonwealth. A political system was foisted upon the masses that will result in handicapping their children in the struggle to receive an adequate education.

To carry the illustration further, may I inquire whether our roads are built by engineers? Or are our penal institutions administered by students of criminology whose advice is sought in restoring criminals to good citizenship, or by politicians interested only in the spoils of office? Are psychiatrists and psychologists called to the aid of those who direct the affairs of our asylums in helping the mentally unbalanced back to mental health? Are men of science in Kentucky called upon for any service other than teaching the youth a lot of theories about which the average man does not have any convictions?

The conclusion of the whole matter is that scientists cannot afford to be out of touch with the masses. They will have to interpret the findings of the laboratories to the people. They must translate their works into a language the common man can understand. Furthermore, scientists will find it necessary to convince the people that their work is being done in the interest of the public and for the promotion of a better civilization. Somehow or other the masses must be led to have confidence in the scientist and in his ability to help them in the solution of their problems. The gap between what is known to be good and desirable and what is applied, is far too great. The scientist must not only discover the truth but he should be interested in helping to interpret it to the masses, so that they will demand that truth shall be the guiding principle under which they live. Dissemination of scientific truths may be as important as their discovery, in the building of a better social order. My plea is that scientists may be able to lead the average citizen to accept the scientific approach to our problems and abandon our old futile efforts to solve them by the political system which now prevails.

2. The Philosophical Basis of Education in Germany. (President's Address.) Anna A. Schnieb, Eastern State Teachers' College.

Today, as one observes the German boys and girls at work in the various types of schools, for there is still a great variety in Germany, and as one studies in the German universities, he cannot help but be impressed with the philosophical atmosphere which permeates the entire educational system. All branches of learning seem to have a philosophical slant. Every German student in the secondary school as well as in the university, has a Weltbild, a Weltanschauung—a view of life, a definite feeling for worths or values for which he stands. As one attends the lectures, comes in contact with his professors and with the students, he asks himself again and again, just what is this philosophy? After much study and personal contact, I tried to satisfy my thinking by defining this philosophy. To verify my interpretation, I conferred with my major professors at the University of Vienna, Professor Meister and Professor Buehler, and with Professor Spranger of the University of Berlin and Professor Litt at the University of Leipzig. With a few minor changes made by them, it is this interpretation which I shall convey to you now.

The philosophy of German education is necessarily different from that of American education because of the difference in background. Here in America, as we well know, we had no tradition to commence with; we had the influence of frontier life, the necessity of subduing a wilderness on its own terms. European tradition was not sufficient to meet these needs. New ways must be found. Strong individual self direction was needed, a reliance on self and on small-group cooperation. Thru successive generations, characteristics of initiative, self-reliance, and face to face cooperation were built into the folkways, along with an impatience at restraint of any sort whatsoever. From the beginning we have been a freedom-loving people and a people of action.

To appreciate the German philosophical viewpoint, one must understand the German classification of the sciences. According to German thinking, the sciences can be classified as theoretical and practical. The theoretical sciences are pure theoretical knowledge. Their purpose is simply knowledge as such. Education in Germany until now was considered a practical science, which is clearly illustrated by Comenius, Locke, Rousseau, Basedow, Pestalozzi, Herbart, Froebel and others. Until now the development has been one-sided. It was but a system of norms. Nothing was said concerning the **meaning of education** and its **place in culture.** If one spoke of the meaning of education, this did not belong to pedagogy, because until now pedagogy or education was entirely practical.

In 1915 there came a new viewpoint. This was the consideration of education as a pure science on a philosophical basis. From this date, education ceased to be merely a practical science. A philosophy of education began to be developed. The outstanding men in this movement were Spranger from Berlin, Meister from Vienna, Litt from Leipzig, and Fischer from Munich. These educators worked for a theoretical basis for the existent practical education.

Pedagogy as a pure science, according to German thought, raises the question, **What is education?** Pedagogy as a practical science raises the question, **How shall one educate?** In this last question, one goes from the facts of education, as it is being carried out, to the demands of education or how one should educate. Pedagogy as a pure science gives rise: First, to a historical side in which one sees the: History of education; Types of education. Second, to a pure philosophical side which gives: A theory of worths which, in turn, indicates the place of education in culture and the general purpose of education; a theory of knowledge in pedagogy.

Concerning the place of education in culture, the question arises: What is culture? According to German thinking, culture is the sum of all objective intellectual products. For instance, art, science, religion. Objective intellectual products are those which have duration. Everything which man produces belongs to culture, the physical as well as the intellectual.

Culture must be classified and should be classified according to the different fields. For example, art, philosophy, religion. The existence of culture is bound first to cultural work and second to the passing on of the entire cultural possession. Thru this we see the meaning of education. Education has the task of leading man to culture. Education must lead the child in the process of critically assimilating culture. Therefore, education has a double function concerning culture: First, passing on culture; second, making the different fields of culture a unity in man, an integrating process.

From this comes the purpose of education, which is to form personality. A personality, according to German thinking, is an individual who actively takes part in the cultural life of his time; who has a general view of the entire field of culture and who possesses a philosophy of life. The idea of personality must not be confused with the idea of individuality. Individuality is an unborn disposition. Personality is an ideal. Only thru an ideal of personality can a cultural work be secured and maintained as living and universal, as a part of the entire field of culture.

From reflection about the idea of culture and the conditions of culture, comes the meaning and the purpose of education. From the meaning and purpose of education are derived the three fundamental forms of education: First, general education, which gives the general view of culture. Second, education for profession or trade, which makes for intellectual workers and for commerce and production. This provides for actively taking part in the cultural work. Third, education for a philosophy of life.

Concerning the theory of knowledge of the pedagogical laws or norms several questions arise: First, Whence do the pedagogical ideas come? Second, How far are they true? Third, What are the limits in education in general?

Concerning the first question, they come from reflection and from the meaning of culture. From these conclusions we find the meaning and the purpose of education. The general supposition for these pedagogical principles is the appreciation of cultural work and the wish to continue and to further this cultural work. Culture is a worth. This is the fundamental idea.

Concerning the question as to how far the pedagogical norms are valid, it is said their validity depends upon: 1. General psychology, thru its research and method. 2. The type and heighth of culture. Culture provides the content of education. For instance, in Austria, English is taught in all night schools and in nearly every public school. The same can be said of art. 3. Individuality of the pupil. 4. The specific individual case. The disposition of the teacher and the pupil as well as the environment play a part. Pedagogical norms can never be made to serve all conditions or all cases. They must be adapted to the individual case. While the general pedagogical norms are not always true, their philosophical suppositions **are always true.** They only depend upon the appreciation of cultural worth.

Concerning the question as to what are the limits of education, it is said that the individuality of the pupil is the first limit of which we must take cognizance. Earlier it was believed that education had no limits—nothing was impossible. Today it is believed that human individuality forms a limit for education which must be recognized. Second, we cannot foresee all pedagogical situations and make norms for them. Here we need intuition which is an inward consciousness of the right. One cannot learn to be an educator. He must be born an educator. Pestalozzi was a born educator. Here science ends and art begins. Today, according to German thought, pedagogy is not merely a practical science. It does not depend as before upon psychology and ethics, e.g. Herbart; but today it depends upon its own philosophical principles and has its own scientific methods. Thru this, pedagogy has become an independent science.

In the case of a people like the German, who can look back on a glorious educational tradition, it is possible for a new cultural ideal to arise only if the spiritual forces are given their free play. So long as humanity is made up of men and women, and not of machines that may be ordered from some factory, so long will we have to deal with personal aptitudes of various kinds, requiring a corresponding variety in our system of teaching. Today diversity of talent is recognized as a dispensation of nature; the student who gives evidence of superior intellectual powers, must be given a chance to develop them, no matter to what social group he may belong. This arises from a recognition of the welfare of the nation as a whole.

The Weimar Constitution of 1919 calls for the cultivation of a patriotic and loyal sense of citizenship; it also demands a recognition and cultivation of friendly relations with other peoples. No nation can successfully work out its own destiny except in harmony and peaceful cooperation with the other nations. The ideal of cultivating a spirit of peace and harmony among the nations must be a principle of the education in Germany. Religion, music and art are now recognized by the schools as necessary specific outlets for the spiritual emotions in order to meet the spiritual demands of the time. The gulf between art and science is commencing to disappear, which is shown by many of the books published today. It is rather difficult to know if they belong to art or to science. As Dr. Meister said "Whenever we honestly acknowledge the subjective character of the scientific mind we are well on the way of realizing that what is called the scientific talent springs from those mysterious sources in which the artistic talent also has its origin. To quote Dr. Becker of the University of Berlin, "Even if our minds should one day be able to discover and give a rational account of how the scientific and artistic sides of our nature are interrelated, this discovery would only be of the same kind as all the discoveries made in the realm of physical science; for these only raise one veil after another, and leave us always face to face with newer mysteries. Therefore, such an achievement on the part of the human intellect, great as it might be, would not bring us to a cold intellectual understanding but rather to an attitude of awe and wonderment before the mystery of our own being. That attitude would be akin to the contemplative mood in which we gaze upon and appreciate a great work of art, which our reason cannot account for or explain." And further Dr. Becker says, "The spirit of genuine humanity has been strongly awakened and brought into the activities of everyday life. That spirit will not sink back into its primal inactivity; nor will it cease to be a formative force in the outer world. It is an all-important matter that the mental orientation received from this philosophy of life does not look for eternity only in what is dead and past, but in what is living and near at hand. Be it as unscientific as it may, this faith in the eternal endurance of one's own personal experiences is a faith that is not a mere outward and passing thing but rather something which has in it the capacity to set in action and sustain the creative powers of the human spirit.

In the spiritual tendencies of the present age, the most productive element has been their power of fusing individual views and purposes into a common social ideal. This is clearly shown in the Youth Movement of Germany. In the social aspect of its organization, the Youth Movement was a protest against the accepted social forms which had become worn out and which were only mechanical restrictions on the liberty of the individual. We see, then, that a new spirituality has come up to offset the old intellectual idea of education. According to Dr. Becker of Berlin, with this spirituality which is of the soul rather than of the mind, we have a new conception of the function and the place of the human body in our practical lives. Gymnastics have come to take an outstanding place in the training of the German youth. The currents of many streams come together here. The development of respect and care for the body, as the sacred house of our human nature, is largely due to the Youth Movement. To develop muscle, valor and gallantry, is no longer the exclusive purpose of the athletic sports and games. The German interpretation is that these exercises are essentially the outer expression of the spiritual forces which actuate the whole human being. So we see that the use of athletics has its integral place in the general educational system. According to German thinking, it develops the character and the will and brings them into harmony with the activities of the body; and thus leads to the all-round development of mind, spirit, and body which constitutes the new ideal in education.

3. **Experiments on the Development of the Pelvic Girdle.** Harvey B. Lovell, Biol. Dept., U. of Louisville.

The pelvic girdle proper of *Amblystoma punctatum* consists of a flat ischio-pubic plate and a slender ilium extending dorsally to articulate with the sacral rib on the 16th vertebra. In heterotopic grafted limbs it differentiated as a topographically complete structure in every case in which the free limb was fully developed. When the extirpated rudiment failed to regenerate, the girdle was found to be absent, but when the limb regenerated completely, the pelvic girdle also was structually normal. It was therefore shown that the pelvic girdle proper is an equipotential restitution system. In an inverted limb bud (stage 42) the symmetry of the girdle agreed with that of the limb. The ypsiloid process which extends forward from the center of the ischio-pubic plate was found to be a separate embryonic rudiment. It was absent from the girdles of grafts and in the orthotopic position the right fork was or was not present according to the size of the extirpated rudiment. An intimate developmental relationship between the pelvic girdle and the sacral rib was demonstrated. When the girdle was absent the sacral rib was no longer than the ribs on the vertebrae immediately anterior.

4. **Heterothallism in the Water Mold, Dictyuchus.** Harlow Bishop, Biol. Dept., U. of Louisville.

The organism discussed, *Dictyuchus monosporus* Leitgeb, is closely related to the commoner fungi, *Saprolegnia* and *Achlya.* All these characteristically reproduce asexually by biciliate zoospores and sexually by thick-walled oospores. Sexual reproduction is accomplished by a high type of heterogamy, with the formation of antheridia and oogonia. In all conclusively studied cases other than in Dictyuchus, the plants are monoecious or homothallic and each is capable of producing antheridia and oogonia. The material studied was collected in October, 1927, from a stream in the Blue Hills Reservation, near Boston, Mass. The cultivation of the fungus was continued on agar. Pure cultures were obtained and single zoospores were isolated from them. Many such zoospores were isolated and the strain of the fungus arising from each zoospore was maintained in pure culture. Many matings of the resultant strains were made, without, however, the production of oospores. This is characteristically to be expected of dioecious or heterothallic plants. Later experiments demonstrated that all the first strains were antheridial. At length, in July, 1930, the mating of two strains was successful in producing abundant oospores. A recently isolated strain had proved to be a female or oogonial strain. In this way the fact of heterothallism for the genus was established for the second time. Dr. John N. Couch, of the University of North Carolina, discovered and proved heterothallism in Dictyuchus for the first time (see Annals of Botany, vol. 40, No. 160, October, 1926, pp. 849-881). In a recent letter Dr. Couch states that the work of the writer is the first confirmation of his proof of the heterothallic nature of Dictyuchus.

5. **The Effect of Alcoholism on the Thyroid Gland of Guinea Pigs.** Albert Stoner, U. of Louisville.

6. **The Iodine and Bromine Content of Animal Tissues.** J. S. McHargue and D. W. Young, Chemistry Dept., Ky. Agr. Expt. Station.

Preliminary feeding experiments with rats indicated that bromine is essential in the metabolism of animals. The apparent importance of bromine in the metabolism of animals has led us to ascertain the iodine and bromine content of organs from a few species of domestic animals. A modification of the method of analysis published by Pincussen and Roman was used. A 25-gram portion of dried, finely divided tissue was heated with a strong solution of potassium hydroxide, in an iron crucible, over a small flame, until the water had been expelled and a carbonized residue remained, after which the crucible was heated in an electric furnace at a temperature not exceeding 400°C. until most of the carbon had been burned. The water solution of the residue was divided into two parts and acidified with sulfuric acid. Iodine was set free by adding nitrite to one part, extracted with carbon disulfide and its quantity measured in a microcolorimeter. Bromine was set free by adding chlorine water very cautiously to the other part and was extracted and measured in a similar way. The results show that iodine and bromine are present in the tissues of rats, chickens, hogs, sheep, cattle and horses. The quantity of bromine found was larger than that of iodine, except in the thyroid gland. Milk and eggs contain nearly equal amounts of iodine and bromine and it is the opinion of the authors that iodine and bromine are contributing factors to the nutritional value of these important foods. Further experiments will be made to ascertain more definitely the importance of bromine in the metabolism of animals.

7. The Mineral and Nitrogen Content of the Leaves of Some Important Species of Forest Trees at Different Stages During the Growing Season. J. S. McHargue and W. R. Roy, Chemistry Dept., Ky. Agr. Expt. Station.

Analyses were made of the leaves of 21 species of trees, at three stages of development: when the leaves were about one-third grown, when they were mature, and just prior to the first frost. The analyses show the trend toward accumulation or decrease in mineral content and nitrogen of the leaves. Percentages of ash, SiO_2, Mn, Ca, and Mg increase thru the growing period, while P, Na, K and N decrease in percentage. These tendencies are fairly uniform in all species analyzed, tho some varieties of leaves seem to have a preferential requirement of certain elements. Several aspects and applications of the findings are discust.

trees; many kinds of fruits; the fruit of the spineless cactus of Luther Burbank; a rattler, coiled, ready to strike; and a copperhead in the same situation.

Photography makes it possible to get all kinds of slides which, with the coloring true to nature, can be used at any time during the year to bring before the pupil all that grows out of doors. The author has made a large number of slides and has sent them to twelve schools in New York City, to Luther Burbank in California, to colleges and universities all over the United States and Canada, and to many high schools of the middle west, south and northern United States, and is still making them.

10. Physiographic History of the North Branch of the Susquehanna River in Northern Pennsylvania and South-Central New York. Wilbur Greeley Burroughs, Berea College.

The Susquehanna River from Athens to Towanda gorge, Bradford County, Pennsylvania, flows nearly southward in an "open-valley". The river then swings toward the southeast and continues in this direction in a sinuous course to Pittston, Pennsylvania, where it turns toward the southwest. Thru-out the southeast course the valley is of an "in-grown" type. At the north end of Towanda gorge the southward course of the "open-valley" is continued as a "strath" in the Mine Ridge peneplain of late Tertiary time. There is no stream in the remnant of this "strath", but field evidence indicates that the "strath" formed the valley of the southward-flowing Susquehanna in Tertiary time. This ancient valley continues in a direct line to the gorge of the South Branch of Towanda Creek where that stream cuts thru Kellogg and associated synclinal mountains whose summits are remnants of the Cretaceous peneplain. "Berms" or "strath-terraces," high up on the valley sides, indicate where the Susquehanna Valley existed in Cretaceous and Tertiary time.

In Tertiary and probably Mesozoic times the southward-flowing Susquehanna River was paralleled on the east and west by other southward-flowing streams. Portions of these rivers exist today. By a series of captures performed by tributaries of these streams, the present upper Susquehanna

CORRECTION

Paper 9 is concluded on page 56; paper 10, on page 58.

8. **Comparative Methods of Determining the Normal Rates of Growth of Experimental Animals.** G. Davis Buckner, W. M. Insko, Jr., and J. Holmes Martin, Ky. Agr. Expt. Station.

In an experiment to determine the normal rate of growth of White Leghorn chickens raised under favorable experimental conditions, individuals were removed from time to time, either for experimental purposes, because of sickness or by death. Separate growth curves were made of cockerels and pullets, according to each of the following three procedures: (1) by using the average weights of all chickens alive on each weigh day; (2) by omitting the weights of all that died during the experiment; and (3) by omitting the weights of those removed for experimental purposes, as well as of those that died. Each lot originally contained 120 chicks. The curves obtained in these three ways were practically identical. This shows that the number of chicks in each group was sufficiently large to overcome individual variation. The removal of chicks from the experiment by death and the removal of two average sized chicks from each lot on monthly weigh days, for the purpose of obtaining information concerning the individual development of the average chick in each lot, did not materially alter the curves of growth, which we believe to be normal for the White Leghorn cockerel and pullet.

9. **Photography as an Aid in the Study of Nature.** G. D. Smith, Biol. Dept., Eastern State Teachers' College.

The thousands of negatives taken in the study of plants and animals under natural conditions constitute a wonderful record and are a great aid to the memory. The author has taken 5600 negatives of wild mushrooms and other closely associated fungi and, at sight, can give the scientific name of nearly every one. A few of the things that the author has preserved with the camera are: the eight-legged pig; the black raspberry; young rabbits; the gray squirrel; the opossum; the American coot; the oyster mushroom; the marasmius mushroom; the coral mushroom; the inkpot mushroom; quail and nest; mockingbird's nest; catbird's nest; blackbird's nest; young flickers; young sparrow hawks; many kinds of and upper sections of the other south-flowing rivers to the west of that stream were diverted westward into the southward-flowing Susquehanna at Athens. In the meantime, a stream flowing southeast on a coastal plain or peneplain in pre-Kittatinny time became superposed upon the underlying strata. This stream worked headward and in Tertiary time captured the southward-flowing Susquehanna in the vicinity of Towanda, Pennsylvania.

The northward-flowing Seneca River or a tributary cut thru a divide in the present Chemung River valley near Narrow Hill, northwest of Waverly, during late Tertiary time, tapped a tributary to the Susquehanna and diverted that stream into Seneca River. A divide formed near Towanda. The Susquehanna from near Towanda to Waverly was reversed in its direction of flow, as indicated by "barbed" tributaries, and became a tributary to the Susquehanna-Seneca River. Streams cut thru the divide at Towanda, and the northward-flowing section of the Susquehanna was turned southward into the southeast-flowing, sinuous Susquehanna, long before Wisconsin time.

Physiographic features indicate that the region under discussion was glaciated by a pre-Wisconsin glacier. An interglacial stage then ensued, followed by Wisconsin glaciation. Evidence of glacial lakes and local ponding in the Susquehanna Valley during Wisconsin time are seen. Glacial and fluvio-glacial deposits include recessional moraines, ground moraines, morainic terraces, valley trains, kames, and other features. Two river terraces have been cut in the fluvio-glacial deposits of the Susquehanna Valley. At a higher elevation is a morainic terrace.

11. The Origin of the Topographic Term, Jumps, in Kentucky and Tennessee. Lucien Beckner, Louisville.

12. Erosion or Non-deposition on the Cincinnati Geanticline. Lucien Beckner.

13. A Demonstration of Photoelectric Control. A. D. Hummell, Eastern State Teachers' College.

Relays which can be operated by a photo-electric cell directly usually are too delicate to carry the current required to operate an ordinary 100-watt lamp. This experiment demonstrates the common practice of using an amplifier between the cell and a more rugged relay.

14 **Inconsistencies in Chemical Color Terminology.** Thos. C. Herndon, Eastern State Teachers' College.

The colors of a number of the commoner colored chemicals were named by 179 freshman college students, 98 boys and 81 girls, some with and some without chemical training. Also, the colors applied to these chemicals by the authors of 14 well-known textbooks were determined. The results indicate that neither students nor authors are altogether accurate or consistent in their terminology. The authors differ as to the exact colors of these chemicals and often omit the colors entirely. The students give a wide range of color terms to each colored compound studied, many of them obviously erroneous. Among the students, sex and previous chemical instruction seem to play minor parts in influencing color terminology. The facts observed in this study probably apply to many other colored chemical substances.

15. **A Study of Mixed Benzoins.** Meredith J. Cox, Eastern state Teachers' College.

The literature of ketols and of symmetrical and unsymmetrical benzoins was reviewed. Ketol condensation was contrasted with aldol condensation. The paper included a study of benzoins other than those found from benzaldehylde. The work of Liebig, Woehler and Emil Fisher was reviewed. Apparently very few ketols have been prepared. The work of Buck and Eyde was reviewed. Also their method of separation. The research consisted in preparing the two mixed ketols of benzaldehyde and anisaldehyde and separation by fractioning. Crystallization of the mixed ketols and the melting points were determined.

16. **Reactions of Aromatic Tertiary Amines with Benzene Sulfonyl Chloride**. Paul Goodloe, student, and Thomas C. Herndon, Professor, Chemistry Dept., Eastern State Teachers' College.

In textbooks where the reaction is mentioned the statement is made that tertiary amines are unaffected by benzenesulfonyl chloride in the presence of an alkali. Some even say the reaction does not take place, regardless of the conditions. To test the truth of these statements, the reactions of six aromatic tertiary amines with benzenesulfonyl chloride were tested, both in neutral and in alkaline solutions. The amines were diethylaniline, dimethylaniline, paranitrosodimethylaniline, dimethylorthotoluidine, dimethylmetatoludine, and dimethylparatoluidine. It was found that they all reacted in neutral solution, either at room temperature or with the application of heat. In alkaline solution only three reacted. The three which did not react, diethylaniline, dimethylorthotoluidine, and dimethylparatoluidine, evidently did not react because the ten percent sodium hydroxide used as solvent boiled at a temperature lower than that required for the reaction in neutral solution. The authors concluded that the statements concerning the reactions, found in many textbooks are at least misleading and that, since at least one of the amines tested, paranitrosodimethylaniline, reacted at room temperature in both neutral and alkaline solutions, the method advanced by O. Hinsberg in 1890 for the separation of primary, secondary, and tertiary amines is not infallible.

17. Relative Memory Value of Pleasant and Unpleasant Words. Mrs. F. J. Ratliff, Western State Teachers' College.

One hundred and fifty students were given a list of 240 words and asked to mark each word as pleasant, unpleasant, or indifferent, upon two different occasions. A list was made of ten pleasant and ten unpleasant words upon which there was absolute agreement among the judges, upon both occasions. These words were presented serially upon the Rasnchburg memory apparatus to forty-two subjects, separately, with instructions to master completely. In order to control the factor of position of words within the series six arrangements of the words were made and each arrangement was used with seven students. Delayed recall was taken 7, 10, 14, or 21 days after learning, the students being divided into four groups for this purpose.

It was found that (1) pleasant and unpleasant words were learned with equal ease; (2) more pleasant than unpleasant words were recalled; (3) the dominance of the pleasant words increased in direct proportion to the length of the time interval between learning and recall; (4) the results were the same for both sexes. These findings suggest that forgetting may be an active process.

18. Effect of Changes of Pulse Rate on Recall. Lawrence M. Baker, U. of Ky.

19. Effect of Change of Surroundings on Recall. M. M. White, U. of Ky.

The problem was to determine whether recall is affected if the external environment is different at the time of recall from that at the time of learning. There are three parts to the experiment. First, ten nonsense syllables were presented visually to 24 students, with the request to memorize. The syllables were presented five times to each subject separately. All subjects returned a week later; half of them, chosen by chance, were sent to a room in another building for recall and half were tested in the room where learning originally ocurred. Second, the students worked in groups. Four groups of twenty students each were given three visual presentations of ten nonsense syllables, with a request to memorize. Immediately after learning, each group was divided into two parts of equal intelligence as determined by the Kentucky Classification Test; one part was tested for recall in the room in which learning had occurred; the other, in a room across the hall. Third, the subjects were 14 reformatory school boys with an average chronological age of thirteen years, all of whom were retarded in school. Five presentations of six nonsense syllables, given one at a time, were made to each boy separately, with a request to memorize. Twenty-four hours later seven of the boys were asked to recall in the room in which learning had occurred and seven in a different room.

The results were: (1) Where partial learning occurs, a change of surroundings affects the recall detrimentally, regardless of the sex, age, or intelligence of the subject. (2) The effect is more pronounced in immediate than in delayed recall. On the basis of this and other experiments it is suggested that we learn material not in isolation but in relation to the environment at the time of learning or expected environment at the time of recall. The question is raised as to the effect of knowledge that there would be a change of environment for recall.

20. Intelligence Testing in Teachers' Colleges. Noel B. Cuff and H. L. Donovan, Eastern State Teachers' College.

The paper discusses briefly the present status of intelligence tests and reports on the answers received from 156 teachers' colleges to a questionnaire on the use that is being made of such tests. The following conclusions are stated: 1. Only four intelligence tests have wide use in teachers' colleges. (Thurstone, Otis, Ohio State, and Terman Group test, in order of frequency.) 2. The Thurstone (American Council on Education) and the Otis are the tests most frequently used in teachers' colleges. 3. Seventy-seven percent of the teachers' colleges use some mental test. 4. Most of the teachers' colleges use only one test, but seven use three, and one uses five. 5. Twenty-two uses of mental examinations are made by two or more teachers' colleges. 6. The most common use is in giving advice on study programs. 7. Most of the percentile ranks required on such tests as Thurstone and Ohio State are lower than those required on such tests as Otis and Terman. 8. Several colleges use intelligence measures in combination with high-school records or achievement tests.

21. The Language of General Psychology—A Statistical Analysis. Milton B. Jensen ,Western State Teachers' College.

Fifteen judges, representing as many major departments of psychology, rated 403 vocabulary terms taken from texts in beginning psychology and from "A Student's Dictionary of Psychological Terms," by English. Words considered as having no meaning or usage singular to psychology were excluded. The judges were instructed to rate each word in terms of its singular value to the field of general psychology. They used the following scale: 10 = maximum value; 0 = worthless; -10 = maximum negative value, i.e., leading away from psychology into some other field.

Agreement between the ratings of the judges on individual words is expressed in standard deviation of the mean. In general, the higher the rating given a word, the greater the agreement of the judges as to its value. The product-moment correlation between size of mean rating and standard deviation of these means is —.658. The combined ratings of the judges are described as having a reliability of .825 computed by application of the Spearman-Brown formula to the average of the intercorrelations of the judges' ratings. The words rated highest and lowest, respectively were **recall,** 33.7, and **perceptor,** 0.5, mean rating divided by standard deviation. It is inevitable that many, if not most social procedures, because of a lack of independent objective criteria, must be evaluated in terms of personal opinion. It is believed that processes similar to those used in this study might be of marked advantage in other fields.

22. An Inventory of the Habits of Children from Two to Four Years of Age. Anna L. Payne, Berea College.

Such an inventory, based on the work of Dr. Ruth Andrus of Teachers' College, Columbia University, is a valuable instrument for acquainting students—undergraduates, graduates, parents—with child behavior. An intensive study is made of the individual child for a period of three hours. The notes taken during those hours of observation of all the child does and says and of all that is done or said to the child, give a permanent record from which the child may be studied objectively from various angles. The Inventory consists of a series of questions relative to four phases of growth: Emotional, Mental, Motor, and Social-Moral habits. The scoring of the questions of each division gives a numerical score of the child's habits, which may be developed into a graph showing the relationships of the status of the habits of a child, or further developed to show the relationships of the habits of an individual to the average of a group of children; or inventories of a child made at different times thru a school year, or a given period of time, show the changes in adjustment in various habits.

The following sample of observation is given to show how such notes may be considered permanent records for various phases of child study.

OBSERVATION OF CHILD 20 MONTHS OLD

8.45—D. arrived in playroom. Went straight to shelf, took down peg board and box of pegs. Carried them to table, sat down at table, put pegs in board here and there with r.h. T. came over to table, interrupted D. D. started crying. T left, as adult suggested he not interrupt D's play. D. laughed as he picked up one of the colored pegs. Held it in air for adult to see. G. O. and T. came over to table, each went to shelf, took a peg board. O. took pegs out of box of pegs. D. said, 'Ah-ah-ah' and started pulling box of pegs toward him. Adult suggested he share pegs with others. D. smiled and pushed box toward O. D. listened to M at other side of playroom, as she talked over toy telephone. D. put pegs in mouth while watching other children at table. Sat watching them for five minutes. D. interested in pegs 20 minutes.

9.05—D. left table to play with wooden horse (Lynton Pony). Couldn't get on pony's back. Cried 'Ah-ah-ah' and looked toward adult. Adult helped him on. D. unable to reach floor with feet, looked to adult and held out his hand Smiled at each child as he was pushed by them. P. asked if she could push D. D. cried as P. started to push him. Adult: 'Yes, D., P. will give you a nice ride.' D. continued to cry a bit when P. pushed him, but soon stopped. When adult returned to playroom, P. had left D. sitting on horse. Adult pushed D. a little bit, then left him to go to story corner. D. discovered that he could reach the floor with his feet and push himself backwards. He laughed as he got to the side of the room. From story corner adult said, 'That's fine, D. You are having a nice ride.' M. pushed him forward and D. tried to push backwards again. At first he seemed to forget how, but succeeded after a few seconds, putting hands on reins. Adult went by him again. D. stretched out hands toward her. Tried to get off horse. Adult held horse secure, while he tried to get first one leg then the other over horse's head. Then adult held his hand as well as holding horse, while he got off.

Some suggested phases of study of this child, from these permanent records:

(1) Play interests—showing initiative and span of attention. (a. peg board; b. colored pegs; c wooden horse.) (2) Language development—(use of crying, sounds, gestures.) (3) Social development—individualistic. (Seeks adult attention. Watches and listens to other children. Cooperates—at suggestion of adult: a. sharing pegs; b. allowing other child to push horse). (4) Motor development—a. handling pegs; b. learning to manipulate wooden horse with adult guidance). (5) Adult guidance—(a. suggestion as to sharing; b. verbal approval, encouragement; c. giving child security; 1. by being near child; 2. by steadying the pony).

Reference: An Inventory of Habits of Children from Two to Five Years of Age, by Dr. Ruth Andrus, Teachers' College. Columbia University Press.

23. Some Recent Contributions by Science to the Field of Medicine. Irvin Abell, University of Louisville.

The recent contributions of science to the field of medicine have come chiefly from the fields of biophysics and biochemistry. The Science of Physics has developed instruments of precision both in diagnosis and treatment. In recent years the study of the heart and its diseases has been tremendously enhanced by the electrocardiograph, a galvanometer sensitive to one sixty-millionth of an ampere, which accurately records the contractions of the heart muscle and permits interpretations of disease obtainable in no other way. An interesting feature of such tracings is that, like finger-prints, each is specific for the individual from whom it was made. The science of pharmacology has aided in the treatment of heart affections by furnishing preparations of digitalis of known strength. Preparations of this drug may be active or inert; today each one is tested on frogs or cats, the minimum amount required to kill a frog or a cat of given weight is designated as a unit, upon the known strength of which the dose for the human can be accurately computed according to weight.

The X-ray has been made to visualize the innermost recesses of the body, bringing to diagnostic light parts hitherto remaining dark except when exposed by open exploration. The intestinal tract from the mouth to its lower termination is filled with barium under actual inspection which together with subsequent films or pictures show its contour and permit accurate recognition of deviations from the normal. A harmless combination known as lipiodal is injected into the sinuses of the head and the bronchial tree of the lung, giving ready visualization. The gall bladder and the kidneys with their eliminating ducts are made visible by the injection into the veins of dyes which are eliminated only by the liver and kidney. Even the recesses of the brain are yielding data of diagnostic value with the injection of air into its ventricles or cavities, making the contour and relations of the latter visible to X-ray examination. The same is true of the abdominal cavity, the injection of air into which permits X-ray recognition of the sizes and relations of its organs.

Physics is playing its part in treatment, notably in fractures, in the management of which the principles of physics have been uppermost in securing the greatly improved results of today. The surgical treatment of pulmonary tuberculosis is based largely on the principles of physics in securing rest for the diseased lung rather than in surgical attack on the disease itself. Division of the phrenic nerve, which supplies the diaphragm, one of the chief muscles of respiration, paralyzes in part its activity, relieving the diseased lung of part of its constant motion, furnishing the needed rest for recovery. The same result in greater degree is accomplished by removing sections of the ribs on the affected side, with resulting collapse of the chest wall and physiological rest for its contents. Tuberculosis of the larynx or talking box has in past years signalled the beginning of the end; today as the result of the labors of Strandberg the carbon arc light is curing an appreciable number of otherwise hopeless individuals.

Syphilitic disease of the brain, known as paresis, heretofore an incurable malady, is today arrested by fever therapy. The fever is induced by inoculation with the germs of malaria, the temperature elevation being continued for periods of ten to twelve days at a time. This results in an arrest of degeneration in the brain and if applied early in the course of the disease the patient is restored to community capacity; if applied late it still arrests the disease but does not overcome the degeneration which has affected mental ability. The beneficent effect of this treatment was at first thought to be due to an effect of the malarial germ on the syphilitic germ; at present it is believed due to the stimulation of certain cells of the body by the continued fever. An electrical device has been perfected by which the temperature of the body can be elevated to any given degree and maintained as long as desired for carrying out such treatment.

The science of chemistry applied to the study of the body in health and disease has thrown a flood of light upon phenomena hitherto unknown or but imperfectly understood and presages for the future the chief line of advance in the march of medical progress. That various organs of the body form chemical substances which are of importance as regulators of body functions is an idea long entertained. Primitive peoples had some such conception when they ate the hearts of their enemies to increase their courage. The ancient physicians followed the same line of thought when they prescribed wolf's liver for hepatic disease, rabbit's brain for nervousness, and fox's lung for respiratory disorders. We now know that certain glands in the body form secretions termed hormones which are distributed to the body by means of the blood and which alter or modify its functions. The important ones in the light of our present knowledge are the thyroid, the pituitary, the adrenal, the sex glands or gonads, the pancreas and the liver.

The thyroid, situated in the neck, is known to lay people thru the name given by them to most of its diseases—goiter. The active principle of the gland is thyroxine, of which there is but $^1/_5$th to $^1/_4$th grain in the body at one time, the total amount needed for a year being but 3½ grains. This pinch of material spells the difference between imbecility, normal health and disabling disease. When inadequate in the infant, a stunted, bandy-legged imbecile results; when in excessive amount at any age, an unstable nervous mechanism with secondary degeneration of heart and kidney follow. It largely regulates the amount of energy produced in the body and deviations from the normal produce dire results. The test by which the production of energy in the body is determined is known as the Basic Metabolic Rate test. This is also known as the goiter test and records with mathematical accuracy the deficiency and the overactivity in secretion of thyroxine by the thyroid gland.

The diseases of the thyroid gland may roughly be divided into two groups: the insufficiences and the overactivities, the latter known as exophthalmic goiter or Graves disease. Since thyroxine is 65% iodine, the development of the first group can be prevented by the administration of iodine. In the goitrous districts, known as such because of the widespread prevalence of the disease, it is assumed that a lack of iodine in the water and food causes an overwork on the part of the thyroid gland in an effort to manufacture sufficient thyroxine for the needs of the body, resulting in its disease. The correctness of this is proved by the prevention of goiter in such districts by the administration of iodized salt, a combination of iodine and table salt. In the overactivities, iodine has proved of value in preparing patients for operation, forming, when administered by mouth, a chemical combination with the thyroxine, thus neutralizing its activity and permitting a subsidence of symptoms, during which its excessive formation may be curtailed by a removal of a part of the gland.

The pituitary gland, quite small, weighing but 10 grains, is situated at the base of the brain. It secretes three hormones, one having to do with growth, one with sex function, and one with the action of the involuntary muscles. A deficiency of the growth hormone results in a diminutive man, a dwarf or midget; an excess results in a symmetrical giant. If the overactivity of the gland occurs after puberty, well-rounded development is no longer possible, the resulting overgrowth taking place only in such parts of the body as are susceptible to the hormone, resulting in a misshapen individual who seems to have reverted to the gorilla type. Deficiency of secretion in adults results in abnormal deposit of fat, largely in trunk, hips and thighs, the face, breasts, hands and feet showing but little increase.

The sex hormone, Prolan A and B, produces rather amazing results in laboratory animals, the A hastening maturity with stimulation of the sex urge and early reproduction, the B producing sterility. So far quite a bit has been accomplished in the application of these two hormones to the correction of human ailments and the reports in medical literature indicate that the research work under way will shortly produce even more tangible results. The third pituitary hormone, influencing involuntary muscle and known as pituitrin, is in daily use as a stimulant to the heart, to the uterus and to the intestines.

The adrenal or suprarenal glands, two in number, weighing about 60 grains each, are situated one over the upper part of each kidney. The hormones secreted by the glands are known as Cortin and Adrenalin. An excess of cortin causes marked accentuation of masculine sex traits, the male showing a marked accentuation of virility, the female a transformation toward the opposite sex. The deep-voiced, coarse-featured, bearded ladies of the sideshows are probably victims of this glandular mishap. A deficiency of cortin results in what is known as Addison's disease, a heretofore fatal malady. At present, for the first time, extracts of the gland containing cortin are being used in the treatment of this disease with the promise of good results. The second hormone, adrenalin, stimulates the heart, raises blood pressure, controls surface bleeding, and is of great value in temporarily relieving asthma and hives.

The sex glands, or gonads, constitute the essential organs of reproduction, the female furnishing the egg, the male furnishing the fertilization element; in addition to which both secrete a hormone which affects structural development. Removal of the gonads in both sexes before puberty profoundly affects the further structural development of the body, causing an absence of the masculine and feminine features and traits which are referred to as the secondary sexual characteristics. So far but little has been accomplished in securing the hormone of the male gonad while much has been attained in identifying and making extracts which contain the various hormones of the female gonad. These are now successfully used in establishing delayed puberty or maturity, in regulating the menstrual cycle, in controlling the nausea of pregnancy and in relieving the distressing symptoms of the menopause.

It has been recently shown that the urine of the pregnant woman contains a hormone of pituitary origin which is used in making a diagnosis of pregnancy. Before the advent of this test, the only positive signs of pregnancy were the heart-beats of the fetus, the movements of the fetus and the detection of the fetal bones by X-ray examination, none of which can be elicited before the fourth month of pregnancy. The hormone of the pregnant woman appears in the urine within two to five days after impregnation and when such urine is injected into the abdomen of the sterile female rabbit it produces a hemorrhage into the follicles of the ovary containing the eggs. The test requires but 48 hours and permits the recognition of pregnancy twelve to sixteen weeks earlier than by former methods.

The pancreas, or sweetbreads, situated in the abdomen behind the stomach, is the most powerful gland of the digestive system, furnishing to the intestinal tract three ferments or enzymes which have to do with the digestion of fats, carbohydrates and proteids. It also possesses an internal secretion, a hormone called insulin, which is essential to the proper utilization by the body of sugar-forming foods. Diabetes is a disorganization of the metabolic processes by which the body utilizes foodstuffs for the production of energy, due to insufficient elaboration of insulin by the pancreas. It is characterized by an increase of sugar in the blood and later in the urine. Left to itself it is often fatal; with the administration of insulin made from the pancreas of the lower animals the body sugar functions are restored to a normal balance with the result that diabetics are enabled to live out an ordinary life. Formerly tabooed as surgical patients, they now, with the aid of insulin, withstand with relative safety operations for the relief of ailments which formerly were regarded as necessarily fatal.

The liver is the most important biochemical laboratory in the body, possessing multiple functions of chemical character which have to do with body welfare. A new one was brought to light when in recent years it was discovered that liver substance possessed a hormone which stimulates the formation of red blood cells. Anemia is a deficiency of red blood cells and their iron-carrying constituent and is dependent upon one of three known causes: bleeding, excessive destruction of red blood cells in the body, and lack of production of red blood cells by the blood-forming organs. The last named are known as primary anemias or pernicious anemias, the latter adjective indicating its almost inevitably fatal outcome. Blood transfusions, foods rich in iron and medicaments supplying the latter element have afforded but transitory improvement. The administration of liver or its extract, stimulates the blood-forming organs, notably the red bone marrow, with the result that red cells are formed in normal quantity and carry on the functions so essential to life. William Pepper, 1843-1898, University of Pennsylvania, gave the first description of the changes in the bone marrow in pernicious anemia (1875) and concluded in his articles on pernicious anemia that "an affection of the chief blood-making tissues, spleen, lymphatic glands and marrow of the bones" was at the base of all of them.

Extremely interesting are the achievements which have been made in the field of immunity. The individual as well as the species and the nation are constantly employing the means at hand to protect themselves against their enemies and striving to develop new means of increased efficiency. Chemical warfare of the recent world contest was long antedated by the skunk in his onslaught on the olfactory sense; the smoke screen of the destroyer but followed the example set by the cuttlefish or squid with its ink cloud; the poisoned arrow of the savage but imitated the fangs of the venomous snake. Nature has provided some animals with claws, some with tusks, others with impervious skins and shells to afford them protection against their natural enemies.

Man, the individual, is constantly surrounded by bacteria which threaten his health and his life; they are to be found in the nose, throat and intestine, on the skin and on the food upon which he depends for sustenance. What are the forces which we group under the term immunity, which enable him to resist disastrous invasion by bacteria? The hydrochloric acid of the stomach secretion proves destructive to many that enter with the food while certain body reactions and functions resist entrance and growth within the organism.

Immunity may be classified as natural and acquired, and the important known factors in its maintenance are three: first, antitoxins or antibodies which are manufactured by the body to neutralize the toxins or poisons produced by given bacteria and which serve further to inhibit the growth of the latter; second, the presence in the body fluids of two substances, the first of which renders the bacteria susceptible to destruction by the second; and third, the action of certain cells of the body in incorporating the invading bacteria within their own substance and devouring them. When bacteria gain entrance to the body these three qualities are the determining factors in recovery and restoration to health or in disease and death. Nature, in addition to fighting bacteria by means of these three activities, produces in the blood stream materials which have the property of causing the bodies of the bacteria to adhere to each other in groups or clumps. This is the underlying principle in the serum test for typhoid fever, rabbit disease or tularaemia, Malta fever, and with some modification, the blood test for syphilis.

The blood serum of the patient suspected of having typhoid fever is added to a growth of typhoid bacilli or bacteria; if the latter agglutinate or clump together, it is positive proof of the presence of typhoid infection in the patient from whom the serum was taken. It is of course possible that an individual may have been endowed by nature at birth with these properties in resisting infectious disease; there are, however, certain observations which lend credence to the belief that exposure in infection has resulted in mild or overlooked disease which has resulted in their production in the body. Aboriginal people who have had no opportunity to come in contact with infectious diseases are notoriously susceptible to them whereas people living in more or less crowded communities show a varying immunity to them. Forty percent of adult people living in the country are susceptible to diphtheria while but fifteen percent of city inhabitants show susceptibility. Infantile paralysis is best treated by serum obtained from patients convalescent from this disease, yet 70% of the serum obtained from otherwise healthy adults shows the same protective quality, indicating that they have had the disease in a mild unrecognized form resulting in the formation of antibodies in the blood.

Acquired immunity is either passive or active. Passive immunity is conferred on the human by injecting into him the serum of an animal in which the antitoxin or antibodies have been formed as the result of injections of dead bacteria together with the toxin or poison they have produced. The best known example of this type of immunity is afforded by the serum treatment of diphtheria as introduced by Von Behring of Marburg, Germany. Beginning with minute quantities, the dead diphtheria bacteria with their toxin are injected in constantly increasing doses into the horse until the blood of the animal contains a maximum quantity of the antitoxin or protective substance which the horse has manufactured to neutralize the injected toxin. The blood serum which contains the antitoxin is then withdrawn, as much as five to eight quarts at one time, treated with a preservative and sealed in suitable containers for later administration to the human diphtheria patient. At the present time the only excuse for a death from diphtheria is tardy recognition and delayed serum treatment. Serum prepared in the same way is used in the treatment of lockjaw, scarlet fever, gas gangrene, and some types of pneumonia, but not with the uniformly good results obtained in diphtheria.

Active immunity is developed in the human by an attack of an infectious disease and by the injection of vaccines. The body, by means of the three factors mentioned, recovers naturally from many germ infections, both mild and severe. Pasteur, working on fowl cholera, noticed that old laboratory cultures failed to kill fowls artificially infected by means of them, while fresh cultures killed, and he further noted that if fowls were first infected with cultures weakened by aging and, several weeks later, with freshly isolated ones, they failed to contract the disease or showed an increased resistance to overwhelming doses. This as well as Jenner's discovery that milkmaids infected with cowpox did not contract smallpox has led to the development and use of vaccines as a prevention of infectious diseases. A vaccine essentially consists of the weakened or killed germs which are injected into the body. The substance released on the disintegration of these germs stimulates the body tissue to increase its antibodies or germ resisting substance so that the person on natural exposure to an infection is better able to overcome it. At the present time vaccines are fairly successful in preventing smallpox, rabies, typhoid fever, boils, common colds, diphtheria and scarlet fever. Smallpox as a menace to civilization has disappeared, rabies is effectually prevented, and typhoid fever no longer takes its wonted toll. The disappearance of the latter is in large measure to be credited to sanitary science, since the detection of the typhoid bacillus as its cause permitted sanitary regulations to greatly control its incidence before the employment of the vaccine was generally adopted. During the Spanish-American War, one soldier in every five contracted the disease, while during the World War but one in four thousand showed the infection. The immunity against colds and boils produced by vaccines is of but short duration, at the end of which patients again become susceptible. A great advance in immunology has been made in scarlet fever and in diphtheria in that tests now reveal those susceptible to them. Known respectively as the Dick and Schick tests, they consist in injecting into the skin minute quantities of the toxin of the respective causative bacteria; in immune persons no reaction is noted while in susceptible ones a discoloration appears at the site of injection within 24 to 36 hours. Persons of known susceptibility can then be rendered immune by further injection of the toxin.

Bacteriophage, one of the newest names in the field of immunity, means the eating of bacteria. Searching for filterable viruses, germs that are invisible even under the microscope and that pass thru the pores of an earthen filter, Dr. d'Herelle, in 1917, discovered that filtrate of stools of a dysentery patient undergoing improvement would digest young dysentery germs growing in a liquid medium, causing the turbity of bacterial growth to disappear. The destructive agent is known as a "phage" and is believed to be a minute parasite which destroys the bacteria by eating them or else an enzyme causing their digestion just as the enzymes of the stomach digest food. It is finding an ever widening field of usefulness and furnishes another lead in overcoming the infectious diseases.

Studies in immunity are yearly reducing the death rate from infectious diseases. Pneumonia, designated by Dr. Osler as the captain of the forces of death, and responsible for

30,000 deaths in the 100,000 cases in this country, has been made to give ground, the death rate having been reduced in certain types from 26% to 11% by means of serum treatment. Each serum is specific only for the germ causing a given disease, indicating the complexity of the reactions by which the body protects itself against the many bacterial enemies which assail it. The accomplishment of the past and the present in the study of the chemistry of the body augur well for the future and hold out the hope that in the fight against the infectious diseases science will in the end be accorded the victor's palm.

24. **The Nature of Intelligence.** Charles E. Spearman, University of London, England. (Excerpted by J. B. Miner.)

Doctor Spearman, an international authority in psychology, was introduced to speak on this topic, concerning which his hypothesis is regarded as of outstanding importance. He directly attacked the problem of what is measured by the so-called intelligence tests, such as those used in testing the American army during the World War. He showed the difficulties arising from lack of agreement as to what is meant by "intelligence" and as to the evaluation of it by one measure. Taking up each of the modern schools of psychology, he indicated the inadequacies of their answers to these problems. He then set forth his own theory, that there is a single "General Common Factor" (G) in all intellectual activities. Moreover, this general factor may be isolated and measured by methods of partial correlation which he has worked out. The special factors also involved in any ability are thus left for further study.

Summarizing his view of human learning, he stated that it is expressed in several fundamental laws. The first is that learning starts with experience. We know our own experience. We say, "I thought this; I knew this; I want this." These statements refer to our experience which is characterized by the qualities of our sensations, emotions and feelings.

From the standpoint of intelligence, the next two principles on which his hypothesis is based are of more importance. We are not only aware of our present experience, but we are directly conscious of relations between the items in our present experience. He illustrated this by demonstrating with sounds the perception of the difference between chords and discords. The importance of this comes from the fact that some people perceive relations among their experiences which others do not perceive.

Among intelligence tests, one of the most common depends upon the recognition of whether two ideas are the same or different. "Go" and "depart" are recognized as the same; "go" and "come" as different. Another form of test for this capacity to recognize relations, is to ask which of a series of words does not belong with the others. For example, "drum, piano, ball, violin." Grasping simple and more complex relations may thus be tested apart from other manifestations of mental activities such as memory, imagination, judgment, etc.

The third law which sets intelligence apart for measurement is manifested when we are given any item with a relation and are asked to think of the correlative item. For example, "cat is to kittens as dog is to what?" Or take the example of music. You are given an interval of a fifth and then asked to sing a tone which is a fifth higher than one given. This third process of thinking of correlates is mainly responsible for creativeness in the fine arts, for inventions, and for discoveries. One gets a relation from experience which he can then apply to an item and thus attain by his mental activity a new correlative item.

Under Dr. Spearman's hypothesis these three laws provide the ways by which knowledge can be brought about: (1) Know your own experience. (2) Become aware of its relations. (3) Recognize the correlative items rising out of these relations. These are the three ways, and they are the only ways in which intelligence works. These three laws govern the mental operations down to the lowest grade of minds that we know of. High or low, the difference between one and another intelligence is the extent to which these activities can be carried out.

There remains a fourth process in education which we call the "power of reproduction," or memory. Intelligence and memory afford two ways of performing the same task: by calling up various items in the mind by thought, or by mere reproduction (memory). It is dull children who use reproduction. We all use reproduction for many purposes. It is the most economical and best process to use in many cases, but in others it leads us very far astray.

It appears from the work that has been done on intelligence, that any knowledge activity seems to depend upon two factors. One of these, "G", is the same for every kind of process, i.e., it is general; the other, "S", varies from one process to another, being specific for each activity. If you can measure "G" for any individual, you are uncovering an important phase of all his mental operations, and you are getting an extremely valuable piece of information about him. The special factors in any intellectual activity are often connected with reproduction. The general factor is measured approximately, with big errors, by tests such as those of intelligence.

This theory of Two Factors, general and special, in every knowledge process, first met very strong opposition from physiologists. It suggested that the mind includes one single energy which could be applied in any direction, for carrying on any particular mental operation. It assumes that a person always has the same amount of mental energy which determines his intelligence. When the theory of two factors was first put out there was no theory like it in existence. The physiology of the brain had been based on the analogy of the telephonic system. That analogy seems now to have crumbled down. While it is still supposed that a certain position in the brain does act in a particular response, a general fund of brain energy re-influences any type of operation. When anybody performs any task his success depends partly upon this general function of the brain. This seems to supply a physical counterpart for the principles developed by statistical procedures as to the nature of intelligence. When this new physiological knowledge of the general function of the brain, demonstrated by Lashley and Franz, progresses further, the time will come when the whole topic of intelligence will be extraordinarily illuminating.

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In Memoriam

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

Cloyd N. McAllister,	1870—1933
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* Wolfson, Alfred M., Murray Teachers College, Murray ...... Biology
* Wolfson, Mrs. Marcelle, Murray Teachers College, Murray .... Botany
Womack, E. M., 2021 Grasmere Drive, Louisville .... Zool. Bot.
Wurtz, Geo. B., 1216 Fontaine Road, Lexington .... Meteorology
N. Wyatt, Grace .... Biology
Young, D. W., Exper. Station, Lexington .... Chemistry
N. Zarbell, Iver H., 1041 Cherokee Road, Louisville .... Biology

MINUTES OF THE 1933 MEETING

The 20th annual meeting of the Kentucky Academy of Science was called to order by President Roberts at 9:00 a. m., in the physics lecture room of the University of Kentucky, April 29, 1933. About 75 were present. Others coming in later made about 100 for the business meeting.

The Treasurer's Report was read by W. S. Anderson. It showed a balance in the treasury of $212.16.

Professor Karraker, for the Auditing Committee, reported that the committee had examined the accounts of the treasurer and found them correct. The report was adopted unanimously.

No reports were made by the Publications Committee or the Committee on Legislation.

The report of the Councilor was read by Doctor Middleton. Upon motion, the report was accepted unanimously.

Doctor Schnieb read the report of the Committee on Junior Academy, which was unanimously accepted. (See report)

Doctor Schnieb then called for reports on science clubs by delegates from different counties, asking Doctor Payne to give his report first.

Doctor Payne said he communicated with each high school in Lexington and Fayette county and that the response was remarkable. Some have sent as many as four delegates. As some of the schools had no science club, they sent delegates from their science classes.

Doctor Middleton, speaking for Jefferson county, stated that he did not receive notice that he had been put on the committee until about ten days ago, so had nothing to report as yet, but he thinks that the work in Louisville and Jefferson county will quite easily be done.

Mr. Starnes reported by letter that a science club had been organized in the Owenton High School and that much interest is being manifested by the students. The club was building an amplifying set.

Charles Wagers, of Waco, Madison county, representing the Biological Science group, reported that his club had concentrated on birds and trees; that each member was interested in identifying birds; that 35 trees had been planted on the school grounds. (This and the reports of delegates were received with applause.)

Margaret Cotton, representing the Science Club of Kirksville High School, Madison county, reported that her club had organized an Audubon Society; that they were keeping a record of birds of their community.

Allington Crace, of Booneville, Owsley county, science teacher in the school, reported the milk testing program and stated that the club had set out 40 trees.

Gilbert Hay, of the Picadome High School, Fayette county, reported much interest was being shown in the science work since the club was organized.

From the University Training School, three reports were given, by Alfred Roswell of the Radio Club, Robert Fish of the physics class, and Donald Van Irvine of the chemistry class.

Dorothy Whalen, of the Henry Clay High School "Bozo Club," reported that the name of her club was taken from the first syllables of botany and zoology; that their club was five years old and that they hoped to be a part of the Kentucky Academy of Science.

From Hamilton College the report was read by Clementine Smith, of the science class.

From St. Catherine Academy the report was read by Herbert Keller, of the science class.

From Sayre College, the report was read by Marcella Martin, of the science class.

At 10 o'clock President Roberts delivered his presidential address, "Why a Kentucky Academy of Science?," after which the general session adjourned until 2 p. m.

Afternoon Session

President Roberts called the meeting to order at 2 p. m. About 50 present.

The Secretary read his report in outline. Upon motion it was approved.

The report of the Council was read by Doctor Peter, submitting the proposal to suspend the initiation fee for the present. Doctor Middleton moved that collection of the initiation fee be suspended. Seconded by W. S. Anderson. Adopted unanimously.

The report of the Membership Committee was read by Doctor Peter, recommending the election of the following 21 new members and one honorary member:

Luther Kelley, Berea College; Samuel Combs, Berea College; Maude McAllister, Isaac Hayes, William H. Hunt, Martha Lampkin, Henry P. Johnston, Sarah Hamilton, Bowles McMillan, Norman Dodson, Emerson Hatcher, seniors in Berea College.

The following persons were elected by the Council previous to the meeting:

W. G. Sulzer, University of Kentucky; Leland A. Brown, Transylvania College; W. H. Gaines, Berea; Thelma Wells, Richmond; Ada L. Brown, Lawrenceburg; Iva Faye Egner, Richmond; Edmund K. Hall, Medical School, Louisville; L. Frederick Jones, Science Teacher, Picadome School, Lexington; Forest Mercer, Anchorage City High School, Anchorage; Armor P. Taylor, University of Kentucky.

Upon motion, all were unanimously elected.

Dr. E. E. Snoddy, Transylvania College, was elected an honorary member.

Doctor Middleton read a report of the meeting of the Conference of State Academies of the A. A. A. S.

The report of the Resolutions Committee (Leggett, Pierce and Wurtz) was read by Mr. Wurtz and, on motion, was adopted unanimously.

Resolutions Committee Report

In appreciation of the courtesies and facilities extended to the Kentucky Academy of Science, Be it Resolved:

That we express our appreciation of these considerations and request the Secretary to send a copy of this resolution to the President of the University of Kentucky.

Be it further Resolved: That we express our appreciation of the successful work of the Committee on the proposed organization of a Junior Academy of Science, affiliated with this organization, and to the delegates we extend a most hearty welcome.

WHEREAS: since the University of Kentucky has extended to the Academy an invitation to file its papers and proceedings in the University Library, and has perfected arrangements for their preservation and public use:

Be it Resolved: That this offer be accepted and that each person preparing or reading a paper for the Academy file TWO (2) copies with the Secretary of the Academy, and that one copy be bound in accordance with a previous report and be placed in the library of the University of Kentucky for further use by the public; and furthermore,

Since there are at present insufficient funds for the binding of the several hundred papers accumulated by the Academy, that binding backs be supplied by the authors by designating such of their papers desired published and placed in the Library of the University of Kentucky and furnishing to the Secretary with this information 20 cents for each paper to be bound and catalogued.

And in appreciation of the splendid address on the Socialization of Science delivered before the Academy by Dr. E. E. Snoddy, of Transylvania University, we express our obligation and gratitude.

President Roberts called on Doctor Schnieb to complete the report on the Junior Academy work. The remaining delegates gave their reports:

Speedwell School. Anna Frances Todd gave a detailed account of the organization and the work of her club which showed originality.

Berea Academy. Miss Ula Fike, of the science department, reported that the club had brought more life into the school than anything else; that they had studied birds; had organized four Audubon Societies with a membership of 96; that regular meetings are being held and that the students are most enthusiastic.

Horace Davis, of the Bryan Station High School Millikan Science Club, reported that his club was studying electricity, and had held ten meetings.

William Graves, of the physics class of the same school, also reported work in electricity.

Miss Ula Fike, teacher, of Waco, said that the science teachers needed much help and encouragement; that the Academy of Science might give great assistance; that the larger high schools have fully equipped laboratories, etc., but the smaller high schools have little if any equipment, yet they are expected to teach science; that if they could affiliate with the Academy and feel that they could call on the Academy to send speakers and distribute literature, it would be most helpful.

Elmer Menifee, teacher, of North Middletown, said that every high school should have a science club and be affiliated with the Academy; that so far the students have been dead, as far as modern science is concerned.

Doctor Middleton read the following resolutions and moved that they be adopted. This motion was seconded by W. S. Anderson and adopted by unanimous vote.

Resolutions for the Organization of the Kentucky Junior Academy of Science

WHEREAS: the organization of a Kentucky Junior Academy of Science will prove a powerful factor in stimulating the spirit of scientific investigation among the high school pupils of the State, and

WHEREAS: this effect will be an invaluable aid in the discovery of ways and means by which facilities may be provided for the adequate teaching of sciences in these schools, and

WHEREAS: the oganization of a Kentucky Junior Academy of Science as a branch of the Kentucky Academy of Science will increase the opportunity for service of the Kentucky Academy of Science and will consequently redound to the advantage of that Academy, now, therefore, be it

RESOLVED: that this Academy authorize the organization of the Kentucky Junior Academy of Science:

That each high school science club affiliated with the Junior Academy shall be eligible for membership as a club by paying ten cents per individual student member. Such clubs shall receive any advantages of the Kentucky Academy, such as a copy of the Proceedings, announcements of meetings, and the right to request speakers and other assistance thru the Secretary of the Academy.

That the present Committee of the Kentucky Academy of Science on the Organization of a Junior Academy of Science be instructed to draft a temporary plan of organization for the Junior Academy during this meeting.

That during the coming fiscal year they be instructed to perfect a plan of organization for the Junior Academy and to submit that plan to the next meeting of The Kentucky Academy for its final action.

Submitted by

(Signed) A. R. MIDDLETON
V. F. PAYNE
ANNA A. SCHNIEB

Doctor Schnieb then stated that the boys and girls had met and elected officers for the coming year as follows:

President—Frank Edwards, Waco High School, Waco.
Vice-President—Bernice Hoflich, St. Catherine Academy, Lexington.
Sec'y and Treas.—Dorothy Whalen, Henry Clay High, Lexington.

She also stated that thru the kindness of the Transylvania Printing Company and J. D. Purcell Company, the junior delegates were to receive some small trophies.

The report of the Nominating Committee was read by Doctor Burroughs as follows:

For President—John S. Bangson, Berea.
For Vice-President—J. S. McHargue, Lexington.
For Secretary—A. M. Peter, Lexington.
For Treasurer—W. S. Anderson, Lexington.
For Publications Committee—J. B. Miner, Lexington
Representative in the Council of the A.A.A.S.—A. R. Middleton.
Assistant Secretary—A. R. Middleton.

The Secretary cast the ballot for nominees and all were declared elected unanimously.

President McVey was asked to give a word of greeting. He said in part that he wanted to extend greetings (tho rather late); hoped that our meeting would be profitable and valuable to those who attend; and to say that the facilities of the University are open at all times for meetings, whether quarterly or annual. "Anything that we can do to assist you in the work of the Academy we shall be very glad indeed to do."

"I was very much interested in the report of the Junior Academy. I think it can be a very valuable thing or another weight that high school people will have to carry. If it is just another activity, I think the Academy ought not to foster it.

If it means only another club; if it means just another badge for your watch-chain so that the badges will reach from pocket to pocket, it is not worth the time and energy you put on it. But if it can really be a thoro-going thing to put into the minds of the members what science is, it might be a very valuable thing; but I have seen so many clubs started on the campus and then dropped or maybe drifted into social organizations, and the youngsters belong because it is another thing to put into their year book—high schools have year books the same as colleges. The high schools have everything that colleges have now, so that when the boys and girls get to college they are awfully tired of it all and there is nothing new. Sometimes I think that the college will have to drop all these things and leave them all to the high schools, or adopt something different. I give you this for what it is worth and think it is something that ought to be looked into. If the Science Club is just going to be another organization, very little benefit will result. A good deal depends on the teacher—that he gives them the scientific attitude of mind—if one can give them an appreciation of science so that they will be full of the scientific attitude, it is what would be worth while. If the Academy does right by the Junior organization it cannot meet only once a year but must put its shoulder to the wheel and keep things going. Merely bringing these boys and girls to the meeting is not going to further any scientific spirit. It is a fine thing to have a place where you can present what you have been doing but it is going to take a new relationship or new attitude. You should play up to the youngsters and put your shoulders to the wheel and get to the place where you can publish an annual volume;—or get some angel to contribute the wherewithall to publish your Proceedings for you—I am sure there must be some around somewhere—it is just a question of making a contact—$500 or $600 a year—with the promise of an inscription in the volume that "These Proceedings are published as a result of the helpful monetary assistance given by (so and so) to the Kentucky Academy of Science."

President Roberts introduced Dr. E. E. Snoddy, of Transylvania College, who delivered an address on "The Socialization of Science."

Meeting adjourned.

The Divisions reported officers elected as follows:

Biological Sciences—R. T. Hinton, chairman; J. Holmes Martin, secretary.

Physical and Mathematical Sciences—A. D. Hummell, chairman; F .W. Warburton, secretary.

Philosophy and Psychology—J. L. Leggett, chairman; Noel B. Cuff, secretary.

SECRETARY'S REPORT, 1932—1933

To the President and Members of the Academy:

Of the 37 persons elected to membership at the last meeting, 21 qualified and have been added to the roll, namely:

Abell, Irvin, M. D., Louisville.
Adams, Kerney, Eastern Ky. State Teachers College, Richmond.
Bishop, Harlow, University of Louisville, Louisville.
Caldwell, C. E., Eastern Ky. State Teachers College, Richmond.
Carter, A. B., Eastern Ky. State Teachers College, Richmond.
Clashman, William H., 1400 S. Brook St., Louisville (elected last year but did not qualify then).
Coates, J. Dorland, Eastern Ky. State Teachers College, Richmond.
Ferguson, Dorcas Louise, Berea College, Berea.
Hoke, R. S., Morehead State Teachers College, Morehead.
Hume, O. F., (M.D.), Richmond.
Jones, W. C., Eastern Ky. State Teachers College, Richmond.
Keith, Mrs. Chas. A., Eastern Ky. State Teachers College, Richmond.
Osborn, John S, Eastern Ky. State Teachers College, Richmond.
Owen, O. F., Berea College, Berea.
Ray, Mrs. Willie C., Superintendent Schools, Shelbyville.
Shutt, Chas. Noble, Dean of Academy, Berea College, Berea.
Spearman, Chas. E., University of London, London, England.
Spillman, C. O., City High School, Berea.
Starnes, W. Gayle, Science Hill.
Todd, Russell I., Richmond.
Watts, Nola C., (Miss), Waddy High School, Waddy.

Drs. Abell and Spearman were made honorary members. We have lost 13 for various reasons.

Number of members at time of last meeting	211
Added since then	21
	232
Lost since then	13
TOTAL	219

Sixteen of those who were elected did not qualify. The large proportion who did not qualify after having been elected emphasizes the importance of getting a positive expression from a nominee before his or her name is proposed for election. Perhaps we should require payment of the initiation fee before election.

The total membership of 219, includes 98 national and 84 local members, making 182 active members, 22 corresponding members, and 15 honorary members.

Actives in good standing, including 2 life members	96
Active members in arrears 1 year	51
Active members in arrears 2 years	35
Corresponding members	22
Honorary members	15
	219

The manuscript for Volume 5 of the Transactions, covering the 18th and 19th meetings, has been edited and is ready for the printer.

The Council and Program Committee met at the University Commons on January 14, 1933, at 12:30 p. m.; agreed that the next meeting of the Academy would be on April 29, 1933, arranged for the program, and decided to invite President McVey to give the address. Doctor McVey accepted, but found later that press of business would prevent his acting. Dr. E. E. Snoddy consented to make the address.

Other business was attended to by correspondence.

In a letter of October 5 (1932) Dean Cooper suggested that under existing conditions the Academy dues may be considered by many to be out of proportion, inasmuch as the salaries of many members have been reduced or paid only in part. The suggestion was submitted to the Council Members for an expression of opinion. Their answers were against reduction of dues.

In a letter of March 16, Doctor Schnieb suggested that the initiation fee be suspended because of the existing difficult financial conditions. Members of the Council agreed unanimously to submit this proposal to the coming meeting of the Academy, without prejudice.

Your Secretary had a communication from the Secretary of the Ecological Society of America, asking for contributions towards their work of preserving natural conditions. He enclosed an article entitled "Preservation of Natural Biotic Communities," and asked that it be included in our publication. The article was too long for this, but some extra copies were distributed to members.

Some years ago the Kentucky Academy passed a resolution advocating the adoption of the Metric System by the United States. Inasmuch as the present time was deemed favorable for pressing the matter in Congress, the Secretary sent blank petitions to several Academy members connected with colleges in the state, to get signatures in favor of the measure and forward them to the Chairman of the Committee on Coinage, Weights and Measures, House of Representatives, Washington, D. C. This was done.

Some correspondence was had with Mr. A. R. Cahn, of Champaign, Ill., with reference to endorsing the setting aside of the Everglades National Park in Florida. This matter was referred to Hon. Samuel M. Wilson, Chairman of our Committee on Legislation.

On October 8 (1932) President Roberts appointed Dr. Anna A. Schnieb, Chairman of the Committee on Junior Academy. This committee is now composed of Schnieb, Middleton, Payne, Osborn and Starnes.

On April 3 (1933) President Roberts appointed for the nominating committee, W. G. Burroughs, Chairman, A. R. Middleton, and Lucien Beckner.

Thru an oversight, the Secretary did not send the proposed letters to secretaries of scientific societies in the state inviting them to send representatives to a conference with a committee of the Academy on the question of affiliation with the Academy. Therefore no report on this matter is ready. The President did not know of this matter until after writing his address which deals largely with the question of affiliation.

President Roberts also appointed J. L. Leggett, J. Stanton Pierce, and Geo. B. Wurtz as Resolutions Committee; and P. E. Karraker, A. J. Olney and W. D. Nicholls as Auditing Committee.

A. M. PETER, Secretary

REPORT OF COMMITTEE ON JUNIOR ACADEMY OF SCIENCE, APRIL 29, 1933

I—Introduction. Mr. President, Members of the Academy and Friends. I think I have never been quite so happy because it looks as if this committee had accomplished something. We have a different personnel here today—so many young persons and we hope that they are going to be members very soon. All honor to these boys and girls.

Our report consists of two parts: 1. Explanation; 2. Demonstration. We hope that each will interest you.

Because of the very good report given last year at the Richmond meeting by Mr. G. R. Starnes, Mr. J. Osborne, and Dr. V. F. Payne, on Junior Academy, the committee was requested by the Academy to continue its work. Doctor Middleton was added to the committee. Shortly before Christmas, Secretary Peter notified me that I had been made a member of the committee and that I was to serve as chairman.

II—Personnel. The Committee: Dr. A. R. Middleton, University of Louisville; Mr. John Osborne, Clarence, Kentucky; Dr. V. F. Payne, Transylvania College; Mr. Gail Starnes, Owenton, Kentucky; Anna A. Schnieb, Chairman, Eastern Teachers College.

III—Policy. As the members live rather far apart, much of the committee work had to be done by correspondence. Three meetings were held with different members of the committee. The following is the policy adopted: 1. The Junior Academy of Science should be an organization made up of high school science clubs. 2. Each member of the committee is to be responsible for the organization of science clubs, at least in the high schools in his respective county, and in as many others as possible. 3. Each high school science club is to send two delegates and as many members as it wishes to the state meeting of the Kentucky Academy of Science to be held in Lexington, Saturday, April 29, 1933. 4. A place on the program is to be given to the delegates who will report what has been accomplished in their respective clubs. The delegates as a group are to be given recognition at the general session. 5. Those science clubs sending delegates will receive one copy of the Proceedings of the Kentucky Academy of Science. After the organization has been completed, the affiliated clubs may call upon the members of the Kentucky Academy of Science for speakers and for other assistance in the science work.

IV—Results. 1. Madison County. Thru the assistance of Dr. Harriette Krick, all high schools in Madison County, including the Academy of Berea College and the Model High School of the Eastern Teachers College, were visited and were given scientific literature. Science clubs were organized at Berea Academy, Kirksville, Newby, Speedwell, and Waco. Nineteen delegates and members were sent from Madison County to the Kentucky Academy of Science meeting. 2. Owsley and Shelby Counties. Conferences were held with the principals of the Shelbyville High school and Owsley County High school. A Biology club was organized in the Owsley County High school at Booneville. One delegate represented the Booneville High School. 3. Fayette County. Thru correspondence and interviews by Dr. V. F. Payne, seven high schools, including the University High School, Sayre College, Hamilton College and St. Catherine, sent representatives from their science clubs and science classes to the Lexington meeting. Five science clubs were represented. Twenty-six delegates and students represented Fayette County.

V—Demonstration. Reports were made by the following representatives: Charles Wagers, Biology Club, Waco; Margaret Cotton, Science Club, Kirksville; Allington Crace, Agriculture Club, Booneville; Gilbert Hay, Science Club, Picadome; Alfred Roswell, Radio, University High School; Robert Fish, Physics Class, University High School; Donald Van Irvin, Chemistry Class, University High School; Dorothy Whalen, Bozo Club, Henry Clay, Lexington; Clementine Smith, Science Class, Hamilton College; Herbert Keller, Science Class, St. Catherine; Marcella Martin, Science Class, Sayre College; Anna Frances Todd, Audubon Society, Speedwell; Ula Fike, Audubon Society, Berea Academy; Horace David, Millikan Club, Bryan Station; William Graves, Physics Club, Bryan Station; Elmer Menifee, Teacher, North Middletown; Ula Fike, Teacher, Waco.

VI—Resolutions. In the light of our findings, I have asked Doctor Middleton to present resolutions concerning the Junior Academy:

Whereas: The organization of a Kentucky Junior Academy of Science will prove a powerful factor in stimulating the spirit of scientific investigation among the high school pupils of the state, and

Whereas: This effect will be an invaluable aid in the discovery of ways and means by which facilities may be provided for the adequate teaching of sciences in these schools, and

Whereas: The organization of a Kentucky Junior Academy of Science as a branch of the Kentucky Academy of Science will increase the opportunity for service of the Kentucky Academy of Science and will consequently redound to the advantage of that Academy, now, therefore, be it

Resolved: That this Academy authorize the organization of the Junior Kentucky Academy of Science:

Resolved: Each high school science club affiliated with the Junior Academy shall be eligible for membership as a club by paying ten cents per individual student member. Such clubs shall receive any advantages of the Kentucky Academy such as a copy of the proceedings, announcements of meetings and the right to request speakers and other assistance thru the Secretary of the Academy:

That the present Committee of The Kentucky Academy of Science on the Organization of a Junior Academy of Science be instructed to draft a temporary plan of organization for the Junior Academy during this meeting.

That during the coming fiscal year they be instructed to perfect a plan of organization for the Junior Academy and to submit that plan to the next meeting of the Kentucky Academy for its final action.

Respectfully submitted,

(Signed) ANNA A. SCHNIEB, Chairman.

REPORT OF THE RESOLUTIONS COMMITTEE

In appreciation of the courtesies and facliities extended to the Kentucky Academy of Science, Be it resolved: That we express our appreciation of these considerations and request the Secretary to send a copy of this resolution to the President of the University of Kentucky.

Be it further resolved: That we express our appreciation of the successful work of the Committee on the proposed organization of a Junior Academy of Science, affiliated with this organization, and to the Delegates we extend a most hearty welcome.

Whereas: since the University of Kentucky has extended to the Academy an invitation to file its papers and proceedings in the University Library, and has perfected arrangements for their preservation and public use:

Be it resolved: That this offer be accepted and that each person preparing or reading a paper for the Academy file two (2) copies with the Secretary of the Academy, and that one copy be bound in accordance with a previous report and be placed in the Library of the University of Kentucky for further use by the public; and furthermore,

Since there are at present insufficient funds for the binding of the several hundred papers accumulated by the Academy that binding backs be supplied by the authors by designating such of their papers desired published and placed in the Library of the University of Kentucky and furnishing to the Secretary with this information 20 cents for each paper so to be bound and catalogd.

And in appreciation of the splendid address on the Socialization of Science delivered before the Academy by Dr. E. E. Snoddy, of Translyvania University, we express our obligation and gratitude.

J. L. LEGGETT
GEORGE B. WURTZ
Committee on Resolutions

ABSTRACTS OF PAPERS PRESENTED AT THE TWENTIETH MEETING

1. **Why A Kentucky Academy of Science.** (President's Address) George Roberts, University of Kentucky.

One of the penalties of being president of the Kentucky Academy of Science is complying with the unbroken custom of making a presidential address. My first impulse was to break with custom and set a precedent for the future president who, like myself, might have nothing burning within him for expression, or who, also like myself, might prefer the ease and luxury of smoking a pipe to the painful and exhausting effort of trying to write an address with visions of sleeping or critical professors sitting before him while he is presenting it. But he who controls the destiny of this organization, and to whose judgment I have been accustomed to yield for so many years, says the tradition must not be broken. So, if I cannot break tradition, I shall try what damage I can do by continuing it.

Dr. P. P. Boyd and Dr. Davis Buckner, former presidents of the Academy, have stressed the importance of the Academy of Science to the welfare of the state, but I fear we have not given their suggestions the serious consideration they deserved. I wish to reiterate their suggestions and add some observations of my own, altho it may be presumptuous in me to retread the ground.

Why do we have a Kentucky Academy of Science? The question is answered in Article II of the Constitution, which states:

"The object of the Academy shall be to encourage scientific research, to promote the diffusion of useful scientific knowledge, and to unify the scientific interests of the state."

This is a comprehensive statement, certainly an ideal high enough to keep the organization moving forward for all time. Without any criticism of the methods and accomplishments of the past, I wish to raise the question, "Has not the time arrived when some steps might be taken to enlarge the scope and effectiveness of the organization?

My first suggestion is, that since the organization has grown to the point where we are having a number of sectional meetings, the one-day session is not sufficient for the proper development of such a program. A typical program is sufficient to illustrate my point. The meeting was called to order at 9:30. The preliminaries, one of which is the presidential address, took until 10:40. The sections assembled at 10:50, with difficulty in getting the members in by that time. The sections held until 12:30, allowing one hour and forty minutes for the session, including presentation of papers and transaction of business. Two of the sections had seven papers, allowing ten minutes to each paper, and one section had six papers, allowing ten minutes, except for two of fifteen minutes each. In the sections the first and most important object of the Academy is accomplished, namely, the encouragement of scientific research. I am convinced that the sections should have more time, so that papers would not be limited to less time than is neccessary for a clear presentation and that there may be more time for discussion, which is often essential to a clear understanding of the paper and often more of a stimulation to research than the paper itself. The results of good research can usually be published in some scientific journal, and I submit to you that it is often much more satisfactory to sit in the quiet of one's study and read a paper than to listen to the reading of it, if there is to be no discussion. More time is needed at the meetings for the acquaintance and discussion that come from personal contacts of members. So I suggest a two-day meeting, beginning on Friday, in which the preliminaries and all business will be transacted in a convenient period with at least a full half-day for section meetings—with an inexpensive dinner meeting at which the principal guest speaker will give his address, and a general session on Saturday morning devoted to addresses and papers interpretative of science and to the discussion of problems particularly affecting the welfare of the state in a social, political and economic way, of which I shall have more to say.

My next suggestion concerns the last phrase in the statement of the object of the Academy—"To unify the scientific interests of the state." I believe it would be highly desirable for all scientific organizations in the state to be affiliated with the Academy of Science, and for their members to be members of the Academy. I believe the only difficulty in the way of such affiliation is the working out of a satisfactory plan of membership fees by the payment of which one automatically becomes a member of the Academy and of the affiliated organization. The affiliated organizations could become sections of the Academy, or they could retain their separate organizations and have, in either case, as many meetings within the year as they desired, but have their most importnat meeting in conjunction with the annual meeting of the Academy in the two-day program I have suggested. The choice of the chief guest speaker could be rotated among the sections or affiliated organizations, and the sections might use important visiting speakers at this annual meeting. Such an affiliation of organizations would enable the various organizations to publish their proceedings at a lower unit cost than if each operated separately, and would obtain for them a wider circulation. Organizations not affiliated with the Kentucky Academy of Science are the Kentucky Academy of Social Sciences, the recently organized Psychological Association, the Lexington section of the American Chemical Society, and the Kentucky section of the American Mathematical Society.

If a plan for the organic affiliation of the various societies cannot be agreed upon, in which the members become members of the Academy, at least some plan might be worked out by which all would meet with the annual meeting of the Academy of Science, with the hope that many of the members would become members of the Academy.

We have had a committee at work for some time on the proposed Junior Academy of Science, whose report you have just heard. If properly organized and guided, the Junior Academy should prove a very helpful organization in its influence upon the teaching of science in the high schools of the state. My conception of it is that it should not be used primarily to encourage students to enter upon the study of science as a vocation, but to develop an appreciation of science in its relation to human welfare and to develop the scientific attitude of mind, so much needed and so much lacking, in dealing with human affairs.

It is my belief that a unification of the scientific interests of the state thru an affiliation of their organizations and the creation of the Junior Academy will not only more effectively encourage research but that it will greatly facilitate the accomplishment of ,the second objective of the Academy namely, the diffusion of useful scientific knowledge, which I consider the most important objective of the organization. If I may be permitted to speak frankly, I doubt if the Academy has disseminated a great deal of knowledge except among its few members. It is my conception of this object of the Academy that it implies the diffusion of useful scientific knowledge among the citizens of the state, with the object that it shall in some way make for the betterment of the state. By useful, I mean something vastly more than material wealth made possible by scientific research.

There are many ways in which this may be done. There are problems too numerous to mention affecting the welfare of the state, such as an inventory of our resources and the measures that should be taken for their conservation and proper utilization, instead of the present wasteful exploitation. These include soil, minerals, forests, and water power. There are problems of government, particularly local government, upon which research is needed; and problems in the administration of penal institutions and of institutions dealing with defectives, which are becoming ominous problems. There is the ever-present question of health, with its many problems, such as cost of medical and hospital services, which are much more than personal matters, as great as these are.

An academy of science made up not only of research workers, chiefly members of college and university staffs, as it is now, but of public-spirited, influential citizens as well, could do much to create public opinion that would support research and have confidence enough in the findings of research to insist that our governing bodies act when a sound basis for action is found. An academy so organized and functioning could, to advantage, have its meetings in different parts of the state, particularly in the larger cities, and try to interest the thoughtful part of the public in its proceedings. I believe that many influential persons who are not actively engaged in scientific pursuits might become members of the Academy and otherwise support it if they were led to see its importance to the walfare of the state . I think one important consideration in enlisting the interest of such citizens would be the prompt publication of proceedings, particular those papers of general interest, as well as those of technical scientific interest.

Much is being said about what science has done to further or retard civilization. There are many who say that man's inventions will ultimately bring ruin upon him, and decry the machine as a menace. They cite the terrible destruction of men and resources in the World War, made possible by research in the physical sciences which resulted in machines of transportation and destruction and in explosives and poisons used for human destruction. Others cite what the perfection of machines for displacing human labor has contributed to our unemployment, and believe that, if production should rise to the level of 1929, not more than half of the unemployed could be taken back to work, and that new industires cannot be developed steadily and rapidly enough to absorb men technologically displaced. Consider the storm of ridicule, innuendo and propaganda of discredit that broke loose when "Technocracy" began to talk thru the public press. On the other hand, there were those who accepted the statements at face value, without much thinking about them, simply because they seemed to contain some threat against the present economic order. Without doubt, there is a considerable measure of facts back of all these opinions that I have cited which it would behoove society to think seriously upon but which need not unduly excite people of either conservative or radical attitudes.

There are two requisites for the proper consideration of all such matters—one is the facts in the case, and the other is honesty and a desire for social justice that will not be thwarted by the desire for gain.

I conceive it to be the function of scientists to do something more than to discover. Too long have they had the attitude that it was their business only to discover and not their business to interpret science to the public mind; that what use was made of their research was not a primary concern of theirs. I have sometimes felt that scientists have had a sort of high-brow contempt for the lay mind. But who should be more capable of and more concerned in properly interpreting the findings of scientific research and pointing out the probable results of their application than the scientists themselves? This is particularly a function in which the sociologist and political economist can be of great service, along with the physical and biological scientists.

The machine and the other results of scientific research are not an evil in themselves. Who can say that the shifting of the burden of toil from human beings to machines and multiplying their productive capacity should not be a great blessing to all mankind? It is commonplace to say that it is the greed and selfishness of man, and possibly some stupidity in exploiting natural and human resources by the use of the machine and other products of research that are responsible for so much human suffering.

We have about the same attitude today toward the operation of economic law that the clergy had in the eighteenth century toward smallpox when they opposed vaccination and other preventive measures as defying the will of God who sends these scourges upon mankind as a chastisement. I read in a speech of a prominent United States official the statement that the law of supply and demand is bedded deep in human nature; that nobody invented it. While I admit that there is something known as the law of supply and demand, I am not so sure that it has not been tinkered with to the hurt of mankind, at least of some groups. It might be tinkered with to the betterment of mankind. Electricity is obeying a law of nature when lightning strikes a house and burns it to the ground. It is also obeying a law of nature when it harmlessly follows a man-made conductor into the ground or is carried from the waterfall over miles of line to light our homes and lighten the burden of human toil.

Is it not time that we began to try to get people to think sanely upon these problems, with scientists obtaining the facts and interpreting them to the people? What greater proof do we need of such necessity than the events which have taken place in the United States from 1917 to 1933, and in the rest of the world for that matter? Could there be any less sound thinking based on fact, so far as the public is concerned, than there has been since 1929? Witness the last presidential campaign and events following.

It may be a pretentious suggestion, but why should not the Kentucky Academy of Science set for one of its tasks that of trying to interpret science and its social implications to the people and begin to make an appeal for sound thinking and unselfish action? How else can society be reformed so that all people who are capable and worthy can have a chance to live comfortable and useful lives? Unless the products of science can be better used, the public perhaps may come to the place where it will no longer support research out of public funds. Already suggestions have been made which are fraught with serious consequences should they be put into effect.

We have accepted the products of research in the physical sciences because we could see a dollar and comfort in their use. We are not so ready to accept the findings of social, economic and political research because too often it disturbs entrenched privilege.

We need a broader conception of science. The old definition that science is knowledge properly classified is not sufficient. It is a method of approach no matter what the problem. It is an attitude of mind which seeks all the facts that can be found, an interpretation of their meaning, and finally what effect they will have on human beings individually and in their social relationships.

I have no illusions that the Kentucky Academy of Science, along with forty-seven other such academies, can in our lifetime change the mental attitudes of people from laziness, superstition, dishonesty, and greed, but we may make a start, and finally the majority of mankind can be convinced that common honesty and decency, after all, are the only guaranty of an enduring civilization. It may be that all agencies working together can begin to produce an honest leadership among men of intellect who will inspire enough confidence that others will follow.

You will remember that James Harvey Robinson, in his "Mind in the Making," says that there are four types of thinking—first, day dreaming, in which the mind wanders from one thought to another without any effort at control; second, the type of thinking in which a decision is made, when compelled by an emergency to do so, whether to take the left road or the right; third, rationalizing—that is, bringing forth arguments to support some position which we have assumed because it gives us profit, power, or supports our pride—and how full of this the world is; even scientists are guilty of it. A corollary of this type of thinking, fraught with grave consequences, is the use of misleading propaganda of various kinds, including commercial advertising based upon false claims or containing subtle suggestions intended to mislead. Coupled with this is the tendency of so many people to believe what is well said, especially when it contains just enough truth to create confidence, but not necessarily related to the conclusion the propagandist wishes the public to accept. Stuart Chase has stated that for every 70 cents spent for education of every kind in the United States there is one dollar spent for advertising, much of it legitimate, of course, but much of it misleading and pernicious. The only antidote to misleading propaganda and the only protection against the penalties of loose thinking come in the fourth type of thinking listed by Mr. Robinson—seeking the facts, attempting to interpret them, and following them no matter where they lead. Perhaps people are more conscious now than usual of the power of misleading propaganda, and this would be a propitious time for the Academy to enlarge its scope by trying to direct people into clearer, more honest thinking.

Professor Milikan interprets, in "Living Philosophies," the "unpardonable sin" as a "deliberate refusal, after reflection, to follow the light when seen."

2. **Sexual Anatomy of the Garter Snake.** C. Parry Kraatz, student, Department of Zoology, University of Kentucky. The portion of the work here reported deals with: (A) distinction of the sexes, and (B) estimation of gonad position for operative work. In Garter snakes in general the sexes can be distinguished by two criteria. Externally, the body of the male tapers gradually from the anus to the tip of the tail. The anal scutes fit neatly across the body, fre-

quently to conceal the position of the cloaca. In the female, often the diameter of the body is reduced suddenly, posterior to the anus. The cloaca is less neatly closed by the anal scutes which frequently gape apart. Internally, the male cloaca has a narrow, short, longitudinal fold, and an aperture for each of two cloacal glands on the dorsal side. The female cloaca, as seen thru the anal aperture, has a broad longitudinal fold, and a single dorsal median aperture for the single cloacal gland. For operative work, gonad position may be estimated in *Thamnophis sirtalis* as follows. If N=the number of scutes from chin to anus, $N^2 \times .00202 =$ the number from the anus to the center of the left testis, and $N^2 \times .00257$ is the corresponding number for the right testis. $N^2 \times .2801$ and $N^2 \times .3965$ are the corresponding values for the ovaries, subject, however, to greater variation. No correlation of body length with distance of gonads from either end, was found.

3. **Follicular Atresia in Ovaries of Garter Snakes.** Armor P. Taylor, student, Department of Zoology, University of Kentucky. The normal histology of the ovarian follicle of *Thamnophis sirtalis* is described. Atresia of follicles occurring normally in the ovary first becomes manifest in the innermost follicular cell layer. The evidences in progressive order are: swelling of cell body, loss of nuclear staining reaction, pycnosis, fragmentation, karyolysis, and, finally, fatty degeneration. Degenerative changes in innermost cells affect the large secretory cells of the stratum granulosum, since these cells originate from the former and are maintained by their proliferation. These changes permit the small granulosa cells to infiltrate the underlying *theca interna* and, finally, the *zona pellucida.* The infiltration is accompanied by connective tissue and capillary formation from fibroblasta. The small cells next enter the egg as phagocytes. Progressive cytophasmic changes in the egg are followed by pycnosis in the germinal vesicle, and its final disappearance. Eventually, contraction of connective tissue results in constriction of capillaries and formation of scar tissue.

4. **On the Derivation of the Notochord in Higher Verte-**

brates. Has It a Functional Significance? Alfred Brauer, Department of Zoology, University of Kentucky. Recent descriptive works attributing the origin of the notochord in mammals, man in particular, to specific germ layers are critically analyzed. Attention is called to the similarity of the illustrative material to sections thru the dorsal blastopore lip of amphibia or thru the primitive node of the chick, where the origin of the notochord is known to be from indifferent node cells. Attention is called also to the relationship between early notochord and the medullary plate as indicative of the functional value of the former as the organizer of medullary plate, as it is in amphibia and probably in birds.

5. **Pancreatic Stimulation.** Dr. Stanley G. Bandeen, Louisville, Kentucky. Ever since the discovery by Von Mering and Minkowski in 1889, that pancreatectomy greatly lowered the carbohydrate tolerance and produced glycosuria, the pancreas has been looked upon by most workers in the field as the crux of the diabetic problem.

In 1900 Opie focused the attention of investigators upon the study of the pathology of the Islands of Langerhans. In 1901, Opie demonstrated that the Islands of Langerhans, first described by Paul Langerhans in 1869, were the elements of the glands involved in pancreatic diabetes.

In 1907, Lane discovered the Alpha and Beta cells of the Islands of Langerhans which gave a new impetus to the search for a pancreatic hormone. Many physiological researches were carried out by physiologists and clinicians in an effort to demonstrate a relation between the pancreas and the carbohydrate metabolism, and to obtain from the pancreas an internal secretion which would be of value in the treatment of diabetes.

Beginning with Minkowski himself, many observers tried various forms of extracts of the pancreas. Among the extractives used were water, saline, alcohol and glycerin. The extracts thus obtained were administered by mouth, subcutaneously, intravenously or by rectum, both to experimental animals and humans suffering from diabetes. Little or no improvement was obtained and any favorable results were overshadowed by their toxic effects. In 1908, Zuelzer tried alcoholic extracts on six cases of diabetes mellitus and obtained favorable results, one case of severe diabetes becoming sugar free. His extracts were then tried by Forschbach in Minkowski's clinic with less favorable results, and the investigation was abandoned by this group of workers. Rennie found that the islet cells existed separate from the acinar cells in certain bony fishes and in conjunction with Fraser extracts of the principal islet cells were tried both on animals and on the human. Their results, however, were not sufficiently convincing to warrant clinical application. The problem of the extraction of the antidiabetic principle from the pancreas was then taken up, for the most part, by physiologists, among whom were Scott, Paulesco, Kleiner and Murlin.

In 1911, Deason demonstrated that pathology of the mid and lower dorsal spine produced reflexes thru the pancreas which resulted in disturbance of carbohydrate metabolism and the occurance of sugar in the urine.

While these efforts were being made by physiologists, valuable knowledge was being gained on carbohydrate metabolism. Lewis and Benedict, Folin and Wu, Schaffer and Hartman and Ivar Bang had elaborated methods whereby the percentage of sugar in a small sample of blood might be accurately estimated. At the same time a vast amount of knowledge was accumulating on basal metabolism. Special attention was being given to the relative importance of various foodstuffs, and emphasis was being put on dietetic treatment of diabetes. Guelpa, Van Nordam, Allen, Joslin, and Woodyatt had elaborated systems of diabetic diet.

The idea underlying the experimental work on pancreatic stimulation was formulated after reading Deasons article on spinal pathology in relation to carbohydrate metabolism, and an article by Moses Baron, in which he pointed out the similarity between the degenerative changes in the acinus cells of the pancreas following ligation of the duct and changes following blockage of the duct with gallstones. Joslin makes a statement that "There is no case of diabetes so severe but that the pancreas secretes some hormone, therefore the administration of insulin is not absolutely necessary to save life except in a small percentage of cases."

Advantage was taken of the above facts and preparations were made to find out where, when, and how to stimulate the functioning islet tissue of the pancreas as well as those that might be lying dormant from some unknown cause . If pancreatic stimulation could be accomplished, would it assist in temporary or permanent recuperation of the islet cells?

The first and most important item in the treatment of disease is diagnosis, knowledge of the pathology and of the procedure to overcome it. The most important means of controlling these reactions are (1) the selection of foods to provide the proper chemical reactions, and (2) the use of physical and chemical stimuli to influence the character of the reactions. With a knowledge of what each group of organized cells or organs can contribute in a therapeutic measure for the alleviation of a given pathologic condition, we can direct the forces directly to the specific cells or organs to restore the normal electrochemical balance in the body, thereby normalizing the blood sugar.

Since the discovery of insulin by Banting and Best, of Toronto, Canada, and their recommendation of this hormone as an aid in the treatment of diabetes, we would consider the diagnosis of greatest importance. There are many physicians today who consider glycosuria, either constant or transient, as sufficient basis for a diagonis of diabetes. That this is an unwarranted assumption is shown by studies made in the Cleveland clinics . It was there found that 13.8% of the patients having glycosuria were non-diabetic, and that 18.3% of the diabetics failed to show sugar in the urine. Moreover, it has been shown that some diabetics have absolutely no symptoms referable to the disease other than increased blood sugar, and that some of the commonly accepted symptoms of diabetes may be found in non-diabetic individuals.

It is true, however, that if it were not for the finding of glycosuria the majority of cases would go undiscovered and undiagnosed until late, if at all. This fact emphasized the importance of routine urinalysis, and we should consider cases of glycosuria as potentially diabetic until proved otherwise. For the sake of emphasis let me repeat: glycosuria is not pathognomonic of diabetes.

The old conception of disease, based upon the morbid anatomy of the morgue and the patho-histological laboratory, has long dominated medical thought, and, altho conceding that great service has been done in furthering its progress, it is often forgotten that in their beginnings, at least, most all pathology and symptoms depend upon derangements of function, and that, like an X-ray picture or photograph of the results of a tragedy, post-mortem findings and microscopic slides are the final evidence of the structural changes arising from such derangements.

Pathologists only view damaged tissue and never see the beginning of a disease, because the derangements of function were going on for weeks or years, and the pathologist examines the structural changes arising from such derangements. This is particularly true of those conditions which, in recent years, have come to be classed as disorders of metabolism. Altho gross anatomical changes may be found at the morgue, they are essentially dependent upon faults in the relative values and direction of application of physicochemical forces constantly at work within the body. So long as organized outward opposition to such theories as, "The rule of the artery is supreme," and that structural change from normal is an etiological factor in disorders of metabolism, and attention is paid solely to their morphologic pathology—then genesis and symptomatology will be difficult to interpret, and just so long will progress in the therapeutic field be retarded. A dynamic, rather than a static conception of disease, is essential if such conditions are to be clearly understood.

A normally functioning body consists of finely balanced electrochemical reactions occurring in organized units known as cells and tissue. As the result of such electrochemical reactions, electro-physical forces are brought into play which determine the size and shape of cells and bring about such phenomena as growth, reproduction, muscular contraction, flow of the body fluids, and passage of nervous impulses. An alteration in the electrochemical processes mentioned, or interferences with the action of the electrophysical forces produced, results in disease or a complete incoordination of activities known as death.

Partly as a result of the prevailing static conception of disease it has been customary to study departures from the normal as separate entities, and to label each with a distinguishing name, such as gastritis, neuralgia, diabetes, etc. While such a procedure is convenient and may be justifiable where there are gross anatomical changes, it is apt to be misleading where disturbances of function are chiefly concerned, and may, in fact, give an altogether false conception of the problem involved, as it has done in one of the most common results of defective function; the presence of sugar in the urine and reducing substances akin to it, or, absence of sugar in the urine with a high fasting blood sugar, a good tolerance for carbohydrates even with a high fasting blood sugar, a normal fasting blood sugar with a low tolerance. As a result of these various discoveries a new terminology based upon the nature of the sugar present in the urine, and the utilization of carbohydrates, arose and the term, "diabetes mellitus" lost its definite significance. By some it is still used to cover all conditions where sugar is present in the urine, or where there is a high fasting blood sugar, or where there is a deficient utilization of carbohydrates, the middle condition with the presence of sugar in the urine being referred to as glycosuria. This conclusion is further confusing by a study of the evidence bearing on the causes thru which it has been shown that sugar may be made to appear in the urine, or a high fasting blood sugar; for if we consider them individually and as separate entities, a number of complications enter into the picture. We realize now how it is possible for a variety of causes which appear to have little or no direct connection with each other, to influence the result and interfere with the smooth working of the normal process. We note a marked change in the fasting blood sugar following the change of pH of gastric contents by the natural or artificial means. Also, a change of fasting blood sugar is noted when the pH of the blood is increased or decreased from normal.

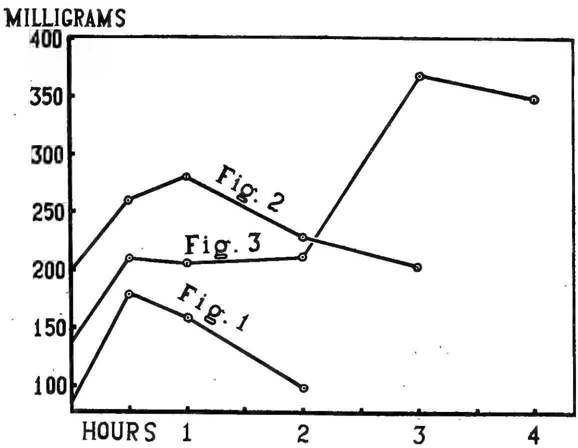
The glands of internal secretion such as thyroid, pituitary, suprarenal, liver, and pancreas play a big part in influencing the electrochemical balance of the body by changing the number of electrons revolving around its proton. Any such change not only changes the pH of the blood and cells, but also the sugar-carrying ability of the cell protein.

In conformity with advancing knowledge, diabetes mellitus has been assigned a different pathology with almost every generation, and has been regarded in turn as a disease of the kidneys, stomach, nervous system, liver, and pancrease. At the present time the pancreatic theory holds the field. Diabetes mellitus being essentially an electro physicochemical problem, altho morphological changes associated with it are only of secondary importance, what we really want to know is how the electrochemistry of the diabetic differs from that of the normal body.

The concentration of the dissolved substance, the salts and sugars, is higher in the blood of the diabetic patient than is normal. The reason is, that the blood proteins have a higher surface tension and therefore do not hold the dissolved substances in the non-ionized state of physical absorption. The osmotic pressure of the fluid is increased. The red blood cells share this condition and therefore are not crenated by the presence of higher than normal concentrations of salt solutions to which they are exposed.

The normal concentration of the blood salts and sugars varies around 0.85%, but in the diabetic or pre-diabetic state, it may be 1% or higher. The behavior of the concentrations of the dissolved blood sugar is also characteristic, and depends upon the same alterations in the surface tension and absorption power of the red blood cells. Thus, in the normal individual, if a solution of 100 grams of glucose in 300 cubic centimeters of water is taken into the stomach after a twelve-hour fast, and blood withdrawn for analysis every half hour for comparison with the blood before the glusose is taken, the sugar is rapidly taken up by the colloids of the blood and tissues and does not stay in solution in the blood very long. The curve plotted in figure 1 illustrates:

If the glucose is taken by a diabetic the sugar is not absorbed as rapidly by the blood and it is not readily taken up by the blood and tissue colloids, but reaches a high concentration of solution in the blood from which it disappears to the normal level slowly as indicated in figures 2 and 3:



Every presympton electrochemical change is based upon a direct tissue injury produced by a toxic agent. Even the so-called functional derangements, as headaches, neuritis, dizziness, loss of equilibrium, the visual disturbances, as well as the physical abnormalities, depend upon an electrochemical and physical change in the mechanism concerned.

The destructive lesions, palpable or visible thru the microscope, in any disease to be described, depend for their earliest start upon the electrochemical changes that lead to the functional disturbances. The various gross differences which determine their expression, as diabetes, diabetic gangrene, colitis, gastric ulcer, endometritis, etc., depend upon secondary factors. The primary change which makes possible the various secondary developments, always connects itself with a certain amount of endarteritis, that is, obstructive inflamation of the inside coat of the blood vessels. Any change or injury to the blood vessel causes its partial or complete closure and the surrounding tissues fail in adequate blood supply and lose their resistance to other harmful agencies. ("The rule of the artery is supreme") They thus become subject to a variety of secondary changes.

The blood is the transportation system of all nutrition and waste products. The blood protein is the vehicle that holds these materials in a state of absorption during the distribution.

Life depends upon the correct electrochemical balance of this protein whereby it is able to absorb and carry these materials. The endocrine system exists for the purpose of maintaining the correct state of blood protein and tissue colloids. Every toxic agent and physical interference with the flow of blood or passage of nerve impulses has an injurious action on the state of protein dispersion.

The blood protein is made up of small particles or spheroids, each one moving in its little orbit under the repelling forces of the other forces about which it also repels . Each spheroid carries an electric charge on its surface, by virtue of which the repelling force keeps up the mutual propulsion and motion. Any agent that reduces this surface charge will either cause the particles to break up into worthless bits, pass into solution, or lose their motion and clump together. The symptons caused by these changes are different and various toxins and degrees of interference with flow of blood and passage of nerve impulses favor different degrees of splitting or lysis of the particles or of clumping or hydration of the particles.

When lysis takes place, the materials are held more tightly in the protein so that they are not given up so easily to the tissues as normally. Therefore, insulin, from the islands of

Langerhans, of the pancreas, is designed to prevent lysis by setting up an optimum amount of hydration. Any interference with the blood protein that causes lysis reduces the carrying power of the blood protein for sugar, the osmotic pressure of the fluid is increased, the blood concentration for sugar increases until a point above the kidney threshold is reached then sugar tends to pass out in the urine instead of being held by the blood protein. The degree of concentration of blood sugar is in proportion to the degree of hydration and the point at which sugar is passed into the urine depends on the kidney threshold.

When there is a decrease in insulin from the islands of Langerhans, of the pancreas, we believe the same poison that inhibits the islets cells also is the lytic substance of the blood protein. When this lytic substance has the upper hand, a higher than normal concentration of blood sugar occurs and beyond the kidney threshold it is lost from the body and so-called "diabetes" exists.

The majority of diabetic cases under insulin treatment are required to take insulin from one to several times each day to hold the blood sugar concentration to normal. The reason for this constant state of protein lysis is the constant electrochemical disturbance in the body and the only permanent way to overcome this abnormal condition is by the removal of the cause. Unfortunately, insulin effects a change of the electrochemical disturbances from a masked lytic substance to a hydration agent, but the type of hydration brought about does more harm than good. It is deadly to the body chemistry and it does not stop further lytic production, as can well be demonstrated by eliminating the injection for one day. Nevertheless, the hydration produced increases the carrying power of the blood protein for sugar and the diabetes is masked even while its cause is active.

Unfortunately, the electrochemical disturbance that produces hydration as a result of a toxin or insulin administration makes an ideal chemical field for tuberculosis, pneumonia and cancer.

Effect of Pancreatic Stimulation on Fasting Blood Sugar in Diabetic and Non-Diabetic Patients (Blood-Sugar Findings expressed in mg. per 100 cc. of Blood).

Case No.	Before Stimulation	30 min. after Stimulation	1 hr. after Stimulation	Case No.	Before Stimulation	30 min. after Stimulation	1 hr. after Stimulation
1	140	122	—	51	228	200	—
2	154	130	—	52	416	380	—
3	156	116	—	53	180	156	—
4	162	150	—	54	220	206	—
5	140	128	—	55	396	368	—
6	150	126	—	56	280	244	—
7	162	150	—	57	200	188	—
8	198	168	—	58	628	564	—
9	130	70	—	59	200	230	—
10	222	200	—	60	260	230	—
11	192	166	—	61	232	212	—
12	160	136	—	62	330	306	—
13	168	156	—	63	198	156	—
14	198	146	—	64	288	—	242
15	204	172	—	65	140	—	132
16	234	208	—	66	160	—	120
17	310	288	—	67	178	—	156
18	190	178	—	68	150	—	136
19	368	340	—	69	200	—	160
20	282	244	—	70	288	—	194
21	200	174	—	71	160	—	140
22	364	350	—	72	222	—	192
23	224	190	—	73	192	—	168
24	238	222	—	74	160	—	148
25	168	124	—	75	142	—	106
26	188	160	—	76	126	—	108
27	228	200	—	77	114	—	102
28	232	194	—	78	180	—	170
29	212	182	—	79	120	—	106
30	412	370	—	80	150	—	100
31	260	242	—	81	126	—	110
32	336	302	—	82	156	—	130
33	288	242	—	83	130	—	70
34	140	128	—	84	150	—	118
35	228	194	—	85	122	—	110
36	192	168	—	86	142	—	118
37	170	160	—	87	132	—	110
38	300	280	—	88	124	—	112
39	362	296	—	89	112	—	76
40	220	174	—	90	162	—	149
41	240	172	—	91	130	—	110
42	226	182	—	92	160	—	140
43	284	274	—	93	320	—	282
44	236	220	—	94	124	—	110
45	280	192	—	95	140	—	100
46	210	184	—	96	122	—	100
47	260	260	—	97	110	—	80
48	230	190	—	98	130	—	120
49	360	340	—	99	150	—	110
50	280	220	—	100	126	—	100

SUMMARY

1. Total number of cases observed, 100. 2. Total number of cases observed 30 min. after stimulation, 63. 3. Greatest drop observed 30 min. after stimulation, 88 mg. 4. Average drop observed 30 min. after, 29.1 mg. 5. Total number cases observed 1 hr. after stimulation, 37. 6. Greatest drop observed 1 hr. after stimulation, 50 mg. 7. Average drop observed 1 hr. after stimulation, 25.6 mg.

The author has made statements in most all of his lecture work during the last twelve years that islets of Langerhans were not dead but were lying dormant, and relief from diabetic disturbances could be obtained only by removing the substance keeping them dormant, thereby restoring the normal electrochemical balance of blood protein and tissue colloids.

Quoting from an oral conversation with one of the research men from McLeod Laboratory, Toronto, Canada, "The results from your research work substantiate your theory that the islet cells are dormant and not dead, as the blood chemical tests reveal a marked response to pancreatic stimulation."

If this paper took into consideration the temporary or permanent recuperation of the islet cells, many cases could be given where the blood sugar was markedly decreased at the same time the carbohydrate and fat of the diet were increased. The most outstanding case was Mrs. D. L., whose blood sugar was decreased from 204 mg. per 100 cc of blood to 100 mg. per 100 cc of blood, and her diet increased from carbohydrate 51 gm., protein 32 gm., fat 37 gm., up to carbohydrate 110, protein 58, and fat 90. This was accomplished in 27 days. The patient has been able to maintain this improvement for the past 18 months. Only time will determine the lasting qualities and recuperative power of pancreatic stimulation. The longest time to date is 10 years on a woman who had a fasting blood sugar of 376 mg. per 100 cc of blood.

Stimulation of the pancreas over a period of a few weeks, with correct diet to fit the individual case, brings about marked improvement. At least the symptoms do not return until the original cause again becomes operative. It must be borne in mind that the cause is much more likely to return than if it has never been present; therefore, whether the disease is diabetes or something else, the patient must cooperate with the physician and do his best to avoid habits of life which predispose to bring about a return of the condition.

Pancreatic stimulation consists of raising the second, third, fourth, and fifth ribs. With the patient lying on the back, stand on the left side and place the right hand on the angle of the upper dorsal ribs. Have the patient reach up and place the left hand on your shoulder. With your left hand placed on the angle of the ribs just below the right hand, step back and at the same time apply pressure at the angle of the ribs. By the use of the pectoral muscles and the patient's arm as a lever, a marked movement of the upper dorsal ribs is obtained, which by the anatomical arrangement, thru the lateral chain ganglia produces a marked stimulation of the islets of the pancreas. This is evidenced by the rapid drop in blood sugar as shown by the accompanying table.

6. **Theories Regarding the Decline of the Seed-bearing Ferns of the Paleozoic,** Harriette V. Krick, Biology Department, Eastern State Teachers' College. Several current theories regarding the decline of the pteridosperms of the Paleozoic were discussed, with evidence derived from fossils for their substantiation.

7. **Birth Control.** Leon L. Solomon, The Solomon Clinic, Louisville.

8. **The Organization Center of the Amphibian Embryo.** Edmund K. Hall, University of Louisville. The organization center of the amphibian embryo consists of the dorsal lip of the blastopore in the gastrula, of the roof of the archenteron in the neurula, and of the notochord and somites in later stages. Transplanted under the central or lateral ectoderm, the organization center induces, at the time of neurulation, the formation of a secondary neural plate and tube from this ectoderm.

The author's experiments show that the center guides the development of the neighboring organs after the differentiation of neural tissue has been initiated. If the notochord is displaced laterally, the medullary groove points toward it, as does the pointed dorsal portion of the gut. If the posterior half of the archenteron roof ("trunk organizer") is replaced by the anterior half ("head organizer"), the spinal cord develops normally; head organizer has manifested its general powers of neural induction without revealing its specific brain-inducing properties. When head organizer is replaced by trunk organizer, the brain which develops is very long and narrow, without eyes or vesicles. In this case, trunk organizer has probably manifested its specific spinal cord-inducing tendencies.

9. The Thigh Muscles of Amblystoma Punctatum. Harvey B. Lovell, University of Louisville. In connection with experimental studies upon the morphogenesis of the hind limb of *Amblystoma punctatum*, it was found necessary to identify the muscles of the thigh. They have been named according to the system introduced by DeMan ('74) for *Triton* and *Salamandra*, the name, whenever possible, being a combination of the origin and insertion of the muscle. The names given to these muscles by several earlier investigators were discarded. However, since Mivart ('69) on *Menopoma* had already used this system for four muscles (ischiofemoralis, caudalifemoralis, ischiocaudalis, and femorofibularis), these names were accepted by DeMan. The adductor femoris was first so named by Perrin ('92). The iliotibialis was first recognized by Wilder ('12) as a distinct muscle in *Necturus* and separated from the ilio-extensorius. The ilio-extensorius of DeMan therefore includes both it and the iliotibialis. The name ilio-extensorius was first used in its present limited sense by Wilder ('12).

Noble ('22) has shown that the thigh muscles of urodeles are of importance in tracing evolutionary relationships. He also finds on the basis of innervation that the homologies between the muscles of salamanders and higher vertebrates made by the earlier investigators are largely inaccurate.

In the present study all the muscles known to be present in the thigh of urodeles have been identified and figured for *A. punctatum*.

The sacral plexus is formed by the union of three spinal nerves. The first caudal nerve also sends a twig to one of the extrinsic caudal muscles. The chief branches of the plexus are the obturator, crural, ischiadic, fibular, and two additional nerves which I have called the adductor and the caudal nerves. The ischiadicus divides into the lateral and median divisions at the middle of the thigh.

First, we shall consider the muscles of the ventral or adductor side of the thigh, which consist of a superficial layer of three muscles and a deeper layer of two muscles.

1. *M. pubotibialis* (*pt*). This muscle is well developed and quite separate in *Amblystoma.* It has its origin (*pt′*) in part by a short tendon from the preacetabular process of the pubis and in part from an aponeurosis to the adjacent fascia. It is inserted (*pt″*) upon the proximal end of the tibia by a short tendon. Innervation: adductor nerve.

2. *M. puboischiotibialis* (*pit*). This is a broad muscle partly divided into a distal and a proximal portion by a raphe′. It has its origin (*pit′*) from the posterior two-thirds of the ventral median line of the puboischium, and its insertion (*pit″*) is on the ventral surface of the tibia distal to that of the pubotibialis. Innervation: adductor nerve.

3. *M. ischio-flexorius* (*is-fl*). This muscle has its origin (*is-fl′*) on the posterior outer edge of the ischium, where its proximal fibers are partly fused with those of the puboischiotibialis. It is inserted upon the fascia of the shank. Innervation: adductor nerve.

4. *M. adductor femoris* (*ad.f*). This slender muscle lies dorsal to the pubotibialis between the puboischiofemoralis internus and externus; it has its origin from the ventral outer edge of the pubis and is inserted on the distal third of the femur between the insertions of these two muscles. Innervation: adductor nerve.

5. *M. puboischiofemoralis externus* (*pife*). The proximal portion of this muscle is very broad, having its origin from the median line of the entire puboischium. It is inserted on

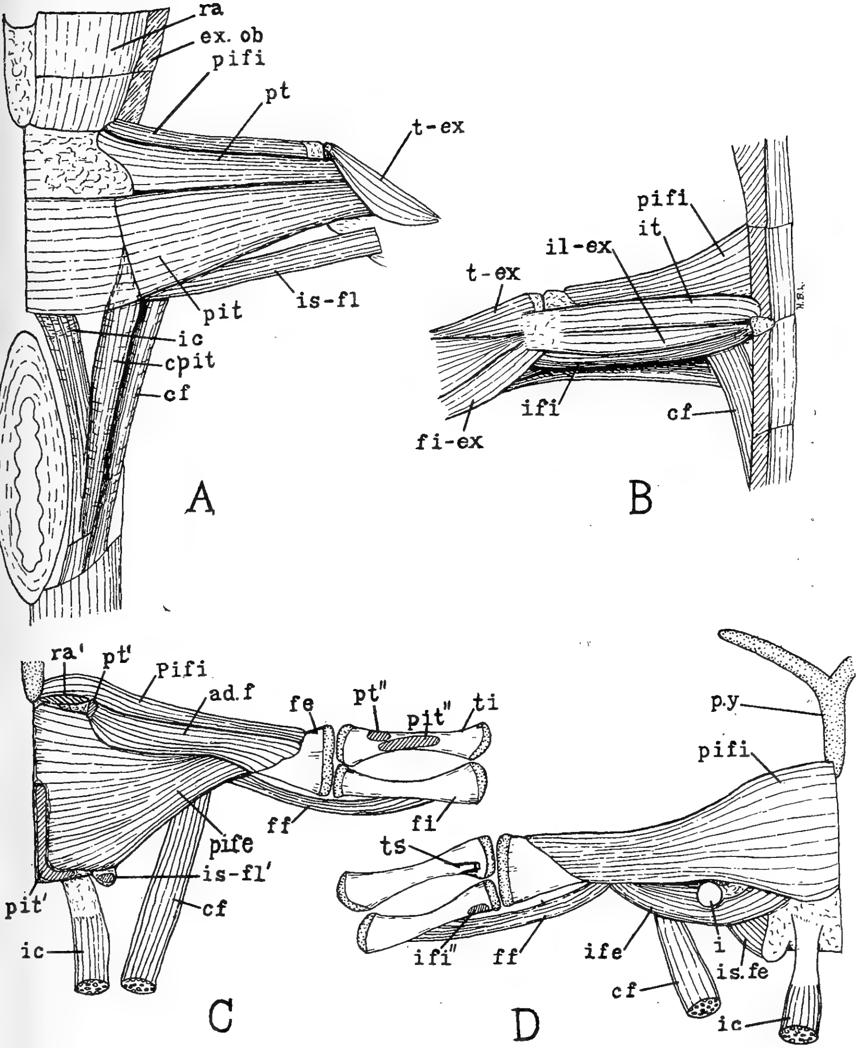


FIGURE 1. Muscles of hind limb of **Amblystoma punctatum.** A. Ventral side of the thigh. B. Dorsal side of thigh. C. Deeper muscles of ventral side of thigh. D. Deeper muscles of dorsal side of thigh.

the ventral side of the femur and on a bony crest, the crista femoris. Innervation: obturator nerve.

The second group is composed of seven muscles which are found on the dorsal or abductor side of the thigh. The first three form a sheet of superficial muscles arising from the lateral surface of the ilium.

6. *M. iliotibialis* (*it*). This muscle arises from the anterior side of the ilium. At its posterior end it is closely associated with the ilio-extensorius, both muscles ending in a continuous aponeurosis which passes over the knee to the fascia of the shank. From the middle of this aponeurosis a slender tendon passes inward between the muscles and is inserted on a slender bony spine on the tibia. Innervation: crural nerve.

7. *M. ilio-extensorius* (*il-ex*). This muscle has its origin in a tendon on the lateral margin of the ilium. It is inserted on the fascia of the shank as described above. Innervation: fibular nerve.

8. *M. iliofibularis* (*ifi*). This muscle also has its origin from the lateral margin of the ilium and its tendon partially fuses with that of the ilio-extensorius. Distally these muscles are quite distinct. The iliofibularis has a broad insertion (*ifi"*) on the posterior side of the proximal end of the fibula. Innervation: fibular nerve.

9. *femorofibularis* (*ff*). The origin is on the posterior side of the femur slightly beyond the middle. It is inserted on the outer side of the fibular distal to the insertion of the iliofibularis. Innervation: lateralis nerve.

10. *puboischiofemoralis internus* (*pifi*). The large mass of muscle lying next to the femur has been considered a single muscle in Necturus (Wilder '12). However, Noble ('22) has shown that there are two distinct muscles. In Amblystoma the portion anterior to the ilium arises from the median line of the anterior two-thirds of the puboischium, and a few fibers

from the base of the ypsiloid process (Cf. Whipple '06). These swing anterior to the ilium and have an extensive insertion on the dorsal and anterior sides of the femur. Innervation: crural nerve and a nerve arising at the junction of the obturator with the crural nerve.

11. *M. iliofemoralis* (*ife*). This muscle has its origin in part on the ischium and in part on the posterior and lateral margins of the ilium. It swings caudal to the latter bone and is inserted upon the posterior side of the femur. Innervation: ischiadicus nerve.

12. *M. ischiofemoralis* (*is.fe*). This short stout muscle has its origin in a notch (ischiadic notch) in the outer margin of the ischium. It is inserted on the trochanter of the femur by a stout tendon. Innervation: adductor nerve.

The third group of muscles consists of three extrinsic muscles passing from the tail to various appendicular structures.

13. *M. caudalifemoralis* (*cf*). This muscle has its origin on the haemal arches of the fourth and fifth caudal vertebrae and is inserted by a tendon upon the caudal process of the crest of the femur. This is the most lateral of the three caudal muscles. Innervation: caudal nerve.

14. *M. caudalipuboischiotibialis* (*cpit*). This muscle is ventral and median to the preceding. It has its origin chiefly upon the haemal arches of the third and fourth caudal vertebrae in close association with the ischiocaudalis and is inserted upon the puboischiotibialis at the point where it is strengthened by the raphe′. Innervation: caudal nerve.

15. *M. ischiocaudalis* (*ic*). This is the most median of the three caudal muscles and lies close to the large cloacal gland. The origin of this muscle is from the inner surface of the ischium by a broad, flat tendon. It is inserted chiefly upon the haemal arch of the third caudal vertebra. Innervation: first caudal spinal nerve.

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10. Methods of Branching in Ailanthus Glandulosus. P. A. Davies, University of Louisville. In volume 15 (July, 1929) of the Journal of Heredity I discussed an abnormal method of branching occurring in *Ailanthus glandulosus* (tree of heaven). Since the publication, I have found many interesting examples of this abnormality. Normal branching exhibits two general types: (1) Forked, irregular growth with many short shoots, found in old trees which exhibit much extension growth. (2) Long, extended growth in which only a few shoots (often only one) develop, is found in very young trees which are growing very rapidly. Abnormal branching appears at the apex of rapidly growing shoots. It is first noticeable by an abnormal arrangement of the leaves and a flattening of the shoot. As the flattening continues, the shoot divides.

11. The Ecology of the Helminth Parasites of Testudinata. D. W. Rumbold, Eastern State Teachers' College. An ecological study of the parasites of North Carolina turtles from four types of habitat which formed a more or less graded series: (1) Land; (2) an artificial lake, about 20 years old, at Lakeview, N. C.; (3) a 45-year-old pond above a dam in Eno river, near Durham, N. C., and (4) an artificial lake about 105 years old, northwest of Gibsonville, N. C. Regular examinations were made to determine what parasites were characteristic in the turtles of each of these localities. Turtles included tortoises and terrapins as well as semiaquatic and aquatic turtles. Correlations were found between habitats frequented and types of parasites present. Certain parasites showed specifically for particular habitats, hosts, or organs, and seasonal variation in numbers were found among certain parasitic worms.

12. The Composition of the Blood of Starved Ewes. G. Davis, Buckner, Wayland Rhoads, and E. J. Wilford, University of Kentucky. Three ewes, weighing 142, 175, and 142 pounds, respectively, were put into stalls February 1, 1933. One was fed normally during the experiment; one was fed normally until February 4, when feeding was discontinued, and one was not given any feed during the experiment. Water was before them constantly. Blood was drawn from the jugular vein of each February 2, 4, and 7. Analysis showed no material differences in the content of calcium, phosphorous, or potassium.

13. The Pythagoreau Theorem in Fourier Analysis. Leon W. Cohen, University of Kentucky.

14. The Value of the Ph. D. Dissertation for Teachers of Undergraduate Students. Waldemar Noll, Berea College. Nine Doctors of Philosophy with degrees from six universities were asked their opinions as to whether or not the training acquired in working out their doctor's dissertations was of value to them in teaching undergraduate classes. The overwhelming consensus of opinion was in the affirmative. Nineteen reasons were stated in support of this opinion. Among them were: (1) training in getting all details just right; (2) training in exact thinking; (3) broadening value; (4) clear understanding of technical terms, and (5) increased interest and enthusiasm.

15. Homemade Apparatus to Demonstrate Attraction Between Masses. Samuel J. Combs, student, Berea College. Two lead balls, 350 grams each, were attached to the ends of an aluminum rod suspended horizontally in a box, by an electroscope, suspension. The lead balls could be drawn to the sides of the box by heavy cannon balls placed near them.

16. New Discoveries Concerning the Devonian Delta of

the Appalachian Geosyncline. Wilbur Greeley Burroughs, Berea College. The field investigations upon which this paper is based were carried on by the writer in the Towanda region of Bradford County, northeastern Pennsylvania. Correlations were made between the strata of this region and the strata in Pennsylvania, New York, and other states.

The bed-rock exposed in the Towanda region is of Upper Devonian age. Ascending geologically the formations are: (1) Wellsburg gray sandstone, shale and calcareous beds of the Chemung, 800 feet; (2) Chemung-Catskill Transition Zone consisting of gray, green, and red shale and sandstone and calcareous beds, 126 to somewhat over 200 feet; (3) Catskill red, green, and gray sandstone and shale, the red predominating, 1,000 feet. South of the Towanda region the Catskill is overlain in ascending order by the Pocono and Mauch Chunk formations of the Mississippian, above which come Pennsylvanian coal-bearing strata.

The Chemung beds vary in thickness and character within short horizontal distances, due to the shifting currents at time of deposition. Good key horizons in the Chemung of this area do not occur. Calcareous beds, usually only a few inches thick, are found, especially in the upper portion of the Wellsburg. One calcareous deposit at Burlington is made up almost entirely of the fossils, *Spirifer disjunctus* and *Athyris*. These fossiliferous beds are three inches to seven feet four inches thick, the total deposit being 95 feet thick.

The Chemung-Catskill Transition Zone is distinguished from the overlying Catskill by its marine fossil fauna, whereas the Catskill contains a brackish to fresh-water fauna. The most characteristic fossils of the Transition Zone are *Spirifer disjunctus* and *Athyris*. Fossils in the Catskill of the Towanda region are rare. They consist of fish-plates, probably the genera *Holoptychius*, fish scales, and plant remains.

The Catskill formation in this region is a delta deposit. In advance of the main delta, currents carried Catskill sediments into the Chemung sea. These became intermingled in the same bed and also interbedded with Chemung sediments, forming the Chemung-Catskill Transition Zone. As the delta continued to advance, Catskill sediments were deposited upon those of the Transition Zone. Chemung sediments were being deposited farther westward. Thus the higher portion of the Catskill is the time equivalent of the Chemung formation farther west. The base of the Catskill was deposited upon increasingly younger Chemung strata as the Catskill delta advanced westward. The base of the Catskill, therefore, rises in the geologic column as the formation is followed westward.

17. The Benzaldehyde Electrode. Thomas C. Herndon, Eastern State Teachers' College. Benzaldehyde may be oxidized to benzoic acid or reduced to benzyl alcohol; hence, it should exhibit an oxidation-reduction potential. This paper discusses this potential, its magnitude, and its relation to the pH values of alkaline, buffered solutions. The numerical data are summarized by means of a graph, and an equation relating the electrode potential to the pH values is given.

18. The Educational Sound Picture "Molecular Theory of Matter." A. D. Hummell, Eastern State Teachers' College. The effectiveness of the film on silent equipment was demonstrated. Since the lecturer does not appear in the picture, absolute synchronization is not so important and the lecture may be given by the instructor.

19. An Alkaloidal Study of Phytolacca Decandra. Meredith J. Cox, Eastern State Teachers' College. The study was undertaken because of the use of the young poke shoots for "greens" in the South. Analysis of dried plants, about 4 weeks old, gave: water, 4.75 per cent; ash, 17.2; protein, 38.96; fat, 2.04; crude fiber, 9.8; carbohydrate, 25.75. No alkaloid was detected. A review of the literature is given. Three authors claim to have detected an alkaloid.

20. An Amperian Current Model of Magnetization. F. W. Warburton, University of Kentucky. Fifteen small coils, their axes indicated clearly by painted arrows, are inserted in a large, transparent solenoid. In this magnetic field they line up, representing the electronic currents circulating about the atoms in soft iron, which makes the iron magnetic. Reversing the magnetic field in the solenoid causes the coils to reverse direction, and follow thru the hysteresis cycle. Ewing's model of magnetization may also be inserted and carried thru the hysteresis cycle.

21. **A Laboratory Determination of "C", the Ratio Between Electromagnetic and Electrostatic Units.** F. W. Warburton, University of Kentucky. A current balance, consisting of a long, rigid wire and a single loop suspended from a beam balance, is connected in series with a calorimeter heating coil of 100 ohms resistance. A current (of 2 to 15 amperes) may be determined in absolute electromagnetic units by the measured attraction of the wires in the current balance. The potential difference between the ends of the heating coil is measured in absolute electrostatic units by an attracted disk electrometer, and from the heating of the calorimeter, the current is found in electrostatic units. Comparing the values of the current in e.m.u. and e.s.u. gives the ratio $c = 3 \times 10^{10}$ cm/sec.

22. **The Relationship of Socio-Economic Status to Intelligence and Achievement.** Noel B. Cuff, Eastern State Teachers College. The procedure was to score 317 freshmen, in 1931, and 417 in 1932-33, by the Thurstone and Thurstone Psychological Examination (American Council) and Sims' Socio-economic Score Card. Edgerton's table was used to find scholarship rates for data obtained from the Registrar. The results showed that many college freshmen come from the lower socio-economic strata, as measured by Sims' score card; that there is a slight tendency for those in the higher socio-economic centiles to score higher on intelligence tests and to make higher college grades, and that one would make almost as great an error in judging intelligence from socio-economic status as in making a random guess. It follows that college opportunities should not be based mainly upon socio-economic status.

23. **A Comparison of Delinquent and Non-Delinquent**

Girls Paired for Intelligence. Walter E. Watson, University of Kentucky.

24. The Place of Research in the Undergraduate College. Anna A. Schnieb, Eastern State Teachers College. This study is the result of observations made of a large number of German students for more than a year, and a direct contact with students in teachers colleges for several years. The study was prompted by the desire: First, to help remove one of the differences observed between the German students and our American student—that of possessing little, if any, intellectual curiosity. Second, to help students have a desire to think and to form the habit of thinking.

From my work with the German student, I found him to possess a veritable passion for study, a desire to investigate, to question, largely prompted by an inner urge. While he does read in light of what his professor says, nearly always accepting the same view-point, he does go on independently, almost voraciously in his study and in his reading. Even before registration in the universities is completed the libraries are crowded.

We all know too well the poverty of our students with reference to intellectual acquisitiveness, and to making fine and exact discriminations; the paucity of the desire to study and to investigate for self satisfaction. Recently a student was requested to look up the spelling of "Cloisonne'." After writing the word on the board, he was asked to explain it. He immediately replied, "I didn't look that far; you only asked for the spelling." The question is apparent—Why this difference and how can it be removed?

A survey of almost any field of life will soon show that what is most needed is the power, energy, and willingness to think—the open, free, and constantly growing mind. A democracy above all other forms of government needs a thinking citizenry. Our carefully thought-out plans for one decade are out of date and useless almost before the next decade. Only a constantly growing intellect can cope with and keep in rein an ever-changing world. It is not enough to know facts. True thinking is dependent upon insight into the meaning of facts.

Today, in practically every one of our modern school curricula, much attention and emphasis are given to the type of learning known as "Problem Solving." Knowing that outside of the school room we are daily meeting not only large and small problems, but conclusive and inclusive solutions to these problems, our courses of study have endeavored to provide opportunities for the pupil not only to solve his problems individually, but to solve problems thru group discussion also. In recent years, every effort has been made to bring problem solving into the class rooms thruout the grades and into the high schools. Pupils are now given many opportunities to experience those types of problems which come into one's daily life, such as building, dramatic, editorial, aesthetic, problems of organization and personal relationships, as well as problems of expression and morals. Yet when we meet the college student in the class room, he seems to be docile and inclined to look upon much of the work as a task, the performance of which is a favor to the professor. "I have to get that for her. Yes, we have to get 75 specimens for him," and other similar statements are frequently heard on the college campus. Many of our college students fail to have the point of view which says that the student himself must bear his share of responsibility for what is, first, last and all the time his own education and his alone.

The use that the college student makes of that all-important document the "term paper" or the "notebook" further illustrates that many students have rather a perverted notion concerning the meaning of education. Students frequently have reported that it is not at all an uncommon practice for notebooks and term papers to be sold, rented, loaned, and stolen. Much of the reference work required consists of merely rewriting the titles of the chapters, the marginal references and a few notes taken from here and there. Teaching more than the regulated numbers of hours and having large classes, many times results in the acceptance of such work.

Because the professor is enthusiastic for his subject, he thinks, of course, his students are equally interested.

Much of our college work is given in the form of lectures. There are those of us who feel that we can teach 75 as well as 25. Some administrators advocate such classes because it is economical. If it is true that the "lecture system is that mysterious method whereby the notes of the professor's notebook get into the student's notebook without passing thru the heads of either," it could hardly be said to be economical, especially if one is cognizant of the time, paper, and ink consumed and of the resulting habits formed by the students.

In considering how best to arouse the student out of his lethargy, one wonders if we have not all contributed to this apathy, by emphasizing knowing or memorizing rather than thinking and doing. Have we not frequently been like the missionary who gave his class the text": Whatsoever ye would that men should do to you, do ye even so to them." He dismissed his class, telling them that when they had learned this text, they should return and he would give them another. One pupil did not return. When the missionary met him, he asked, "Why have you been absent? Have you not learned the text?" The pupil politely replied, "No." The missionary thereupon started to repeat the words. The pupil interrupted, "Oh, me can say it, but me can't do it yet."

On January 9, Dean George Arps of Ohio State University, strongly advocated that the "college parrot" must be eliminated; that the student with nothing but retentive memory must be taught how "to think." This was the challenge which Dean Arps made to the college teachers. The "college parrot," said Dean Arps, "has generally normal habits and appearance, but is possessed of a propensity for memory work that would rival his elders in the old McGuffey reader days. Many students acquire degrees without ever having responded originally to a simple fact; that is to say they have done no thinking in any real sense of the word."

Dean Arps does not blame the student. The necessity, under the present educational system, of covering certain courses, learning the prescribed subject, and getting a good grade, obstructs them, says Dean Arps, from original reading and thinking. He believes the panacea for arousing the college student from his lethargy is to have courses in which the interpretation of facts is stressed, not mere mechanical mastery of them—in brief, thinking rather than slavish memorizing. Dean Arps believes that the teacher who guides students in their interpretation of subject matter is vastly more important than a whole curriculum of courses in which each student must enroll, master the subject matter, and strive to make good grades. I believe that we agree with Dean Arps when he says, "Subject matter is not inherently possessed of any civic, moral or any other kind of virtue or value. Values are only acquired thru meaningful interpretation." He who reads and reads and *does* not, is like he who plows and plows and sows not.

Everywhere today we hear—"Think for yourselves." Bishop Abbott, of the Lexington Diocese, in addressing a graduating class last August, admonished the students to think. He said, "Think, think for yourself. Go apart by yourself to think. Think to some purpose. And even see to it that you approach the highest themes, the Past, the Present, and the Future. Your true success will depend upon your ability to think and to think straight. Let no man or company of men do your thinking for you. We are bi-partite beings, made up of body and the mind, here including the will and conscience as well as the reasoning faculties. The mind is greater than the body, altho in fact we do not make it so. The secret of success is concentration. Our failures and our blunders are largely due to a dissipation of energy."

In the November meeting of the Educational Records Bureau, and the American Council on Education, New York, practically every paper stressed the importance of work habits and study skills, including speed and comprehension in reading. Such emphasis revealed the increasing awareness of administrators and teachers of the importance of and necessity for effective training in study skills at each level of school experience. It is apparent that education should today as never before, prepare for life in a changing world. This necessitates thinking. The phenomena of scientific changes are all about us, while changes in moral attitudes are equally apparent. The principle of self-activity, according to Professor Becker of the University of Boston, requires that the class work should be so shaped as to develop initiative, not by command or order, but it should spring either from his own inclination and native gifts, or from the nature of the specific subject matter.

Research, according to the writer's experience, is one way of developing initiative on the part of the undergraduate college student, and of developing the habit of thinking; one of the ways to eliminate lethargy, to awaken genuine intellectual curiosity, and to cultivate resourcefulness. "Research," according to Schulter, "is the endeavor to discover, to develop, and to verify knowledge. It is directed toward the discovery of problems, toward well defined procedure, toward the finding of facts and toward a careful evaluation and interpretation of the facts which leads to at least a tentative conclusion on the part of the student."

According to Spaeth, "The discovery of truth is a matter of scientific method; and its instruments are intellectual honesty, perseverance, industry, and imagination. Research is an honest, exhaustive, intelligent searching for facts and their meanings on a given problem." Research, science, and thinking, according to Whitney, all refer to the same type of intellectual activity. This consists of the following steps, according to Dewey: (1) Recognizing a problem; (2) Seeing possible solutions; (3) Gathering data in light of the possible solutions; (4) Organizing the data around specific heads; (5) Comparing and weighing values; (6) Reaching a conclusion.

Caldwell says that inquiry is the basis of education; that directed inquiry and investigations which are planned to satisfy inquiry, are characteristics of modern education. Thorndike in his law of readiness states that if the pupil really learns he must possess the driving power of a question to be answered, a situation to be met, a problem to be solved, or a degree of mastery to be attained. The student does his own learning only when he is impelled by some question to be answered. Thus, we shall agree that the elements of inquiry and research are at the foundation of all true education. "Education," says Caldwell, "attempts more than to provide the means of participation in the enjoyment of the benefits of civilized life. It attempts to provide the means by which people may discover and organize new knowledge and develop new procedures for use in new and changing needs." From the writer's experience, research with the undergraduate student makes for productivity rather than receptivity.

One needs to avoid using the word "research" loosely. It can easily become a name, a slogan, a shibboleth. There is ever a need for upholding standards. One must keep in mind fundamental concepts and maintain the essential meanings and methods of scientific research. Odum says, "Tracing the facts and trying to understand them, searching for truth, and mastery of relationships constitute the process of attaining truth, which is the greater objective of science." To do effective research some criterion must be recognized. Caldwell states that an educational investigation must indicate that the data have been collected and studied carefully and systematically; that the conclusion so derived will be the same for another student dealing with the same problem and the same phenomena.

That research is one means of assisting the undergraduate student to emerge from his lethargy is the conclusion the writer reaches after working for two years with approximately 200 students—sophomores, juniors, and seniors. The plan has been worked out with the class in psychology of adolescence. Each group of students has always read rather widely for about ten weeks for the purpose of becoming acquainted with the adolescent from the psychological viewpoint and for the purpose of discovering some personal interest in some one of the phases of adolescent development.

Before reading the references on psychology of adolescence, the students study the meaning of research. The following are some of the authorities consulted: Caldwell, Otis W., "School Experimentation," Teachers College Record, November, 1931, page 127; Dictionary; Kelley, T. L., "Scientific Method"; Menge, Edward, "Jobs for the College Graduate in Science"; Odum, H. W., "An Introduction to Social Research"; Schluter, W. C., "How to Do Research Work"; Whitney, F. L., "Methods in Educational Research".

Usually, following the study of the meaning of research, observations are made in the Demonstration High School, in the Pre-school at Berea College, Berea, Kentucky; at Greendale, Fayette County, and at Henry Clay High School, Lexington, Kentucky. These observations are written up as a psychological interpretation. By this time the students have discovered some personal interest which they wish to investigate. Thru class discussion the following steps are developed:

I—Clear statement of the problem: 1. Limited. 2. Feasible. 3. Worthwhile. a. Study meriting continuation after course; b. Findings adequate for application. 4. Solution not implied.

II—Procedure: 1. Personal inventory—taking stock of personal knowledge concerning problem. 2. Bibliography. 3. Authorities on the problem. 4. Listing other steps to be taken —personal interviews; correspondence; experiments, questionnaires.

III—Findings listed.

IV—Findings interpreted.

V—Conclusions drawn.

Each student writes up his problem according to the above plan and then confers with the teacher. It is indeed fascinating to discover the interests of the student, to assist him in checking his plan, and to see him discover his errors thru a few pertinent questions. The writer wishes you to note that in every instance the problem presented represents the student's personal interest. This assures genuine maximum effort and eliminates the usual saying, "I have to write a term paper for him." It is applying, according to Thorndike, the law of readiness in no uncertain terms. All plans are carefully gone over before they are carried out, thus avoiding the exploitation of the student's time. The following research studies have been made by students taking adolescent psychology. They illustrate the varied interests:

1. To find out what clubs are in the United States for adolescent boys and girls and to see just what they are contributing to the educational, recreational, and moral activities of youth. Thru this investigation, the student met by means of correspondence and literature: Charles H. Hatton, president of Lion's International, Wichita, Kansas; Dr. W. A. Mendenhall, president of Friend's University, Wichita, Kansas; A. G. Crane, president University of Wyoming, Laramie, Wyoming; J. W. Jarrott, principal, Liberty Junior High school, Hutchinson, Kansas; W. J. Hutchins, president of Berea College, Berea, Kentucky; M. A. Kelley, William McKinley High school, New York City. The student met a score of other authorities and received copies of several moral codes for youth as well as copies of constitutions and by-laws.

2. To find out what students in the secondary schools of California and Wisconsin do who do not participate in the competitive athletic activities. The student received complete and detailed information from the State Superintendent of Public Instruction and from the Director of the Division of Health and Physical Education.

3. To find out what criteria are used in judging moving pictures for adolescents and to ascertain what per cent of the moving pictures shown in Richmond, Kentucky, are suitable for the adolescent. This student corresponded with nine authorities representnig New York City, Washington, D. C., Los Angeles, Chicago, Cincinnati, St. Louis. Her interest was so keen that she purchased the book "Children and the Movies" by Alice Miller Mitchell.

4. Has commerce a place in the high-school curriculum? Why? Thru correspondence, the student met the follow-

ing: Kitson, of Columbia University; Newlon, Lincoln School, New York City; Phillips, University of Iowa, Iowa City, Iowa; Freeman, University of Chicago; Johnson, Wharton School of Finance, University of Pennsylvania, Philadelphia; Woellner, University of Chicago.

Other research problems studied were: (1) To find out what the adolescent boy and the adolescent girl in Berea are reading and whether there is a correlation between their reading and the type of picture shows they attend. (2) To see what is the per cent of increase in high-school attendance in Kentucky from the first high school to the present time. (3) To find out how the high-school students in six towns the size of Richmond spend the noon hour. (4) To find out what periodicals are being sold at the news stands in Richmond; who buys them, and if they are suitable for the adolescent boy and girl. (5) To determine the meaning and the function of juvenile court, and the qualifications for a juvenile judge; and what schools offer special courses for juvenile judge.

When the undergraduate student has an opportunity to discover his interests and to do independent thinking, he shows ability and does not lag in energy or in initiative to make the particular study. This type of work is not only stimulating to the student but equally so to the instructor as it develops in him versatility in thinking as well as patience and endurance. The problem and procedure suggested by the student at first will be crude and almost impossible, but with careful questioning the instructor experiences unparalleled joy in assisting the student to discover a genuine interest, to limit his problem and in assisting him to develop a workable procedure.

The following statements were made by students after having completed their various studies. They are given here to show that undergraduate students do react and do appreciate opportunities to discover and to develop their personal interests. (1) "The first independent thinking I have done in college." (2) "A great satisfaction to be making a study of a problem which is of particular interest to me." (3) "A genuine intellectual stimulation." (4) "A relief to be doing something for myself." (5) "A revelation to have discovered a personal interest worthy of investigation." (6) "The first time I have made a study which I wanted to continue. Why don't we have more of this type of work?" (7) "This study has given me the first honest to goodness form of procedure for organized thinking." (8) "A relief to get away from the traditional term paper." (9) "Delighted and astounded in having made contacts with great authorities and great movements." (10) "Amazed at the great amount of information from one source that leads to another."

The writer is convinced that research in the undergraduate college is not only feasible but advisable; that it may transform routine teaching into creative teaching.

25. The Relation of Electrical Resistance to Relaxation and to Mental Work. Martin M. White, University of Kentucky.

26. Does Pragmatism Involve Indeterminism? M. A. Caldwell, University of Louisville. The author's general thesis is that pragmatism does or does not involve indeterminism, according to the definition of pragmatism. By indeterminism is meant a theory of being which maintains that at least some parts of being can not be deduced from the whole, or from other parts. It is a doctrine of novelty, possibility, chance, freedom, the unexplainable, the uncaused. Determinism holds the opposite view—that all events and conditions are deducible from the nature of things. There are different types of pragmatism, and the relation of any given type to indeterminism depends upon its theory of being. One kind of pragmatism holds that truth consists in the verifiability of ideas. Thus an idea is true or false before any one tries to verify it. This implies that there is stable, determinate being, guaranteeing that the idea can be verified or proved false. Hence this type of pragmatism can not logically be indeterministic. On the other hand, that type of pragmatism which asserts that the truth of an idea does not exist until the idea is actually verified, can look upon indeterminism as a doctrine harmonious with but not necessarily following from its theory of truth. In so far as any pragmatist or instrumentalist holds that being does not guarantee verifiability but is subject to change in its ultimate nature, he is to that degree indeterministic.

27. **Mental Causation.** Joseph C. Burk, University of Kentucky.

28. **The Socialization of Science.** E. E. Snoddy, Transylvania College. I have been asked to write a paper in behalf of a closer and more cordial relation between science and social life; between what might be called technical experience and common experience. This I am glad to do since this has been a primary interest for me in a teaching career of over fifty years. This interest has made for me my major task, in season and out, to understand technical experience on the one hand and common experience on the other that I might play the role of a mediator between the two.

Modern science is a unique affair in the whole history of thought. There were approaches to it in the ancient world, but nothing exactly like it. It is the unique and outstanding characteristic of our modern life. As a rule I do not include philosophy under the head of science, but since in recent years my work has been in the field of philosophy, I want to include it in this discussion. So I shall widen the meaning of the term "science" to include technical thought, whether in the field of science or that of philosophy. This I feel I have a right to do for the reason that my point of view in philosophy is just as empirical and experimental as is that of science. My position is that the rise of modern science has made obsolete the traditional philosophy of the ancient world, and therefore our need is great for a philosophy guided in its methods and patterns of thought by modern science, so while I cannot quite call my philosophy a science, I can easily call it scientific. I shall use science as defined by Robinson in his "Humanizing of Knowledge" as follows: "Science, in short, includes all the careful and critical knowledge we have about anything of which we can come to know anything." This will save me from the constant reiteration of the phrase "science and philosophy" to include my whole meaning and thus in a single term to include my own discipline in the discussion. I sincerely trust then that no words that I may use will be taken as a criticism of science by a philosopher or that they are the result of any antipathy toward science, for I do not see how any one could have a more whole hearted appreciation for science than I have. I have never failed to come to the support of science under the fierce attacks made upon it by dogmatic theology and traditional metaphysics in the past, even when my own interests as a teacher were put in jeopardy by so doing. Any scientist could say what I have to say on the subject.

I must now say a word or two about the meaning of the term "socialization". It is not a good word, it is too ambiguous; but it is the best word I can think of to indicate the task in hand. It has much in common with the terms "humanization" and "democratization" as used by Robinson in his excellent book, "The Humanizing of Knowledge". Robinson's book was written when the controversy over evolution was at its height and the book was really written with that controversy in view. But it is clear from the book that, however great is his technical knowledge, his knowledge of the content and processes of the common mind is very meager indeed, so that if the "humanization of knowledge" were left to him it would forever remain in the realm of pure theory. What I have in mind is a leadership installed in the very heart of common experience; with accurate knowledge of both scientific and common experience, and equipped with methods of procedure for getting science understood by the common man. Thru such understanding, science would become real and vital in the common life. This does not involve carrying over to the common man the complex and elaborate technique of science, but it does involve more what is ordinarily spoken of as "the application of science". I hold that of all the needs of the present crisis in our culture, no need is more dire than this!

That there is a wide cleavage between technical knowledge and the common life I suppose all would admit. Some would perhaps view this with indifference, as something that of necessity must be and for which there is no possible relief. Others view it with great apprehension as a hindrance that keeps science from making its desired contribution to human welfare and also as a situation that subjects science to the possibility of severe criticism and the rise of a social movement against it, far more dangerous than has been the theological opposition of the past. The people know very well that science is the chief cause of the revolutionary changes operative in the modern world, and especially in the economic order. As long as the economic order runs well, science is in favor. But when economic disappointment comes as it has in the present crisis, with the breakdown of social ideals and standards, it would not be difficult for the popular mind to pass over to the belief that science is the cause of all its woes, and as a consequence oppose it outright, or at least refuse to give it its appreciation and financial support. I am not sure that signs of such criticism and opposition are wholly absent at the present time. The thing I have in mind and am seeking to express would make such criticism and opposition impossible by implanting in the common mind such an understanding and appreciation of science that it would see in science a way out of the present situation into a larger and richer welfare. That we may get the problem under discussion before us in a better fashion, I propose to call your attention to some criticisms of science by technical scholars themselves rather than by popular leaders.

The first of these, by Read Bain of Miami University, may be found in the current issue of "Social Forces". The criticism is severe and extravagant beyond measure; so severe and extravagant that any value it might have is almost nullified by its very severity and extravagance. The significance of the article here, is in the fact that such an article appears in a periodical of the standing of "Social Forces". It is symptomatic of the present state of mind. Bain's criticism charges the scientist, with notable exceptions, with indifference to social welfare. The scientist confines his task to the purely technical field forgetting that he is a citizen of the state and a member of the social order; and that as a citizen and a member of society, he is under obligation to share actively in all programs for social welfare. It is all the more obligatory upon the scientist because of the revolutionary character of his science and also because of his prestige in the modern world.

"The scientist" says Bain, "is the center of power and vitality in our culture. He is the modern Mighty Magician. He is the prestige-clothed citizen of our time. He is the dynamic agent of our culture, the most powerful single factor in the most rapidly changing culture that ever graced or disgraced our planet. He has opened Pandora's Box. He has released mighty forces that are pulverizing ancient social structures, producing social and personal disorganization." Because of all this, Bain insists that "scientists must not be any the less 'pure' scientists, but they must become the more 'pure' citizens, using their prestige and their knowledge that is power to promote the good life." We can certainly agree with Bain that the man should not get lost in the expert, nor should the expert forget that his laboratory, study, and class room are all in the social world and are supported by society for social ends, without endorsing the severity and extravagances of the article. Now this social orientation of technical knowledge is a part of what I have in mind in my subject, "Socialization of Science". Technical knowledge thus oriented is already moral and social knowledge on the way, and once carried into the common life, common life itself becomes intelligent, morally and socially, masterful in control and enriched in meanings and values. From this point of view, there is not "pure" and "unpure" knowledge, there is the great ocean of life constantly passing its waters thru the narrowed channel of technical criticism and reconstruction and then out again into the great ocean to sweeten and beautify its waters.

I shall next turn to the criticism of science by James Harvey Robinson, found in his book, "The Humanizing of Knowledge". Robinson's contention is that the technical thinker by his technique and by his specialization has "dehumanized" knowledge. By this he means that knowledge by the methods and processes of science becomes rigidly impersonal, mechanistic, divorced from "human impulse and mankind's native interests". In other words it is forgotten that man himself is a factor in his knowledge. It is this feature of science that gives rise so constantly to the criticism that science is mechanistic and that its view of life and the world is wholly mechanistic. To avoid this criticism, Robinson holds that science must be "rehumanized". By this he means that technical knowledge must be reinstated in the larger life within which it moves and which it serves. "This task" he says, "is the supreme problem of our age and no one can hope to do more than to make modest contributions to its solution". All that Robinson means by the "humanization of knowledge," I include in the term "socialization of knowledge". I would hold, however, that knowledge is never a dehumanized affair; is never impersonal and mechanistic in any real sense. The thinker with his interests and purpose is ever present in cognitive processes. Knowledge is always humanly oriented. So altho the discovery of mechanisms in nature and human nature may be the aim of science, a perfectly legitimate aim, too, and altho science employs mechanisms constantly in its thought, the total thinking process is never impersonal and mechanistic. But my contention goes further. Because people are human, science, if humanly oriented, can be understood by the people, be evaluated by them, it can enter into the very tissue of their lives, and thus become a source of the highest social welfare. Robinson does not get much beyond technical thinkers, college teachers, and college students in his book.

John Dewey's criticism of science I shall next consider. His criticism of science is far more subtle, far more profound, and much more far-reaching than either of those already considered. His assumption is that the modern scientific movement is a unique affair in the history of human thought, and on this account our civilization, generated by it more than by any other single force, is also a unique affair in the history of civilizations. The primary task, therefore, in understanding our civilization is the understanding of the nature, method, significance and value of science for human life. To these ends it may be said that Dewey has devoted his energies as one of the world's outstanding thinkers. It is to this thinker, more than to any other, that I am indebted for the ideal I am seeking to express in this paper. The phrase "socialization of science" puts roughly what I take to be the ideal of Dewey.

Dewey's criticism of science may be found on almost any page of his writings, but it is stated in great clarity in his "Reconstruction of Philosophy", written over twenty years ago. In commenting upon the failure of science to realize in full the idealistic predictions made for it by Francis Bacon, Dewey says, "Up to the present the application of the newer methods and results of science has influenced the means of life rather than the ends; or better put, that human aims have so far been affected in an accidental rather than in an intelligently directed way, signifies that so far the change (wrought by science) has been technical rather than human and moral, that it has been economic rather than adequately social. Put in the language of Bacon, this means that "while we have been reasonably successful in obtaining command of nature by means of science, our science is not yet such that this command is systematically and preeminently applied to the relief of human estate; such applications occur and in great numbers, but they are incidental, sporadic, and external." Put in a less involved way this means:

1. That science is an historical movement, socially oriented from the beginning.

2. That its first achievement was control over nature secured by the methods of physical science.

3. That with the possibilities created and made available by physical science it enters upon its social stage.

4. The social stage is yet incomplete.

The task here is by intelligently directed methods to humanize, moralize, and socialize the aims and values of human life, or as Bacon puts it the "relief of human estate". Science, of course, from the very beginning, has had revolutionary consequences for society, but the task of science is not complete until it brings under intelligent control for human welfare, the consequences themselves which it has generated. The task of doing this is what I mean by the socialization of science. Because science has consequences so revolutionary, and furthermore, because science is a continuous movement, every scientist ought to share in bringing the consequences which issue from science under control for human welfare. Dewey's criticism of science is that it has not yet completed its own movement. At best it can be said that it is just entering upon its social stage. It suffers from "arrested development". And this for two reasons: It has been constantly hindered by traditional metaphysical conceptions that are alien to our modern world. They belong in origin to a pre-scientific age and have been made obsolete by the rise of modern science—yet they have persisted, and by their persistence greatly hampered the progress of science, not only in the common mind but in the mind of the scientist himself. The second cause, according to Dewey for this "arrested development" is found in the fact that science allowed itself to get too intimately tied up with the rapidly developing capitalistic system. It suffered over-commercialization. Profit was accepted as its end rather than the transformation of social ends. Its task is now to extricate itself from its present predicament and rededicate itself to the completion of its own inherent movement.

Thus far I have spoken of Dewey's conception of science. Now for a word about his conception of philosophy. Philosophy ought to be socially oriented just as science; it is an empirical, human, moral and social discipline, and therefore should work in the most cordial cooperation with science. But the fact is, it has been far from this. It can be said that the aim of the pragmatic movement in philosophy has been from the beginning the socialization of philosophy. In this movement, as you well know, James and Dewey are the outstanding leaders. The human character of philosophy is beautifully stated by Dewey in the following language from his "Reconstruction of Philosophy": "Philosophy recovers itself when it ceases to be a device for dealing with the problems of philosophers and becomes a method cultivated by philosophers for dealing with the problems of men." For Dewey, philosophy in the origin of its problems, in the method and processes of its thought, and in its ends is social and has reference to social welfare. For Dewey, the philosopher even more than the scientist must install himself in the thick of common life, which includes both the scientist and philosopher as members of society, as well as the common man, and thus installed, by his methods and technique in cooperation with the people to so assist them in the interpretation of life that all the energies of life, emotional as well as intellectual, shall be released for human welfare.

All the criticisms considered have a common basis in the present cleavages between technical experience and common experience, between the expert and the common man. This cleavage is fraught with tragic results. Because of it science comes to the common man as something external and alien. He thinks of science as having its habitat on some college campus, in some laboratory, or in the experiment station, whereas he ought to think of it as something operative on his farm, in his home, in his community life, enlarging and enriching all the values of life. But he can never do this until his feeling that science is something external to him is removed.

A second result of the cleavage is a lack of appreciation for science on the part of the people. They appreciate the products of science to be sure, but they can have no internal appreciation for science as long as it is external to them. They are like the boy who looks upon his father as a source of spending money but who has no appreciation of his father for his own sake. Appreciation of science for its own sake can only arise when science is understood, when its meaning and value become interior to experience and as such is desired for its own inherent meaning and value.

A third result of the cleavage under discussion is the mass mind so much in evidence in the present crisis. If the critical mind of science had become interior to the popular mind during the progress of science in recent generations, the popular mind would now find itself in possession of standards of criticism, points of view, methods of thought by means of which it could hold itself under control in the presence of the urgent problems of our social order. Instead of a critical mind, we have created a reactive mind open to manipulation by whoever has control of the stimulus. This has come about thru the unconscious demand of our machine age. The industrialist desired workers who react readily and accurately to the stimuli of the factory, the business manager the same in his office, the salesman the same in his store, and so on in all spheres of modern life. We have provided the leaders of our machine age with just the type of mind desired.

Two secondary bad results are apparent. First, the popular mind is wide open to propaganda of all sorts. Second, the popular mind is just as wide open to economic exploitation.

Science can never come to its own until the critical mind of science is carried over into the common mind and, by so doing, the common mind is provided with standards of criticism so noticeable by their absence in the common mind at present.

A final result is far more serious than any mentioned for education just now. Because we in our educational program have not removed the cleavage under discussion—and therefore have left our science as something external to the common mind and so without grounds for appreciation and critical control, we as educators find ourselves at the mercy of a mass mind, whipped into a sort of emotional hysteria over the matter of economy, ready to deny adequate financial support to educational institutions. If the thing I am contending for in this paper were achieved, even in a reasonable degree, the present tragic situation would never have arisen. Our educational institutions would be so imbedded in the intelligent appreciation of the people that whatever reductions might be made for other institutions, none would be made for education.

Perhaps an illustration will serve to clarify my meaning. In 1900, under the direction of Theodore Roosevelt, a commission of army surgeons and privates went to Cuba for the purpose of discovering the carrier of the yellow fever germ. This they achieved altho at a great cost of life on the part both of surgeons and privates. With the discovery of the carrier of the yellow fever germs, a certain kind of mosquito, the task of causal science was complete. It made yellow fever preventable, but it did not yet prevent it. The task then passed over to social science to discover and formulate those ends or conditions which, if they were made facts in the social order, yellow fever would be actually prevented. These ends and conditions were found in screened porches, windows, and rain barrels, in the drainage of stagnant pools of water, in the pouring of kerosene over those that could not be drained, in proper removal of sewage and garbage. This task social science actually succeeded in doing. The next step in the movement was the organization of a program under the leadership of the social engineers for the attainment of the actual social conditions made possible by physical science and envisaged by the social scientist. This involved the cooperation of community, municipal, state and even Federal governments. But just here a new set of obstacles is encountered, found in the popular mind and here and there in the mind of the expert himself. These obstacles are conceptions of life that are obsolete in the presence of such a task and therefore hinder rather than help in the program. Examples of such are the conception that disease may be dealt with by magical means, a relic of animism, the conception that all events in life are fated, that whatever is to be will be, therefore why bother ourselves with the futile attempt to change affairs for the better, a relic of the pre-scientific period of history; the conception that the individual is the final unit, therefore, the matter must be left with individuals for individual action; the conception that religion is a matter of the supernatural world and therefore is not to be invoked for help in any such earthly enterprise as that of saving society from the ravages of yellow fever; and among technical thinkers, the conception that science is purely a technical matter and therefore the scientist is under no obligation for making his science actually operative in social life. Here as I see it the philosopher comes on the scene. It is his specialized task, equipped with training and methods for the task, and in cooperation with all, to remove these obstructing conceptions and replace them by more relevant and accurate ones and by so doing release the latent energy and idealism of human life needed to carry the program to successful issue. The movement is one and continuous from its conception in the mind of Theodore Roosevelt to its completion with the removal of yellow fever from the social order.

Take the problem of war as another example. The first task is the discovery of its causes, the task of causal science whether physical or social. The next step is the formulation of the conditions which, were they made a fact in our social order would not only make war preventable, but would actually prevent it. Then comes the work of social engineering, organizing the social machinery of the world for the achievement of the conditions envisaged by social science. Last the task of philosophy for the removal of obstructing conceptions and then replacement by conceptions relevant and helpful to the peace program. The final stage is the achievement of the program in the actual reorganization and reconstruction of the social experience of mankind issuing in a warless world.

The same program would hold with the problem of our current economic depression; in fact, with any problem in the social order. It is some such task as this that I have in mind under the heading, the socialization of science.

"A beautiful dream" you say, "but impossible of realization." I contend that it is possible.

1. It is already an accomplished fact in great areas of human life and it is already on the way to further achieve-

ment. We are not at the end of the world, an incalculable future lies before us for further achievement.

2. Science is democratic in origin and aim by virtue of the conditions of its origin. It was at first the matter-of-fact knowledge gained by primitive man in his attempt to cope with the actual conditions upon which his life depended. It operated in the building of fires, capture of animals, domestication of plants and animals, the making of tools, etc. Modern science isolated the method of this crude, unconscious science, specialized, refined and elaborated it until it has made out of it the most effective instrument of control ever known in the history of man. Science, therefore, is not something wholly foreign to common life. "It is common sense with the nonsense knocked out of it" in the words of Read Bain. Huxley, in his day, spoke of science in a similar fashion. This matter-of-fact knowledge got identified in course of time with the artisan, the tool user in Athens, for example, where both the artisan and his tools were held in contempt by the aristocratic Athenians. Under such conditions, science in its modern sense could not arise; for a scientist is a tool user and without tools the thinker could not be a scientist. The rise of modern science means the rise of the common man to recognition and participation in the social order; in short it spells democracy. Thus, to make science an aristocratic affair and to keep it from the people would be to contradict the very conditions of its origin. Science, to be true to itself, can and must be made intelligible to the people. Philosophy has the same kind of origin. It is found in primitive life as a knowledge of values without which the primitive man could not live. This kind of knowledge, isolated and specialized in Athens, for example, got wholly into the hands of the rulers and was used for aristocratic control of the people. Our task now is to democratize philosophy and make of it an instrument of social control for all the people. This, too, as with science, can and must be done. With these tasks unachieved democracy is a futile vision.

3. Finally, the socialization of expert knowledge is pos-

sible because the expert, as a man and a member of society, finds himself in an order of life common to himself and to the common man. They are companions in a common life. On the basis of an experience common to both, the expert can get himself understood by his non-expert fellow. And for interests common to both, this can and must be done.*

The question may arise in your minds: What about morality, art and religion? If it has, you are still a victim of the cleavage that I am laboring to remove. Whenever we speak of science and morality, science and art, science and religion, science is thought of as isolated from moral, artistic, and religious life. Science socially oriented is thru and thru moral, religious and aesthetic. Science is morality, art and religion intelligently lived; in fact, it is every *positive value* of life brought under intelligent control for the highest human welfare. No value is left out that can make a contribution to this end.

Such is the vision in my mind, howsoever imperfectly expressed. If it were realized, it would bring to our world a happiness and welfare unknown in any period of the world's history.

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* "It is not necessary that the many should have the knowledge and skill to carry on needed scientific investigations; what is required is that they have the ability to judge of the bearing of the knowledge supplied by others, upon common concerns." Dewey, "The Public and Its Problems," p. 209.

MINUTES OF THE 1934 MEETING

The 21st annual meeting of the Kentucky Academy of Science was called to order by President Bangson at 2:30 P. M. on May 18, 1934, in the auditorium of the Woods-Penniman building of Berea College. Dr. Bangson presented a gavel to the Academy from a friend who desired to remain anonymous. This friend states that the material of the gavel has no historical significance, so far as he knows, but he hopes that much of importance to the progress of science in Kentucky may be associated with this gavel as the years pass.

President W. J. Hutchins welcomed the Academy to Berea College. Prof. W. S. Anderson responded in behalf of the Academy.

President Bangson delivered his address: "Some Implications that Genetics Suggests for the Problem of Organic Evolution."

Prof. W. R. Sebastian read an address by Prof. Gilligan in memory of Dr. Cloyd N. McAllister, past president of the Academy, after which a committee composed of Messrs. Miner, Hendricks and Billings presented memorial resolutions, which were adopted unanimously and ordered spread upon the minutes.

Secretary Peter read his report, which was approved. The report showed 92 members paid, 36 in arrears for one year's dues, and 59 in arrears for two years or more, besides 16 honorary, and 21 corresponding members.

Treasurer Anderson read his report which showed a balance of $203.87 in the treasury, and 3 shares of stock of the Lexington Building and Loan Association of $25.00 each, to protect 3 life memberships. The auditing committee, Messrs. McHargue, Karraker and Nicholls, reported that they had examined the accounts and found them correct.

The reports of the Council, the Publications Committee, and the Auditing Committee were read and approved.

The proposed amendments to the constitution were adopted unanimously as follows:

ARTICLE III—Delete the sentence which reads: The amount of 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.

ARTICLE V—EXECUTIVE COMMITTEE. The Executive Committee shall consist of the President, Vice-President, Secretary, Treasurer, President of the preceding year, and the chairman of the committee on Junior Academy. The Executive Committee shall direct the affairs of the Academy during the intervals between the regular meetings, except those duties assigned to the Council, and shall fill all vacancies occurring during such intervals.

ARTICLE VI—AFFILIATION OF SCIENTIFIC ORGANIZATIONS. Any scientific organization in the state, in a field of science recognized by the American Association for the Advancement of Science, may affiliate with the Kentucky Academy of Science upon application approved by the Executive Committee and a three-fourths vote of the active membership voting at a regular meeting of the Academy.

ARTICLE VII—COUNCIL. The Council shall consist of the Executive Committee and one member elected from each affiliated organization. The duties of the Council shall be (1) to pass upon all matters pertaining to the relation of the affiliated organizations to the Academy; (2) to serve on the program committee for the annual meeting, and (3) to promote the interests of the Academy.

Change numbers of Articles VI, VII, VIII, IX, to VIII, IX, X, XI, respectively.

No. V of the by-laws to read: The initiation fee for active members shall be one dollar, except that any member of an affiliated organizaton may join without payment of an initiation fee. Annual dues of local and national members shall be one dollar. Life membership shall be twenty dollars.

No. XI to read: The program committee shall consist of the Council, and the secretary of each division other than an affiliated organization.

XII—An affiliated organization shall hold a meeting in conjunction with the annual meeting of the Academy and shall present a program, either alone or in connection with an affiliated organization in a related field of science.

XIII—A member of an affiliated organization who presents a paper at the meeting of his organization with the Academy shall have the same rights of publication in the proceedings of the Academy as any other member of the Academy. A member of an affiliated organization who is not a member of the Academy shall have the same rights of publication as a member of the Academy by paying the cost of publication.

The report of the Membership Committee was adopted, and the following persons were unanimously elected members of the Academy:

Brasher C. Bacon, Madisonville, Ky., President of the Ky. Ornithological Society.
Minor Edward Clark, Eastern State Teachers College, Richmond.
Forrest F. Cleveland, Univ. of Ky.
Miss Frances Foley, Eastern State Teachers College, Richmond.
Miss Ruby Hamon, Berea College, (senior student)
J. Wesley Hatcher, Berea College, Prof. Social Science.
W. R. Hutcherson, Berea College, Prof. Mathematics, Pres. of Ky. Section of the Amer. Math. Assoc.
Fain W. King, Wickliffe, Ky.
Jack C. Miller, Berea College.
Ruby Payne, M. D., Berea College, Assoc. College Physician.
Charles S. Price, Berea College.
Beecher Scutchfield, Berea College (Senior)
W. R. Sebastian, Bellevue, Ky.
Warren James Souder, Berea, Ky. (Senior)
H. P. Sturdivant, Union College, Ky.

The following were elected by the Council:

Raymond M. Cable, Berea College.
R. K. Calfee, Lexington, Experiment Station.
Leon W. Cohen, Lexington, Univ. of Ky., Math. Dept.
W. G. Ross, Berea College, Prof. of Bible and Philos.
W. R. Roy, Lexington, Experiment Station.
David W. Young, Lexington, Experiment Station.

Dr. Thomas Hunt Morgan was unanimously elected honorary member, from corresponding member.

The following amendments to the constitution were proposed for action at the next annual meeting:

Add to the first paragraph of Article III, the words: Emeritus Members, Fellows, and Emeritus Fellows, and insert after the fourth paragraph the following:

Fellows shall be persons who have been active members for five or more years, who are actively engaged in scientific work. Their privileges and duties shall be the same as those of active members.

Emeritus Members and Emeritus Fellows shall be members or Fellows, respectively, who have retired from active service, and who petition the Executive Committee for this change in classification. They shall enjoy all privileges of membership except holding office, and shall be released from the payment of dues.

Change the last paragraph of Article III to read: For election to any class of membership the candidate must have been nominated in writing by three members, one of whom knows the applicant personally, and receive a three-fourths vote of the members of the Academy present at any session, or a unanimous vote of the members of the Executive Committee, present or voting by letter.

Change Article VI by eliminating the Membership Committee or defining its duties.

The report of the committee on affiliation of scientific organizations was adopted. Their recommendations are embodied in the amendments to the constitution and by-laws.

The report of Dr. J. S. McHargue on the suggestion of Mr. Elmer G. Sulzer as to Academy radiocasts was approved, and the proposal of Mr. Sulzer to arrange three Academy radiocasts from the University studio of WHAS was accepted.

The report of the representative of the Academy on the Council of the A. A. A. S. was read and approved.

The report of the Committee on Junior Academy was read and approved. Ten science clubs with 310 members, compose the Junior Academy.

At 5 o'clock the session adjourned to attend a delightful tea at the home of President Hutchins of Berea College.

The Academy reconvened at 7:30 P. M. in the auditorium of the Woods-Penniman building, President Bangson presiding.

After music by the Girls' Glee Club of Berea College, Dr. Capps introduced Dr. Edward Mack, Jr., of Ohio State University, representative of the A. A. A. S., who delivered an address on "The Shape and Size of Molecules."

The Academy reconvened Saturday morning, May 19, at 9 o'clock in room 441, Science Hall, President Bangson in the Chair.

The report of the resolutions committee was read and adopted.

The report of the nominating committee was adopted and the following officers were elected unanimously:

President, A. M. Peter.

Vice-President, J. S. McHargue.

Secretary, A. R. Middleton.

Treasurer, W. S. Anderson.

Representative in the Council of the A. A. A. S., A. R. Middleton.

The Secretary reported that the following organizations had voted to affiliate with the Academy. Their affiliation was approved.

The Kentucky Psychological Association.

The Kentucky Academy of Social Science.

The Kentucky Section of the Mathematical Association of America.

The Kentucky Chapter of the American Association of Physics Teachers.

The Lexington Section of the American Chemical Society.

The Academy adjourned *sine die.*

A. M. PETER, Secretary.

COMMITTEES FOR THE 21ST ANNUAL MEETING,

Affiliation of Scientific Organizations: Payne, Noll, Roberts.

Auditing: McHargue, Karraker, Nicholls.

Junior Academy: Schnieb, V. F. Payne, Middleton, Starnes, Sebastian.

Legislation: Wilson, Beckner, Buckner.

Membership: Allen, Capps, Hinton.

Nominations: Burroughs, Middleton, Beckner.

Program: Bangson, Peter, J. Holmes Martin, Warburton, Cuff.

Publications: Bangson, Miner, Peter.

Radiocasts: McHargue.

Resolutions: Wurtz, Leggett, Pierce.

Resolutions on Dr. McAllister: Miner, Hendricks, Billings.

MEMORIAL TO DR. CLOYD NORTH McALLISTER

Leo F. Gilligan

"To live in hearts we leave behind is not to die." Dr. Cloyd North McAllister, erstwhile active member and one of the leading spirits of this organization, lived and still lives. The honors conferred upon him as a scholar during his life pale into insignificance when compared with the magnitude his memory has assumed in the few months since his passing. He trod the boulder-strewn pathway of the scientist. Realizing relatively little in material gains he knew the sublime satisfaction of witnessing the results of his own creative efforts and he must have derived great pleasure from the high esteem in which he was held by his colleagues and thousands of students with whom he came in contact.

It is fitting that on an occasion like this a more or less detailed account of his achievements be given. At Yale he was Assistant in Psychology during the years 1900 and 1902. He was Instructor in Psychology from 1902 to 1906. He was elected to Sigma Xi in 1900. He received his Bachelor's Degree from Yale in 1892 and his Doctor's from the same institution in 1900. In his undergraduate days he was a member of the Phi Gamma Delta fraternity. He was a Fellow of the American Association for the Advancement of Science, and a member of the American Psychological Association and of Pi Gamma Mu. These distinctions represent tributes paid to him by his colleagues and others with whom he was associated. They do not begin, however, to measure the real magnitude of the man. Fellowships in honorary organizations, keys which represent distinction in certain fields, degrees conferred by institutions, give little indication of some of the fundamental qualities that go to make up greatness. One thing that Dr. McAllister possessed is indispensable in both the business and professional world. He had courage both physical and mental. In general in the history of the world that combination has been relatively rare. Today the philosopher thinks, and though he in his humble study may be startled even to the point of terror by the gnawing of a rat, tomorrow the man of action may take the thought of the philosopher and revolutionize a social order. In general it has been assumed by the people at large that intellectual or thinking people are essentially dreamers. It is highly probable, however, that with the years will come the dissipation of this erroneous idea. Dr. McAllister was a type of individual whom, in my judgment, the professional world should consider highly desirable. He had convictions and he had the courage to fight for those convictions when opposition loomed on the horizon. He had sympathy and yet he was not inordinately sentimental. Tho a scholar of the highest order, as an associate of his for a number of years I found the most important of his traits to be those not ordinarily classed as intellectual. Psychologists know that the emotional side of human nature has scarcely been scratched by research. They know, also, that the future of Psychology lies in the plumbing of the depths of human emotions. He never became old but the struggles of his early days did much to disillusion him and to give him a comparatively true perspective of life.

It is not necessary for this record to recount all the services rendered by him to his fellow men. Those things are written where even time cannot erase them. But it is appropriate that on the records of the Academy there be placed some kind of memorial tribute so that those who follow may be inspired by the memory of a man who was not only a scholar but a man of courage and determination. It is, however, impossible for me to close any statement about Dr. McAllister without the statement embodying the philosophy that he drilled into his colleagues as well as his students:

"For when the Great Scorer writes against your name—
He writes not that you won or lost but HOW YOU PLAYED THE GAME."

DEAN CLOYD N. McALLISTER

RESOLUTION

With keen regret and genuine sorrow the Kentucky Academy of Science desires to record the loss which the Academy, the several other learned societies of which he was a member, and the educational forces of the state have sustained thru the death in October, 1933, of Dean Cloyd N. McAllister, former dean of the Berea College Normal School, and for several years before his death Head of the Department of Psychology in Berea College.

Thru recognized leadership and on account of his pioneer work in Teacher Training, he merited and attained the confidence of his fellow educators in Kentucky and in the Southern Appalachian region. In evidence of the loss thus sustained, be it resolved that this notice of his death be incorporated in the minutes of the Academy of which he was a valued member, and copies transmitted to Mrs. McAllister and to Berea College.

Committee

J. B. MINER, Chairman
T. A. HENDRICKS
M. L. BILLINGS

REPORT OF THE COUNCIL

Besides transaction of business and election of members by correspondence, the Council has held three meetings, at which the following items were approved:

1. An allowance to the Committee on Junior Academy, from the treasury, of $25. for travel and working expense, and $20. for awards.

2. Plans to hold the annual meeting at Berea College on Friday and Saturday, May 18 and 19, 1934.

3. Amendments to the constitution, to be submitted for consideration at the Berea meeting. The amendments are intended to make annual dues for active members one dollar and provide for the affiliation of scientific organizations with the Academy. They are submitted herewith, for your consideration.

The Council discussed the following items and decided to refer them to the Academy meeting:

4. A suggestion from Prof. Sulzer in regard to broadcasting by the Academy.

5. An invitation from the Board of Commerce for the Academy to hold its 1935 meeting in Lexington, with the offer of cooperation.

The letters relative to these proposals are submitted herewith for your consideration.

A. M. PETER, Secretary.

SECRETARY'S REPORT

Of the 21 persons elected to membership at the last meeting, 17 qualified and have been added to the roll, viz.:

Brown, Ada L., Gee, Ky.
Brown, Leland A., Transylvania College.
Combs, Samuel J., Bridge St., Hazard.
Dodson, Norman, Berea College.
Hall, Edmund K., Medical School of the University of Louisville.
Hatcher, Emerson R., Berea College.
Hayes, Isaac, Dante, Va.
Howe, Mrs. Iva Faye Egner, Rockholds.
Hunt, Wm. Howard, Methodist Hospital, Pikeville.
Johnston, Henry P., Berea College.
Jones, L. Frederick, Picadome School, Lexington.
Lampkin, Martha, Berea College.
McAllister, Maude E., Culberson, N. C.
Mercer, Forest, City High School, Anchorage.
Sulzer, Elmer G., University of Kentucky.
Taylor, Armor P., Cold Spring, Ky (Rose Ave., Linet Place)
Wells, Thelma, Richmond.

Others who were elected but have not qualified are:

Gaines, W. H., Berea
Hamilton, Sarah, Berea College
Kelley, Luther, Berea College
McMillan, Bowles, Berea College

Dr. Snoddy's membership was changed from active to Honorary.

Those who have been elected by the Council since last meeting and qualified are:

Carr, Katherine, Morehead Teachers College. (Came in thru A. A. A. S.)
King, Fain W., Wickliffe.
Sebastian, W. R., 214 Berry Ave., Bellevue.
Souder, Warren James, Berea College.

Two members were lost thru death since the last meeting, viz.: Dr. Cloyd N. McAllister, Berea College; and Mr. Jos. S. Boggs, Frankfort.

Fourteen have been dropped for various reasons, viz.:

Morris Flexner	Ezra Gillis	Mrs. Chas. A. Keith
O. T. Koppius	John R. Lynch	W. D. Nicholls
H. G. Shoemaker	Geo. D. Smith	Gordon Wilson
Miss Effie King	Dixie Pelluet	Alfred Wolfson

Mrs. Marcelle Wolfson; and Dr. Walter H. Bucher, corresponding member.

Number of members at time of last meeting	219
Added since then	21
	240
Lost since then	16
	224

The total membership is now 224, including 89 national and 98 local members, making 187 active members, besides 21 corresponding members and 16 honorary members.

Active members in good standing, including 2 life members	92
Active members in arrears 1 year	36
Active members in arrears 2 years	31
Active members in arrears more than 2 years	28
Corresponding members	21
Honorary members	16
	224

On account of present conditions we have not dropped those members who are two or more years in arrears, hoping that as times improve they may be able to continue. We will have to drop about 28 after this meeting, unless something is done about it. Perhaps some provision to make it easier for them to keep their memberships, can be made at this meeting.

Eight Junior organizations have joined the Academy:

Bellevue Academy of Science, Bellevue, 40 members.
Burbank Science Club, of White Hall High School, 16 members
Waco Science Club, Waco, 18 members.
Paint Lick Science Club, Paint Lick, 5 members.

Kirksville Junior Science Club, Kirksville, 12 members.
St. Catherine Chemistry Club, Lexington, 19 members.
Pasdella Science Club, of Speedwell High School, 16 members.
Science Society of Anchorage High School, 25 members.
Total, 151 members.

Letters of encouragement were written to the officers of the Junior organizations.

Volume 5 of the Transactions was published and distributed to all members, all Academies of Science, and a mailing list including the library of the State University in each state and a number of the most important libraries in this country and Canada and some foreign countries, making 400 copies distributed of an edition of 500.

An outline history of our Academy was prepared and sent to Dr. S. W. Bilsing, Secretary Academy Conference, A. A. A. S., at College Station, Texas, who is getting up a directory of Academies of Science.

Notice of the proposed amendments to the constitution and by-laws was sent to all members.

The following scientific organizations have voted to affiliate with the Kentucky Academy of Science (so far as the Secretary is informed at the time of writing), and have been accepted as affiliates.

The Kentucky Psychological Association.
The Kentucky Academy of Social Science.
The Lexington Section of the American Chemical Society.
The Kentucky Section of the Mathematical Association of America.
The Kentucky Chapter of the American Association of Physics Teachers

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REPORT OF COMMITTEE ON AFFILIATION OF STATE SCIENTIFIC ORGANIZATIONS

The members of the committee are unanimously of the opinion that closer co-operation between the various scientific organizations of the State and the Kentucky Academy of Science will react to the advantage of all concerned.

The committee recommends that this co-operation or affiliation involve the following features:

1. The participation of each co-operating scientific organization in the annual meeting of the Academy.

2. The joint planning of the section programs of the Academy.

3. The acceptance of papers for the program from any member of a co-operating organization whether or not that member is also a member of the Academy.

4. The same publication privileges extended to such non-members of the Academy as are given to members upon the payment of the bare cost by the non-member.

5. Academy membership extended to members of co-operating organizations wishing such membership without the payment of the recommended initiation fee of one dollar.

6. The reduction of the annual dues to one dollar.

7. The change of the title of the present "Council" to "Executive Committee" with the same functions.

8. The organization of a "Council" consisting of the members of the "Executive Committee" and one member elected by each section or by each co-operating organization.

9. The duty of the "Council" will be that of ruling or recommending on matters affecting the work of the sections, on problems related to this co-operation or on other appropriate projects.

These recommendations were unanimously made at a meeting held at Transylvania College, Saturday, April 7, 1934. Prof. George Roberts, University of Kentucky; Prof. Waldemar Noll, Berea College; Prof. V. F. Payne, Transylvania College, members of the Affiliation Committee, Prof. J. S. Bangson, Berea College, President of the Academy, and Professors Leon W. Cohen and O. T. Koppius, University of Kentucky, and Dr. J. S. McHargue, Kentucky Agricultural Experiment Station, representing organizations interested in affiliation with the Academy were present.

(Signed) V. F. PAYNE, Chairman
(Attest) GEO. ROBERTS

REPORT OF THE COMMITTEE ON JUNIOR ACADEMY OF SCIENCE, MAY 18, 1934

In accordance with the resolutions adopted by the Kentucky Academy of Science, April 29, 1933, the Committee on Junior Academy submits the following report:

I—Meetings. Six meetings were held with different members of the committee and additional business was transacted by correspondence.

II—Plans for the year. At the first meeting of the Committee, the following plans were made: 1. Each member of the Committee is to be responsible for the organization of science clubs in the high schools in his county and in as many other counties as possible. 2. Each high school science club is to send to Dr. A. M. Peter, Secretary of the Kentucky Academy of Science, ten cents for each member as state dues, which affiliates the club with the Kentucky Academy of Science. These dues must be sent by May 19, 1934. 3. Each science club is to elect two delegates who will represent the club at the May meeting at Berea, and will also bring as many other members as will come. 4. Awards to be given at Berea: (a) For the largest percentage of club membership present. (b) To the club having the best exhibit. (c) For the best discussion, not more than ten minutes, six or eight advisable. The awards will be: Subscription to either National Geographic or Nature Magazine; Bird Charts; Set of Science Reference Books; Set of Pictures. Clubs will be given choice of the awards.

III—Finances. Upon request by the Committee, the Council of the Kentucky Academy of Science made the following allowances: 1. For current expenses, $25; 2. For awards, $20.

IV—Affiliation of Clubs. 1. Communications: 100 personal letters were mailed; 300 form letters were given to various high-school science teachers at the K.E.A. meeting. 2. Personal interviews—Cooperation of A.A.U.W. Eleven high schools in Madison County were visited. The following schools organized science clubs and affiliated with the Kentucky Junior Academy of Science with the membership indicated: Berea, 144; Kirksville, 12; Miller School, Valley View, 15; Speedwell, 16; Waco, 18; Whitehall, 16; Madison County, six clubs, total 221; Bellevue, Campbell County, 40; Total affiliation from personal interviews, 261. 3. Correspondence. The following science clubs were organized and affiliated by correspondence with the membership indicated: Anchorage, Jefferson County, 25; Paint Lick, Garrard County, 5; St. Catherine, Lexington, 19; Total, 49. Total affiliation, 310. Teachers in the Shawnee High School, Louisville, and the Picadome High School, Fayette County, requested the privilege of attending the meeting as guests. The requests were granted.

V—Arrangement of program. Berea Meeting. 1. Requested use of Woods-Penniman building with necessary equipment. 2. Arranged for science clubs of Berea Academy to be responsible for music, exhibit attendants, and stenographer. 3. Secured the guest speaker, Mr. James Speed, Louisville. 4. Selected the awards. 5. Assisted the president in making plans for the meeting. 6. Arranged for special rates for room and board for Junior members. 7. Appointed judges for awards.

VI—Constitution and By-Laws. Drew up the following constitution and by-laws for the Kentucky Junior Academy of Science.

It is the opinion of those who have directed the work this year that if the State Academy will continue to support the movement for two or three years, the Kentucky Junior Academy will become self-supporting, and that the Academy itself may look with pride to the maintaining of its leadership in the movement of this vital means of passing to the next generation the values which science has to offer.

It is not intended that the Junior section shall be a parasite upon the Senior organization, even tho the Senior Academy has vouched for us to date. We believe that we will be a better and stronger organization if we work out our own financial problems and look to the Senior Academy for scientific inspiration. We do, however, need assistance now, at the beginning, until we have a well-established organization.

In behalf of the Committee the Chairman wishes to express her appreciation for the support given the Committee by the Council of the Kentucky Academy of Science by granting the financial allowance.

Respectfully submitted,

ANNA A. SCHNIEB, Chairman
W. R. SEBASTIAN
W. GAYLE STARNES
V. F. PAYNE
A. R. MIDDLETON

CONSTITUTION AND BY-LAWS OF THE KENTUCKY JUNIOR ACADEMY OF SCIENCE

Constitution

Article I—Name. This organization shall be known as the Kentucky Junior Academy of Science and is a section of the Kentucky Academy of Science.

Article II—Object. The object of this organization shall be to create and to foster interest in science thru scientific, moral, and social activities in the high schools of the state.

Article III—Membership. The membership shall consist of the members of the high-school science clubs affiliated with the Kentucky Academy of Science, under the regulations prescribed by the latter society.

Article IV—Delegates. Each club shall elect two delegates, regardless of the size of the club, to attend the annual meeting of the Kentucky Junior Academy. Only the official delegates of the clubs shall vote on matters representing the official business of the organization.

Article V—Officers. The officers of the Kentucky Junior Academy of Science shall be a president, a vice-president, a secretary, and a treasurer. These officers shall be elected by the delegates from the several clubs represented at the regular annual meeting of the organization. They shall not be chosen from the graduating class. The officers shall perform the duties usually pertaining to their respective offices, and shall constitute the Executive Board.

Article VI—Governing Committee. The Governing Committee shall consist of the Committee on Junior Academy of the Kentucky Academy of Science together with the Executive Board of the Kentucky Junior Academy of Science.

Article VII—Bills. No bill against the Kentucky Junior Academy of Science shall be paid without an order endorsed by the President, Secretary and Treasurer of the Kentucky Academy of Science and the chairman of the Governing Committee of the Kentucky Junior Academy of Science.

Article VIII—Meetings. The regular meeting of the Kentucky Junior Academy of Science shall be held at such time and at such place as the Council of the Kentucky Academy of Science may designate. Special meetings may be called by the chairman of the Governing committee, by written notice to the several members of the said committee.

Article IX—Programs. The president of the Kentucky Junior Academy of Science shall appoint a Program Committee consisting of three members who shall work with the chairman of the Governing Committee of the Kentucky Junior Academy of Science. All clubs participating in the annual meeting shall notify the chairman of the Program Committee at least two weeks prior to the meeting.

Article X—Affiliation. Affiliation of the various high-school science clubs with the Kentucky Junior Academy of Science shall be obtained by submitting copies of their constitution and by-laws, and by paying the annual dues to the Kentucky Academy of Science and to the Kentucky Junior Academy of Science.

Article XI—Dues. Dues shall be paid to the Kentucky Academy of Science and to the Kentucky Junior Academy of Science as stated in the by-laws.

Article XII—Amendments. This constitution may be amended by a three-fourths vote of the official delegates present at an annual meeting, subject to ratification of the Council of the Kentucky Academy of Science, provided that notice of the desired change has been sent to the chairman of the Governing Committee and to the secretaries of the various high-school science clubs affiliated with the Kentucky Junior Academy of Science at least ten days before such meeting.

By-Laws

I—The following shall be the regular order of business: 1. Call to order. 2. Reports of officers. 3. Reports of standing committees. 4. Election of members; i.e., recognition of new clubs affiliated with the Academy. 5. Reports of special committees. 6. Appointment of special committees. 7. Unfinished business. 8. New business; roll call of clubs with reports of outstanding activity, made by one of the delegates. 9. Program. 10. Election of officers. 11. Adjournment.

II—Dues must be paid at least four weeks before the annual meeting. There shall be annual state dues of fifteen cents, ten cents of which shall be paid to the Treasurer of the Kentucky Academy of Science, and five cents of which shall be paid to the Treasurer of the Kentucky Junior Academy of Science.

III—The president of the Kentucky Junior Academy of Science shall at each annual meeting appoint a committee of three who shall examine and report in writing upon the account of the treasurer.

IV—The Treasurer of the Kentucky Academy of Science and the Treasurer of the Kentucky Junior Academy of Science shall report to the President of the Kentucky Junior Academy of Science the payment of dues by the various high school science clubs.

V—These by-laws may be suspended by a three-fourths vote of the official delegates present.

MINUTES OF THE FIRST MEETING OF THE KENTUCKY JUNIOR ACADEMY OF SCIENCE

The first meeting of the Kentucky Junior Academy of Science was held Saturday morning, May 19, 1934, at Berea, Kentucky. More than three hundred attended the session. While this was the first official program meeting of the Junior Academy, the work was launched in 1932 by the Council of the Kentucky Academy of Science as one of the two objectives for the year. This Council consisted of the following: President, Dr. Anna A. Schnieb, Richmond; Vice-President, Dr. Charles Hire, Murray; Secretary, Dr. Alfred M. Peter, Lexington; Treasurer, Prof. W. S. Anderson, Lexington; Past President, Dr. V. F. Payne, Lexington.

The president appointed a committee composed of W. Gayle Starnes, Owenton, John Osborne, Clarence, and Dr. V. F. Payne, Transylvania College, to report to the annual meeting all findings concerning the organization of a Junior Academy of Science. With the assistance of the President of the Council, the committee assembled detailed data from various State Academies of Science as well as of Junior Academies, and recommended that the Kentucky Academy of Science sponsor a Junior Academy.

The Senior Academy accepted the report and requested that the committee become a standing committee, and that it continue its work thru the year. Dr. A. R. Middleton, University of Louisville, was added to the committee by the outgoing president, Dr. Anna A. Schnieb. Prof. George Roberts, incoming president for 1933-34, appointed Dr. Anna A. Schnieb to the committee and requested her to serve as chairman.*

Thru the efforts of the committee, consisting largely of personal interviews, forty-six high school students representing science clubs and science classes, attended the meeting of the Kentucky Academy of Science held April 29, 1933, in

* For the resolutions authorizing the organization of the Junior Academy, see the minutes of the 20th annual meeting of the K. A. S. in this volume.

Lexington. The reports of the various delegates were so convincing and of such high quality that the Senior Academy voted unanimously to sponsor a Junior Academy of Science.

The high school delegates retired and elected the following officers: President, Frank Edwards, Waco; Vice-President, Bernice Hoflich, St. Catherine Academy; Secretary-Treasurer, Dorothy Whalen, Henry Clay, Lexington.

The Committee on Junior Academy, thru personal interviews and correspondence, kept in touch with the officers and made contacts with a large number of high schools, as is shown by the report of the Committee given in another section of the Proceedings. The Committee arranged the following program for the May meeting of the Junior Academy, 1934:

1. Call to order, President Edwards; 2. Music, "America," Directed by Professor Ambrose, Berea Academy; 3. Presentation of gavel, Dr. Schnieb; 4. Acceptance of gavel, President Edwards; 5. Roll Call of affiliated clubs. The delegates reported the names of the respective clubs, the number of members and what each had accomplished during the year. The following were represented:

	Members
Anchorage Science Club	25
Bellevue Science Club	40
Berea Academy Science Club	144
Burbank Science Club, White Hall	16
Kirksville Science Club	12
Miller Science Club, Valley View	15
Paint Lick Science Club	5
Pasdella Science Club, Speedwell	16
St. Catherine Science Club, Lexington	19
Waco Science Club	18
Total	310

6. Address, President Edwards; 7. Music, Quartet, Berea Academy; 8. Appointment of committees by President Edwards: Constitution and By-Laws, Nominating, Resolutions; 9. Discussions by members of the Science Clubs; 10. Music,

Violin solo, Berea Academy; 11. Address, "The Two-Eyed Camera," Mr. James Speed; 12. Acknowledgement of address by President Edwards; 13. Report of Committees; 14. Election of officers; 15. Granting awards; 16. Miscellaneous business; 17. Adjournment.

The guest speaker, Mr. James Speed, was both entertaining and instructive. The title of his address caught the audience at once. Thru graphic descriptions and realistic imitative bird calls his audience sensed clearly the meaning of "The Two-Eyed Camera."

The Junior Academy of Science felt very much honored when the following telegram was read by President Edwards:

"I congratulate you on the opportunity of leading the Kentucky Junior Academy thru its first year of concerted action. I am convinced that the organization under your guidance will make science teaching a more dynamic means of adjusting the youth of Kentucky to our increasingly complex social era." (Signed).

LOUIS A. ASTELL, Chairman,
Illinois Junior Academy.

Dr. Astell has offered to include a write-up of the Kentucky Junior Academy of Science in a news letter which is published by the Illinois Junior Academy of Science.

Discussions as well as the exhibits indicated thoro scientific work. The discussions were the following: Boulder Dam, Betty Feland, Speedwell; Butterflies and Moths, Clifford Shotwell, Bellevue; Food Poison, Kelly Kieth, Berea Academy; Fungicides and Insecticides, Robert Henry, Berea Academy; Importance of Chemistry, Rosemary Rothan, St. Catherine Academy.

Clubs having exhibits were: Bellevue—Birds, Butterflies and Moths; Berea—Clay modeling and Biology; Kirksville—Evolution of Transportation, and a Source Book on Birds; Shawnee High School, Louisville—Source Book on Wild Flowers; Speedwell—Fossils; White Hall—Trees.

The following members received awards:

For best exhibit—

Schools having more than one science teacher: Bellevue—Set of four framed pictures. Berea Academy—Honorable mention.

Schools having one science teacher: Speedwell—Set of four Science Reference books. White Hall—Honorable mention.

For best discussion—

Clifford Shotwell, Bellevue, "Butterflies and Moths"—Set of four Science Reference books. Robert Hendren, Berea Academy, "Food Poisons"—Honorable mention.

For largest percentage of club membership present—

St. Catherine Academy, Lexington, 100 per cent, and Speedwell, 100 per cent. Subscription to National Geographic magazine with September issue, 1934, to each.

The awards and current expenses of the Junior Academy were met thru allowances of $25 and $20, respectively, made by the Senior Academy.

The Junior Academy, Saturday, May 19, had 310 paid members. Dues of ten cents per member had been paid to Dr. A. M. Peter, Lexington.

Allowance from Senior Academy $45.00

Current Expenses

Clerical and transportation..................	$ 14.70		
Badges	1.75		
Registration Book	.25		
Guest Speaker	5.00		
Photography	5.00		
Total		$26.70	

Awards

Set of Pictures	$ 8.00		
Two Subscriptions Nat'l Geog.	7.00		
Total		15.00	
Total Expenditures paid by Senior Academy...			$41.70
Junior Academy credit thru membership dues.			31.00
Difference paid by Senior Academy			10.70

The Junior Academy thru the efforts of the Committee on Junior Academy has made remarkable gains in membership as is shown by the following:

1932—Committee of four senior members.

1933—Forty-six high school students attended meeting of Senior Academy, Lexington.

1934—A paid-up membership of 310; held first official meeting of the Kentucky Junior Academy.

The meeting was conducted with much precision and dignity. The guests registered from eight to nine o'clock and inspected the exhibits. Genuine interest was manifested by the undivided attention thruout the rather long session, 8:00-12:30. Everyone remained until the meeting adjourned at 12:30.

The delegates voted unanimously to accept the report of the nominating committee. The officers for 1934-35 are:

President—Susie Bullock, Anchorage.

Vice-President—Charles Stewart, Bellevue.

Secretary—Frank Edwards, Waco.

Treasurer—Jayne Barrett, St. Catherine Academy, Lexington.

The outgoing president, Frank Edwards, was charged with the care of the gavel until the next annual meeting when he will present it to the new president, Susie Bullock. The gavel was made from a discarded walnut table leg from old Central University and was given to the Kentucky Junior Academy of Science by Dr. Anna A. Schnieb.

Respectfully submitted,

ANNA A. SCHNIEB, Chairman
Com. on Junior Academy.

REPORT OF THE RESOLUTIONS COMMITTEE

RESOLVED THAT: 1. In modern society a city government or state government should have well-organized, well-equipped, well-staffed scientific bureaus outside political control, competent to deal with those aspects of government which involve technical matters. Examples of such bureaus are: Educational, Agricultural, Conservational, Public Health, Recreational. Failure to deal in a rational way with any such branch of public welfare is disastrous beyond measure. The Academy regrets the abolition of the geological survey and hopes that in more auspicious times it will be re-established on broader lines, with wider powers and responsibilities.

2. The Academy desires to record its approval of a greatly enlarged system of State Parks as a goal for the immediate future.

3. The Academy wishes to record its heartiest approval of the excellent beginning which has been made by the Junior Academy. We believe that immeasurable wealth of human material has been tapped in the interest of Science, and of the State. We pledge the united effort of the membership to further develop these human resources.

4. We vision a future Academy of Science enriched with all this new influx from the Junior Academy, as a most valuable adjunct to the State. We visualize an Academy which shall be to Kentucky what the National Academy of Sciences and Research Council are to the National Government. An Academy of Science at its best should be one of the State's advisory bodies—technical, not administrative.

5. The Academy should look toward a State subsidy for a more adequate publication program. Insofar as the Academy will more and more be useful to the State, the cost of public information concerning its proceedings would be a fair obligation upon the State.

6. The Academy should provide as soon as possible two meetings per year. The additional meeting should be largely for the purpose of conducting field trips to interesting points within the State; for visiting many such points over a period of years.

7. The teaching of science in the public schools be enlarged so as to encourage amongst the coming generations: (a) A better mental and physical development and the maintenance of right living and health. (b) An understanding of

the interrelations of life forms and so promote the elimination of the useless and bad and the conservation of the useful and good. (c) The development of those minds which are so inclined, into scientific teachers or research workers, so as to increase man's control of himself and nature, adding power to his spirit and nobility to his life.

8. The schools should put into their libraries such scientific books as are adapted to the mental status of their pupils and the local needs.

9. The State Book Commission at Frankfort be requested to serve the public with such popular scientific books as will promote interest in solving local and nation-wide problems in ecology, health and development.

10. The authorities of our state be requested to study the library laws and their workings in other states and adopt such governmental measures as will promote the growth of libraries in our county seats and other cities.

11. The present and subsequent legislatures should make ample provision for not only maintaining our educational system in highest efficiency but also to build broad foundations for the future.

12. The approach to our state and national problems should be along scientific lines rather than the old-fashioned political, which has produced such a muddle; and that the collection and interpretation of data and the deduction therefrom of the future steps in progress, should be the duty of those in power.

13. The Academy expresses its appreciation of the efforts of Dr. Schnieb during the past two years in organizing the Junior Academy and it recognizes with great pleasure the progress of this work as it is seen in the number of science clubs affiliated, the number of individual members, the quality of exhibits and the general high standard of the Junior Academy program.

14. Each member of the Academy ought to make himself a committee of one to get a school into the Junior Academy next year.

PAPERS PRESENTED AT THE TWENTY-FIRST ANNUAL MEETING

1. **Genetics and Evolution.** (President's address) John S. Bangson, Berea College. For a little while let us consider together some of the implications that genetics suggests for the problem of organic evolution. In this discussion it would seem irrelevant to recall evidence to establish the fact of evolution, the assumption being that organic evolution is not an hypothesis, but an accepted actuality.

Almost as early as the idea of evolution itself, we find either conscious or unconscious suggestions for its cause. Empedocles—5th century B. C.—gave us the "germ of the theory of the survival of the fittest, or natural selection." The notion was emphasized by Aristotle but later he discarded it on account of his conviction of "intelligent design in the formation of adaptive characters." Centuries later St. Hilaire gave it prominence, as did Buffon. Darwin states that he got the idea from Malthus. Wallace, independently, anticipated Darwin in publishing this theory of natural selection, altho his work was very limited when compared with Darwin's data. Natural selection alone seems inadequate to explain evolution in all its details.

Another early suggestion that would account for the cause of evolution was the inheritance of acquired characters. Among other things, Aristotle believed in the transmission of acquired characters, and probably was the first to express this view. It was subsequently much more completely worked out by Buffon, Erasmus Darwin and Lamarck. Lamarck became such an exponent of the inheritance of somatic variations that the theory today is frequently known as Lamarckism. Darwin believed that characters of this type were passed on to further generations. Geneticists today do not accept the inheritance of acquired characters.

Osborn postulated a "biochemical evolution" that consists of "two distinct processes." The first he calls "alloiometric modification," caused by alloiometrons which are not governed and predetermined by germinal potentialities, and arise independently. He says that they "are relatively rapid in development, or temporal." The second process, announced in January, this year, he terms "Aristogenesis." This is a "creative process from the germ plasm of entirely new bio-mechanisms; the process is gradual, continuous, direct, definite in direction of future adaptation." Geneticists would regard his first proposition with much suspicion.

Particulate theories of heredity. As early as 1863, Herbert Spencer proposed a theory to account for evolution by postulating "physiological units," "all alike in each species." He regarded the egg and the sperm as "fragments of a whole." His theory was based entirely upon speculation.

Darwin (1868) gave us his theory of pangenesis. He believed that minute representatives, called gemmules, from different organs, found their way to the germ cells, and in the gametes represented their organs or tissues. The theory was devised particularly to explain Darwin's contention of the inheritance of acquired characters.

Weismann (1883) challenged the then extant theories that attempted to explain the transmission of hereditary characters. He identified the chromosomes as being the transport system of heredity, and subsequent work confirmed his contentions. Weismann pointed out the tremendous fact "of the immortality of the germ and the mortality of the body."

It is realized today that "the theory of evolution can be studied by the same methods that have been so successful in other branches of science—that evolution is not so much a study of the history of the past, as it is an investigation of what is taking place at the present."

Genetics touches evolution at a number of points. In the first place it has something to offer in regard to the origin of variations. This was a closed book to Darwin, altho he recognized them. Korchinsky, in his heterogenesis, anticipated deVries by a number of years, "but his work was not supported by the large amount of experimental data that characterized" the work of deVries. As we know the mutation theory, it was mainly the work of deVries on the evening primrose, *Oenothera lamarckiana,* and it led him to propose the mutation theory of evolution. Darwin emphasized continuous variations; deVries, discontinuous variations. Mutation alone is insufficient.

By mutation is meant a heritable change; a change in the germ-plasm, a change in the gene, or sometimes a change in the chromosome complex. In some instances the change may be very slight, as a change from red eye in *Drosophila melanogaster* to claret eye-color. The change may be more pronounced, as from normal long wing to vestigial wing, in Drosophila. The change may be morphological, as beaded hair in man; it may be physiological, as color-blindness or left-handedness in man; mutation may be psychological.

As previously indicated, mutation may be the consequence of a change in the gene. This is known as a gene or point mutation and, in the majority of organisms, this is by far the most frequent type of heritable change. Eye-color, feeble-mindedness, baldness and left-handedness in man are of this category. It should be stated in passing that mutations are very rare, except in the so-called eversporting genes.

At one time it was suggested that the cause of mutation was probably the elimination of the causative agent of the character, the gene, but reverse mutations, changes from the mutant back to the wild type, as, for example, the change from white eye in Drosophila to red eye color of the wild fly, show that the change is not the elimination of the gene, but rather a change in the constitution of the gene, evidently a change in the chemical nature of the gene.

Evolution of Dominance. Of the 500 mutations known in *Drosophila melanogaster*, the great majority are recessive, relatively few of these mutations are dominant. That is, the wild-type genes are dominant to the new mutant genes. This fact is not only true of Drosophila, but holds also for many other forms, as Sweet Pea, Maize, and others.

A frequent inquiry wonders how recessive genes are of use in the process of evolution, in view of the fact that wild genes are generally dominant. Fisher and Sewell Wright have attempted to answer this reasonable question. Fisher shows that there is a "tendency of the type gene to become dominant over the mutant as a statistical consequence of natural selection." Mutant genes have reappeared again and again in the past. This is borne out by the fact that in Drosophila white and notch, have each appeared twenty-five times; cut, sixteen times, and yellow, vermilion, and rudimentary, each fifteen times. In *Antirrhinum majus* the mutant, Crispa, has appeared independently thirty-nine times, "while most of the fifty other mutations have appeared but once or twice." It frequently happens that the hybrids are intermediate in various respects, being in some respects like the wild stock. From Mendel's laws of heredity it is known that these heterozygotes will be many times more frequent than the homozygotes. In some of the former there would be some with gene complexes in which the dominant effect would be enhanced over that of the recessive, and these will have a better chance of surviving the rigors of natural selection, "because of their nearer approach to the wild-type character." "In the course of time this may bring such hybrid individuals on a par with the wild type. When the mutant appears again, it will now be recessive to the then existing wild-type owing to the change brought about in the stock by earlier occurrences of this mutant, as just explained."

How then can these defective mutations be of use to the organism in the process of evolution? They probably aren't. Muller suggests that organisms are so nearly perfectly adapted to their situations that almost any change would be a change away from rather than towards better adaptation. He thinks that any purely accidental change in a complicated organism "would be more likely to injure than to improve" the individual. It does not follow, tho, that because the majority of mutations are detrimental, there are no mutations that are instrumental in better furthering the well-being of the individual. Morgan says that by far the most mutations that have been studied have been morphological, and then he raises the question that who knows but that there are many psysiological changes that are positively of value to the individual possessing them.

The average mutation does very little in the furthering of life. Mutations are fortuitous; they are random in their appearance, occurring in all directions. The great majority of mutations are positively harmful. Muller and Altenburg showed that in Drosophila the "greater number of detectable mutations are actually lethal." Evidence is constantly accumulating which indicates that the same situation exists in other organisms. The albino rabbit has two disadvantages over its wild-type sibs. The pink eye is an inferior organ of vision, and the white coat makes the creature conspicuous as a victim of prey. Few albinos are observed in nature. Many Drosophila mutants could not compete successfully in nature. Feeblemindedness in man is surely not a desirable mutation, and the same is true of color blindness, haemophilia and fragile bones.

Cause of Mutation. The cause of mutation has been an enigma for many years. Muller has shown that X-rays are effective in changing the heredity constitution of the gene, in Drosophila, and his work has been abundantly verified in a number of other organisms. Radium has been found to be just as efficacious. Babcock and Collins and Henson and Heys have shown that probably radioactive substances in the earth are effective in this respect. Vernadsky has shown that *Lemna polyrrhiza* and *Lemna minor* can take radium from the water in which they live and concentrate it in their tissues. Brunowsly has evidence that aquatic animals also have this capacity. Whether or not this is also true of terrestrial animals is not known. This storage of radioactive substances might have a bearing upon the fact of mutation. Quite an approach has been made in the solution of this problem, but there is much left to be wished that we might know.

Cause of Evolution. As previously indicated, a second type of mutation is the result of a change in the chromosome complex. It is a well-known fact that, with a few exceptions, chromosomes in animals and plants occur in pairs. It sometimes happens that a change in the number of chromosomes occurs.

In the simplest cases, probably just one chromosome is involved. This one chromosome may be added, giving two of each of all homologous chromosomes, except that one kind is present in three's. This condition is known as trisomic—the 2n+1 mutant—and is known in Datura, Crepis, Matthiola incana. Datura normally has twelve pairs of chromosomes, and over a period of many years twelve different 2n+1 mutations have been observed, each of which involves a different one of the twelve pairs of chromosomes. 2n+1+1, 2n+1–1, 4n+1, 4n–1, 4n+1–1, 4n+1+1–1–1, have been observed in Datura and Nicotiana. The cause of these mutations is probably thru non-disjunction of one or bivalents.

Again, when a single chromosome is involved, it might be missing, instead of being added, as in the haplo-IV Drosophila. It will be seen here that there are more morphological differences, as "paler color of body, large eyes with a rough surface, slender bristles, and shorter wings, with the aristae reduced or absent." "These flies are unhealthy, late in emerging, present a high mortality, and they are often sterile and always poor reproducers." Haplo forms are known in wheat, oats, tobacco, Datura and Oenothera.

It frequently happens that an entire set of chromosomes is involved. The whole pair may be missing, so that the organism possesses just one of each pair instead of the orthodox two of each pair. The forms are known as haploids, and are found in Drosophila, Datura—; in the tomato—; Black Nightshade; Crepis; Triticum; Oenothera; Nicotiana, etc. The haploid number of chromosomes is known to be present normally in a number of organisms, as males of some of the Hymenoptera, Hydatina, etc.

Sometimes the haploid arises thru crossing two "distantly related species, and it is considered that the stimulus of foreign pollen induces parthenogenesis," development without fertilization. Low temperature apparently was a stimulus that resulted in a haploid Crepis. The spontaneous origin of haploids is known. When selfed, the haploid plant generally gives diploid offspring, thus producing individuals that are homozygous in all their characters.

Extra sets of chromosomes may be added. If one set is added, we have the triploid condition, or three times the haploid number of chromosomes, that is, three of each set of chromosomes; two sets may be added, giving the tetraploid; three sets added give the pentaploid; the hexaploid has four extra sets; the octoploid six extra sets. Various causes are assigned to the formation of these forms, as doubling of the chromosome number in the somatic tissue, the formation of gametes containing either the unreduced number of chromosomes or at least containing more than a diploid complement of chromosomes, or they may be due to hybridization between organisms with different chromosome numbers.

A number of multiple groups of chromosomes is known. In the tomato we have triploids and tetraploids. In Datura we have a series. Here it will be observed that there is a constant increase in flower size as the number of chromosomes increases. There are differences in capsule size, too, but the haploid and the triploid forms are sterile, so their capsules are small because they do not produce sufficient seed to swell them out. Black Nightshade has a series. In Papaver there is a series with fourteen chromosomes as diploid, 28, 42 and 70 chromosomes, respectively.

The cultivated varieties of both wheat and oats have forty-two chromosomes in the somatic cells. This might suggest something of significance to which we shall later refer. Barley and rye have also diploid and tetraploid forms. In roses the series has fourteen chromosomes as the basic diploid number. Triploids, tetraploids, pentaploids, hexaploids, and octoploids are known. In *Solanum nigrum*, where the haploid number is thirty-six, there is a series consisting of 36, 72 diploid, 108 triploid, and 144 tetraploid. Many more series are known.

In passing it might be observed that the chromosome series are not always multiples of the haploid number. In Crepis there is a series, the diploid numbers of which are: 6, 8, 10, 12, 16, 18, 22 and 40; in Carex we have 18, 30, 32, 38, 48, 50, 52, 54, 58, 62, 64, 66, 68, 70, 72, 74, 76, 80, 82, 84 and 112. In the Chrysanthemum we have 18, 36, 48, 72 and 90; and in Nicotiana there are 18, 20, 24, 32 and 48 in the diploid forms. These differences in number seem to be the outcome of evolutionary processes.

In some instances polids give us varieties, as in Oenothera, where we have the tetraploid *Ogigas*; in Rosa; in Tulipa; Lypersicum; Datura; Solanum; Iris, etc. Or there might be polyploid species. Examples are Rosa, Primrose, Nicotiana, Triticum, and Chrysanthemum.

Few Series in Animals. Few series are known in animals. In Ascaris there are two types, one with one pair of chromosomes, and another with two pairs. There are two races of the brine shrimp, Artemia salina, one with 42 chromosomes, and another with 84 chromosomes.

We have considered gene mutations, and mutations that involve one or more single chromosomes, or sets of chromosomes. Now permit us to consider displacements that involve only portions of chromosomes.

Translocations. In 1919, Bridges described what he called a duplication—an addition "of a known section of a chromosome that is a duplicate of a known section present in an abnormal location in addition to being present in its normal location." "These cases are reciprocal to 'deficiencies' in which a section is absent from its normal position without being present in an abnormal position," that is, entirely missing. After maturation, the II-chromosome with the added piece from the right end of the III-chromosome will have a number of genes in duplicate, in the gametes to which it goes, while the gametes that get the III-chromosome deficiency will be lacking in a number of genes.

Very frequently deficiencies are lethal, but characters represented by duplications are exaggerated. Many translocations have been produced by the instrumentality of X-rays. These phenomena are abundant in Drosophila, and are known in Datura.

Another type of dislocation of chromosome portions is known as inversion, where fragments "of the same chromosome, both or all, reunite but in a different order than before." Sometimes two "terminal fragments" unite leaving out a median portion. This is a deletion.

The translocation of portions of chromosomes and their subsequent reattachments, give rise to "changes in Mendelian ratios owing to a different balance of genes." In all of these displacements, a number of generations are required to give a combination that is stable.

At this point it might be well to compare the chromosome complexes of two well-known Drosophilas, melanogaster and simulans. The latter is the only Drosophila species with which melanogaster will cross. The two species are very similar, and for a long time they were regarded as the same species. Simulans is smaller and stouter than melanogaster. The eyes of simulans are larger.

Hurst, in his THE MECHANISM OF CREATIVE EVOLUTION, page 70, figure 54 shows the relative positions of many of the same genes. The X-chromosomes are almost identical in the two, the genes lying in the same sequence, and at almost precise map distances. The Y-chromosome of melanogaster is a bit longer than the Y-chromosome of simulans. Chromosome II has not been thoroly investigated, the four discovered loci are in the same sequence, but not in the same relative positions. "In chromosome III the whole of one section has become inverted as compared with melanogaster, and when it was first discovered it was suggested that this might be the cause of the specific differences between the two species." Later research revealed that that hypothesis is not tenable.

In 1925 there were about two hundred described species of the genus Drosophila. About forty of these species are referable to 13 complexes, as many as 13 species are of the same complex type. The relationship of the various complexes is very suggestive.

Reproduction in Evolution. East has shown the importance of sexual reproduction in the process of evolution. He showed that in all probability variation is as frequent in forms that reproduce asexually as in those that reproduce sexually. The main advantage, tho, that sexual reproduction has over asexual methods is the fact that thru the former there is an admixture of germplasms, and thus "introduces the possibility of Mendelian segregation and recombination of traits, with the resulting increase in variability and greater chance of evolutionary modification." "Ten variations in an asexual species mean ten types; ten variations in a sexual species provide the possibility of 2^{10}, or 1024 types. Twenty variations in the one case is again twenty types to survive or perish in the struggle for existence; twenty variations in the other case present 1,032,576 types to compete in the struggle."

Hybridization. "One important factor in the evolution of species has undoubtedly been the occurrence of frequent hybridizations and crossings. By natural and experimental crossings in plants and animals, it is possible to get numerous recombinations of new and old characters, and new mutations and transmutations in related and infertile varieties, while in the hybridization of Linean species in general, many chromosome transmutations arise, some of which being viable and fertile give rise to entirely new species and genera."

There are numerous complications that arise in hybridization. In some instances incompatibilities of various natures make crossing impossible, but in defiance of difficulties, many crossings occur, naturally and under the guidance of man.

A classic instance of the creation of a new species from crossing two species is the example of Haldane's *Primula kewensis.* He crossed *Primula verticillata* and *P.floribunda.* The first generation was sterile. From a cutting, tho, Haldane propagated *P.kewensis,* and a surprising thing happened. A shoot was produced with somewhat larger leaves and flowers which was fertile, and the seeds gave rise to what is horticulturally known as *Primula kewensis.* Haldane-frontispiece.

Babcock at the University of California, and some of his colleagues, created, experimentally, a new species of Crepis (Hawksbeard). They did it by crossing *Crepis biennis* (N-20) with *C.setosa* (N-4). The first generation hybrid had 24 chromosomes, twenty from biennis and four from setosa. In the fourth generation a plant occurred with ten pairs of chromosomes of biennis and two pairs of setosa that bred true. The new species possessed some characteristics of P_1 of the original cross.

Haldane thinks it entirely probable that rice-grass, *Spartina townsendii* which first appeared "on the muddy foreshore of Southampton" about 1870 came from a natural cross between the English *Spartina stricta* and the American *Spartina alterniflora.*

Muntzing created a new species of Galeopsis thru crossing which is indistinguishable from the tetraploid *Galeopsis tetrahit.* "The synthesis of a species of Timothy Grass by the hybridization of two species produced a regular polyploid form identical with the wild species."

Hurst thinks that many "garden roses have arisen thru hybridization." Genetical and cytological evidence indicate that the loganberry arose "as a duplication from a triploid raspberry-blackberry hybrid, thus forming a fertile, true-breeding and regular new hexaploid species." H-166.

Clausen has done much work with Viola species. He believes that *Viola arvensis* "at one time arose from *Viola tricolor* by chromosome non-disjunction."

Kerner states that the "number of hybrids growing wild in Europe can be safely estimated at 1000, and that 41 Linneons of Coniferae growing in Europe have produced no less than seven hybrids."

At one time Lotsy did not believe in mutation, except by loss, and attributed all variation to hybridization. This is certainly an exaggeration."

Natural Selection. "In the form given to it by the newer knowledge of genetics," natural selection "visualizes the environment as a sieve, straining out the possessors of bad or mediocre traits, and letting pass thru those which have qualities fitting them to the particular conditions they encounter. The conditions of life seem not to create new forms; all that selection can do, either as practised by man or by the ruthless hand of nature, is to sift out the new types which arise thru random changes in the hereditary material.

What, then, is the conclusion of the matter? Genetics certainly explains the origin of mutations; it explains variation thru sexual reproduction and recombination; it explains the production of new forms thru hybridization. In other words, genetical processes provide the material; natural selection determines the survival values of that material.

2. The Importance of Crop Adaptation in Crop Production. E. N. Fergus, University of Kentucky. That the principle of crop adaptation is not recognized in the culture of all crops is indicated by farm practice in the culture of red clover. Seed of this crop obtained from various sources produced crops which ranged, in a six-year average yield, from 4350 pounds of air-dry hay to the acre, from adapted varieties, to 1150 pounds for the European varieties. It is suggested that while there are important crops in which differences in adaptation are not known to exist, such differences may cause at least some of the difficulty experienced in their culture. Because unadapted red clover at times is so completely out of adjustment to its environment that it destroys its stored food materials, it is suggested that an apparently well adapted crop or crop variety may vary significantly in food or feed value.

3. A New Spreader for Nicotine. C. O. Eddy, Ky. Experiment Station. In a study to improve the market for tobacco, spreader 385 was developed for use with nicotine. It is highly efficient, convenient to use, since it is a liquid, cheap, easy to make, and is good, also, for other contact sprays. Preliminary tests indicate that it is as good for arsenical and arsenical substitute sprays as the soap and colloidal spreaders now in use, or better.

Among the spreaders for nicotine in use commonly are (1) various kinds of hard soap (80 to 90% anhydrous soap), (2) soap jells such as potassium oleate and cocoanut oil soap (60% anhydrous soap), (3) liquid soap such as cocoanut oil soap (40% anhydrous soap), potassium oleate (40% anhydrous soap) and sodium oleate (20% anhydrous soap) and (4) sulfonated mineral oil and, for limited uses, white mineral oils.

Hard soaps dilute at a minimum of one to two pounds per 100 gallons, liquid cocoanut oil soap and potassium oleate at 4 pints per 100 gallons, sodium oleate, and sulfonated mineral oil at 6 pints per 100 gallons, for effectively spreading nicotine. For equal efficiency with nicotine, Spreader 385 dilutes at one pint to 120 gallons. It is, therefore, five times as effective as the liquid soap spreaders, seven times as effective as sulfonated or emulsified mineral oils, and somewhat more effective than hard soaps. The formula is: 40% Potassium oleate, 45% Pine tar oil, 8% Ethyleneglycolmono-ethyl ether (solvent), 1.3% Glycerin, 5.7% Water.

In making, the raw ingredients are mixed. Heat is evolved in a reaction which is completed in a few hours so that the mixture becomes homogeneous and water soluble. Sometimes a little heat is necessary but it is never boiled. This spreader contains about 95% of active ingredients, including the solvent, or 87% active ingredients without the solvent. This is from $2^{1}/_{6}$ to $2^{3}/_{8}$ times the concentration of liquid cocoanut oil and potassium oleate soap yet, the spreader is more than four times as efficient as the 40% active liquid cocoanut oil and potassium oleate soap.

Notes: Some pine tar oils reduce efficiency, others increase it. In general, cost and efficiency considered, commercial pine tar oil of gravity of 1.035 was most satisfactory. Some pine tar oils require less solvent and the addition of some acetone. The spreader acts as a buffer for soluble arsenic. A formula that dilutes at about the same rate as a carrier or spreader is 85% saponified pine tar oil, 10% potassium oleate and 5% water, but it is not nearly so efficient in killing the aphids and is more likely to cause injury. It is however a better buffer for soluble arsenic.

4. **Effect of Alternating Temperatures on the Pupal Development of Drosophila Melanogaster Meigen.** Raymond M. Cable, Berea College. The generalization has been made that alternating temperatures stimulate development, as compared with the constant mean temperature. The present experiment was to test the validity of this generalization, using the pupae of *Drosophila melanogaster* Meigen. Cultures were kept in an incubator at 25°C, and pupae were collected every hour. They were called pupae as soon as they became quiet and the anterior spines were protruded. Each pupa was put into a test tube in which was a wad of moist cotton, and the tubes were placed in water baths at the desired temperatures, controlled to .10 degree centigrade. Alternations were made every 24 hours, and readings of emergence every hour.

At constant temperature, the optimum was 29.5°C for both sexes, but the pupal stage always was shorter in the female than in the male. At alternating temperatures, one above the optimum and the other between the threshold for development and the optimum, the time required for development always was longer than that required at the constant mean. Retardation was somewhat greater in the early than in the later stages of development. Between 15° and 29°, daily alternations had no affect on the rate of development, as compared with the mean, except in one instance. Between 10° and 20°, assuming that no development occurred at 10°, the acceleration was 11.5 per cent; however, if development occurred at 10°, completed in 42.5 days, no acceleration was indicated.

The experiments indicate that the actual threshold is between 7° and 8°, and that some development occurs at 8°C. The development which occurs between the actual and the theoretical thresholds is sufficient to account for the apparent acceleration, when pupae are alternated daily, between two temperatures one of which is below the theoretical threshold. The effect of low temperature is greatest in the early stages of development.

5. **Experimental Study on the Development of Grafted Optic Vesicles in the Anura.** Harvey B. Lovell, University of Louisville. The optic vesicle together with the olfactory placode of *Rana sylvatica* was excised and transplanted to the ear region of a donor of the same age. The rudiments differentiated in the heterotopic positions formed eyes and olfactory organs. Serial sections showed that the parts of the grafted eyes were well formed, altho the retina was often wrinkled, the vitreous chamber reduced in size, and the lens deformed. Blood corpuscles were present in the vitreous chamber of several specimens. Partial fusion of the grafted eye with the normal occurred in several instances. Some of the donors completely lacked eyes on the operated side, while others developed a small, imperfect structure resembling an eye. In the latter the grafted eye on the host was found to be smaller than the normal eye, indicating that only part of the potential eye-forming ectoderm, the optic vesicle, had been removed. Optic nerves were traced medially from many of the grafted eyes, but no enlargement of the brain in that region was noted. In the donors without eyes, however, the opposite optic lobe was reduced in size. Very little effect on the trabecular cartilage of the chondrocranium was noted in larvae lacking eyes.

6. **Abnormality in the Fowl.** P. A. Davies, University of Louisville. Abnormal developments are not uncommon. Alsop,[1] Tannreuther,[2] Stockard,[3] Riddle,[4] Patterson,[5] Byerly and Olsen,[6] and others have reported numerous cases. The case observed by the writer is of interest because of the nature of the abnormalities.

The fowl exhibiting the abnormal development was a male, seven years old, and weighing, altho carrying very little body fat, six pounds nine and one-half ounces. The color pattern indicated a Barred Plymouth Rock with some hybridization.

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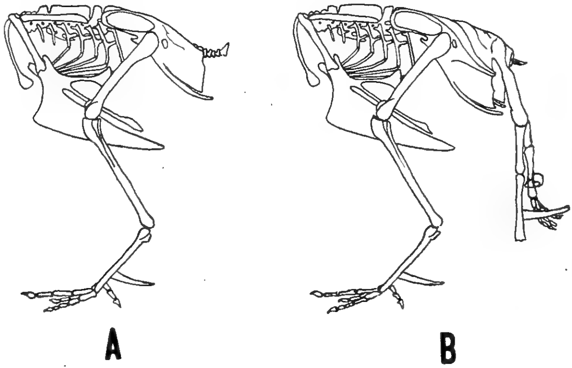
[1] Anat. Rec., 15:307–331, 1919. [2] Anat. Rec., 15:335-367, 1919. [3] Amer. Jour. Anat., 28:115-277, 1920. [4] Amer. Jour. Anat., 32:199–252, 1923. [5] Quart. Rev. Biol., 2:399–426, 1927. [6] Science, 80:247–248, 1934.

The external appearance showed the presence of an extra pair of hind appendages. The extra appendages consisted of two normally dveloped legs below the femur and articulated to a common femur. The femur was articulated to the posterior part of the left ilium slightly left of the mid-line of the body (shown in the figure). At the time the study was made, the bones of the abnormal appendages were ossified to each other, altho the presence of muscles attached to the common femur indicated free movement relative to the body at an earlier age. The tail, because of the twisting of the posterior part of the vertebral column, was 1.5 centimeters right of the mid-line of the body. The caudal vertebrae were nearly vertical rather than horizontal. Two anal openings were present, the larger opening (normal) was situated just beneath the tail, while the smaller opening was just below the junction of the femur with the ilium.



A, shows the position of the skeletal structures in the normal fowl.

B, shows the position of the normal skeletal structures and the position and development of the extra appendages.

Internal observations indicate no abnormal development above the diaphragm. Just posterior to the diaphragm, the vertebral column was twisted toward the right. The twisting of the vertebral column to the right reduced the space normally occupied by the kidney so that only the first two lobes of the right kidney developed. Abnormalities shown in the digestive tract were three caeca and two cloacae. The blood system was modified to supply blood to the abnormal appendages. The nervous system showed abnormal conditions in the spinal nerves posterior to the spinal nerves which form the sacral plexuses.

7. **The Friedman Pregnancy Test.** E. W. Cook, Jr., Centre College. Various tests for pregnancy were reviewed and compared. The technic of the Friedman test which includes the intravenous injection of 10 to 15 c.c. of urine from a suspected case, and the reading after a 36-hour period, was discussed. A positive test is indicated by corpora hemorrhagica on the ovaries, with a hyperemic condition of the tubes. The test, when negative, shows no change in the internal genitalia. The importance of having virgin females was stressed, which virginity includes isolation of prospective test animals for thirty days before the test is performed. A short resume of the literature shows a high percentage (95% plus) of correct diagnosis of pregnant and non-pregnant conditions. A preparation of a positive and negative test was shown.

8. **Alkalinity Measurement of Blood Serum.** Daniel J. Healy. We have demonstrated that the condition known as pregnancy disease of ewes, is an acidosis.[1] We agree with Sellards[2] that acidosis is an impoverishment of the tissues and fluids of the body in fixed bases or in substances which readily give rise to fixed bases. We have found the following modification of Sellards' method for titratable alkalinity accurate and simple. To 1cc of blood serum in a 15cc centrifuge tube is added 3cc of of 95% alcohol, the mixture thoroly shaken, the precipitated protein thrown down in the centrifuge, the liquid decanted into an evaporating dish, three drops of a 0.5%

1. Dimock, W. W., Daniel, J. Healy and J. F. Bullard. Jour. Amer. Vet. Med. Assoc. 72, 4. 511. 1928.

2. Sellards, A. W., The Principles of Acidosis and Chemical Methods for Its Study. Harvard University Press. 1919.

phenolphthalein solution added, the liquid evaporated to dryness on the water bath, a .01*N* HCl solution added drop by drop until all color is discharged, and the quantity of HCl solution required noted. The table shows results obtained by this method.

Alkalinity of the Blood of Pregnant Ewes, Expressed as Quantity of .01*N* HCl to Neutralize 1 cc of Serum.

Healthy		With Acidosis	
Ewe	cc	Ewe	cc
1	1.00	11	0.00
2	0.95	12	0.15
3	0.85	13	0.26
4	0.92	14	0.56
5	0.73	15	0.00
6	1.10	16	0.40
7	0.60	17	0.45
8	0.95	18	0.00
9	1.10	..	...
10	0.75	..	...
Average	0.89	Average	0.23

9. **The Artificial Culture of Sapromyces Reinschii.** Harlow Bishop, University of Louisville. The organism brought into pure culture as a result of this study is an aquatic fungus, belonging to the class, Phycomycetes, family Leptomitaceae. Gross cultures can be raised on barberries and hawthorn fruits. No record of the pure culture of the genus Sapromyces has been found, altho studies have been made by Thaxter[2, 3], and Coker[1].

Pure cultures were obtained originally from a gross culture collected by Dr. Arthur Kevorkian in June, 1933, in a

1. Coker, W. C., Chapel Hill, N. C., 1923. The Saprolegniaceae.

2. Thaxter, R. Observations on the genus Naegelia of Reinsch. Bot. Gaz., v. 19, pp. 49-55, pl. 5. 1894.

3. ——————— New or peculiar aquatic fungi. 4. Rhipidium, Sapromyces, and Araiospora, nov. gen. Bot. Gaz., v. 21, pp. 317–'31, pls. 21–23, 1896.

sphagnum bog near Walpole, Mass. The Barber micropipette was used to isolate spores. A suspension of the sporangium-bearing mycelium was made on the under side of a large cover glass, which acted as the top of a moist chamber. With a sterile micropipette, a zoospore which had come to rest and had just begun to germinate was picked out and blown into a fresh, sterile drop of water. Since the gross culture contained other fungi, bacteria, and some protozoa, the desired spores were often not alone in the new drop. The technique used to separate the spore of Sapromyces from these other forms, was to push it gently to one side of the new drop and then use a second, sterile micropipette to bring it into a third sterile drop. All contaminating organisms except bacteria were eliminated by this second transference. Bacteria were removed by the use of an extremely delicate micropipette, of so fine a bore that bacteria only were drawn into it, the desired spore measuring about 10 microns in diameter, while the bacteria usually measured about a micron.

Test of the purity of the culture from bacteria was made by hanging drop cultures with media favorable to the metabolic activities and reproduction of bacteria. When bacterial contaminants were present the 2% peptone used became, within a few hours, a cloudy, opaque mass. When the cultures were pure, careful observation with high power, of every portion and plane of the drop revealed only the delicate strands of Sapromyces, which grew but slowly at first. There is more rapid growth at the end of the second day, but four days are required to obtain a typical plantlet, with rhizoids, extramatrical mycelium and mature zoosporangia. The latter soon liberate an abundance of free-swimming zoospores in the same drop of culture medium. The vegetative life cycle is thus complete within a single drop.

Successful cultures, absolutely free from other organisms, have now been grown on prune agar and corn meal agar, as well as in solutions of peptone and malt. Many attempts to bring Sapromyces into pure culture have been made by other investigators. The writer attributes their failure to the extremely slow growth habit of the organism. Because of this, all competitive organisms must be completely removed before Sapromyces will thrive in culture. The micropipette method seems to be especially suited to pure culture technique of this group of organisms.

10. **The Arsenic Content of Some Normal Soils, Plants and Animals and the Effect of Feeding Small Quantities of Lead Arsenate and Arsenic Trioxide on Albino Rats.** J. S. McHargue and W. R. Roy, Experiment Station, University of Kentucky. The arsenic content of normal soils, plants and animal tissues was determined by oxidizing the organic matter with sulfuric and nitric acids and by the application of the Gutzeit procedure for arsenic determination. The soils ranged from 0.00011 percent to .00145 percent of arsenic. The arsenic content of plants grown on normal soils ranged from 0.000007 percent to .000114 percent. Plants grown in soil to which small amounts of arsenic were added contained appreciably more of the element than the control plants. Arsenic was found in measurable quantities in all of the tissues analyzed from normal animals. The spleen, blood and liver, in the order named, contained the largest amounts of arsenic in normal animals. Rats fed a diet containing small doses of lead arsenate or arsenic trioxide for several weeks showed a gradual increase in the arsenic content of their tissues over the controls. With cessation of arsenic feeding the element was eliminated rather rapidly.

11. **The Effect of Certain Fertilizer Materials on the Iodine Content of Important Foods.** J. S. McHargue and D. W. Young, Experiment Station, University of Kentucky. The results of the analysis for iodine of forage crops and vegetables grown on similar types of soil showed rather wide variations when different kinds of fertilizers were used. The examination of some crude fertilizer materials showed that they contained varying amounts of iodine. When fertilizers containing iodine were applied to the soil and crops grown, the iodine content of the crop was increased markedly. Tests by dialysis proved

that the iodine was in organic combination. Therefore it is possible to produce foods that contain an adequate amount of iodine by the use of fertilizers containing iodine.

12. Copper, a Vital Factor for the Growth of Flowers and Pollen in Corn Plants. J. S. McHargue and R. K. Calfee, Agricultural Experiment Station, University of Kentucky. Corn plants, a yellow dent variety, were grown in purified sand cultures with and without copper. No differences were observed until the tassels developed. The plants receiving copper (2.2 mg. per plant) produced normal tassels and an abundance of pollen. The untreated plants produced short, stunted spikes and practically no pollen. The total green weight of the untreated plants was slightly greater than that of the treated. The dry weight, however, was only about 75% of that of the treated plants. No copper could be found in the ash of the untreated plants.

13. Myosis in Liquidambar Styraciflua. Stelio Imprescia, University of Louisville.

14. A Summer in Spanish Honduras. A. R. Middleton, University of Louisville. By title.

15. Factors Favoring Male Production in the Cladoceran, Moina Macrocopa.[1] L. A. Brown, Transylvania College. Experimental work on the control of sex in cladocerans has been a search for some single simple factor, the presence of operation of which causes a female to produce male young instead of the usual parthenogenetic females. While this goal has not been attained, three elements of the environment have been studied which influence the sex ratio, to a marked degree. These are, the degree of crowding of the mothers, the amount of available food, and the temperature. It seems that temperature[2] and amount of food[3] act as general or limiting con-

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[1] A report of work done jointly with A. M. Banta of Brown University, at the Department of Genetics, Carnegie Institution, Washington.

[2] L. A. Brown and A. M. Banta, Physiol. Zool., V. 218, 1932.

[3] C. A. Stuart and A. M. Banta, Physiol. Zool., IV,, 72, 1931; C. A. Stuart and H. J. Cooper, Physiol. Zool., V, 70, 1932; C. A. Stuart, J. Tallman and H. J. Cooper, Physiol. Zool., IV, 581, 594, 1931.

ditions. By this is meant that in order to induce Moina mothers to produce males, they must be reared within a certain range of food concentration (bacteria per ml) since above and below this rather extensive range males do not normally occur. The limiting effect of temperature is not so simple, as there are two temperature intervals allowing only limited male production. When the amount of food is within the optimum range and the animals are reared within the proper temperature range, a third factor, the crowding of the mothers, apparently operates to determine just how many males appear among the offspring. Workers in this field disagree as to the manner in which crowding of the mothers acts to increase male production. Recent data seem to indicate that the increased concentration of excretory products associated with crowding is of primary importance. The indications are two-fold: that male production is proportional to the concentration of excretory products (i.e., proportional to the reciprocal of the volume of culture medium per mother), and temporary relief from excretory products during the period of sex determination markedly lowers the percentage of males produced.

16. Viability of Dodder Seed After Feeding. W. A. Price and E. S. Good, University of Kentucky. Most samples of clover, alfalfa and lespedeza seed examined at the seed laboratory contained seeds of dodder, a noxious weed. This shows the wide dissemination of dodder in these hay crops. To ascertain if viable dodder seed may be returned to the land in the droppings of livestock that have been fed hay containing dodder seed, the departments of Entomology and Botany, and Animal Husbandry cooperated in the experiment reported in this paper. A steer that was being fattened in the dry lot was given, in his feed, about three-fourths of a cupful of dodder seed, in three equal portions, one in the morning feed, one at night and one the next morning. The seeds began to appear in the feces 24 hours after the first feeding and were very numerous in 36 hours. They could be detected easily because they had become swollen. Six percent of the seeds recovered were found to be viable. Inasmuch as the viability of the seeds originally was 46 percent, the experiment indicates that 13 percent of the viable dodder seed fed, retained their viability after having passed thru the alimentary tract of the steer. From this it appears that the manure of animals fed hay containing dodder, may disseminate that weed.

17. Cytological Changes in the Thyroid Glands of Bats (Myotus lucifugus LeConte) **from January to March.** Elon B. Tucker, Graduate Student, University of Kentucky. (By invitation). Cytoplasmic changes in the thyroid gland were described. In January the gland presents hyperplastic areas intermingled with areas of normal secreting cells. Three stages of secretion were described as follows: pre-secretory, secretory, and post secretory. In March the gland has no areas of hyperplasia, but all cells are in some stage of active secretion. There is evidence of mitochondral metamorphosis during this time period.

18. The Effect of Hair-loop Constriction on the Development of Bruchid (Coleoptera) Eggs. A. Cecil Taylor, Graduate Student, University of Kentucky. (By invitation.) Eggs of Bruchus quadrimaculatus constricted anteriorly by fleece fibers, show a regulative development of complete embryos behind the knot. Only part embryos may form anterior to constrictions. Egg regions other than normal presumptive areas may contribute to embryo formation.

19. Fishes of the Mammoth Cave Region. J. S. Jackson, Bowling Green High School. (By Invitation.)

20. The Bottom Fauna of Drakes Creek. T. R. Milam, Western State Teachers College, Bowling Green. (By Invitation.) The relation of fauna to character of bottom was studied. Mud bottom had fewest animals, 16 per square yard, followed, in increasing order, by sand, flatrock, gravel, and boulder bottom. The last had 66 individuals per square yard. (Drake's Creek is in Warren County, Ky.)

21. Effect of Accumulation of Nest Eggs on Broodiness. G. Davis Buckner, University of Kentucky. White Leghorn hens that had not become broody when trap-nested in their pullet year, tended to become broody when the eggs were allowed to accumulate in the nests.

22. **Another Lawn Pest.** W. A. Price, University of Kentucky. Larvae of the Green June Beetle, *Cotinus nitida* Linne' ("June Bug") were a serious pest in many lawns, in 1933. Complaints and inquiries concerning these insects were received in September and October, from home owners in the bluegrass area. The beetle deposits its eggs in sod or vegetable matter, such as a pile of grass clippings, from which the grubs, when nearly full grown, migrate to the lawn, on warm, wet evenings. There they make horizontal tunnels near the surface of the ground, and vertical holes, 12 to 15 inches deep, for retreats. The grubs injure the grass by eating the rootlets and loosening the soil, and the little piles of excavated earth are unsightly.

The grubs may be trapped in troughs made by nailing together three boards, $\frac{3}{4} \times 3$ inches. These are sunk in the ground, surrounding the part infested. The migrating grubs fall into them. The grubs can be driven from their holes by flooding the ground with water. They come out quicker if the ground is first sprinkled with a solution of one ounce of extract of pyrethrum in four gallons of water, about 1 gallon to the square yard. If possible, choose a warm evening following a rain. The grubs that come up may be gathered by hand and destroyed. To avoid infestation, piles of grass cuttings should not be allowed to remain near a lawn or golf green.

23. **Evidence of Local Ponding by Glacial Ice in the Susquehanna River Valley.** Wilbur Greeley Burroughs, Berea College. Ponding of portions of the North Branch of the Susquehanna River in Pennsylvania and New York during the close of Wisconsin (Pleistocene) time created, according to some geologists, several large lakes, each many miles in length, in the valley of the Susquehanna and its principal tributaries. Other geologists have questioned the existence of these lakes. The results of the writer's field investigations in the Towanda region of Pennsylvania are as follows: The pre-Wisconsin valley of the Susquehanna River is still partially filled with fluvio-

glacial deposits consisting of blue clay which does not outcrop, and overlying sand, gravel, and cobbles. Two river terraces have been formed by the river in these deposits. At a higher elevation than the river terraces is a morainic terrace which extends along the valley side. The fluvio-glacial sands, gravels, and cobbles which change rapidly in composition and texture within short vertical and horizontal distances, were laid down by streams. There is no uniform transition in the size and weight of these sediments from the center of the Susquehanna Valley towards the sides of the valley, to indicate that they were laid down in a lake. There are no delta deposits in the fluvio-glacial deposits of the Susquehanna and its tributary valleys, such as would occur if the Susquehanna or its tributaries had built deltas into a large lake in the Susquehanna Valley. No stratigraphic or physiographic indications of a large lake exist.

Evidence of local ponding, however, was found. A hanging-delta is seen in the Susquehanna Valley at the entrance to Wysox Creek valley. This delta was formed by a stream flowing from the uplands into water ponded between the valley side and a mass of stagnant ice in the valleys of Wycox Creek and the Susquehanna River. Morainic terraces in the Susquehanna and its tributary valleys were formed between stagnant ice in the valleys and the valleys' sides. Alluvial fans that were deposited on the surface of the stagnant ice and lowered to the valley bottom on melting of the ice, are seen in Wycox Creek valley.

Slack waters may have occurred temporarily over large areas in the Susquehanna and its tributary valleys, but if so, no signs of a large temporary lake were left. Features due to local ponding should not be mistaken for deposits formed in a large lake. All the evidence points to local ponding by stagnant ice.

24. Determinism and Modern Science. Waldemar Noll, Berea College.

25. Removal of Iron from Some Inorganic Salts. Julian H. Capps, Berea College. Ferrous sulfate is a common impurity in copper sulfate. The two are isomorphous and not separable by crystalization. But if the ferrous sulfate were oxidized to ferric sulfate, which is not isomorphous with copper sulfate, crystalization would render the copper sulfate pure. Oxidation usually is done with nitric acid, excess of which remains in the solution. In the proposed method hydrogen peroxide is used to oxidize the iron. Basic ferric sulfate separates. Complete precipitation is ensured by adding pure copper hydroxide and boiling thoroly, which also decomposes excess peroxide. Filtration removes iron and excess copper hydroxide. The copper sulfate has not received impurities in the process except traces of acetanilid from the peroxide and of possible alkali from the copper hydroxide. The salt, therefore, need not be recrystalized for many purposes. The method applies to other salts than copper sulfate.

26. **A New Method of Determining the Relative Location of Points Within a Body by X-ray Photography.** A. D. Hummell, Eastern Kentucky State Teachers College, and O. F. Hume, M. D., Richmond, Ky. Two pairs of scales are mounted in parallel planes with a known distance between them in such a way that the images of these scales and the points in question will appear on the same photograph. To determine the three-dimensional location of a point with respect to an arbitrary zero, two photographs are necessary and differ only in a small lateral displacement of the source of X-rays. The actual relative positions of the points in question and the scales must be the same for these two pictures. After locating the image of the same point in these two photographs, perpendiculars from the image of the point to each of the images of the scales are drawn. The intersections are noted in terms of the units into which the scale images are divided. From these readings the spatial coordinates of the point may be determined analytically or graphically. The distance between any two points may then be calculated by means of the following well-known formula from analytic geometry: the square of the distance between two points in space is equal to the square of the difference of their x-coordinates plus the square of the difference of their

y-coördinates plus the square of the difference of their z-coördinates.

27. Demonstration of Chemiluminescence. Thos. C. Herndon, Eastern State Teachers College. The article, "The Oxidation of 3-amino-phthalhydrazide as a Lecture Table Demonstration of Chemiluminescence" by E. H. Huntress, L. N. Stanley and A. S. Parker, in the March, 1934, Journal of Chemical Education was reviewed and the phenomenon of chemiluminescence demonstrated according to the method given by these authors.

28. Prime Numbers. Richard Brauer, University of Kentucky. (By invitation.) A report was given about the history and the modern development of the theory of prime numbers. The prime numbers are of fundamental importance among the integers. Thus, it is no wonder that this special theory is almost as old as mathematics itself. The first important theorems were proved by Euclid. A characteristic property of the theory is that a large number of theorems may be formulated very easily, as it was shown in many special cases. On the other hand, the mathematical proofs are usually exceedingly difficult and could be given only after the great progress in analysis in the last fifty years. Many problems are not solved yet. For instance, it is very likely that a prime number always exists between two consecutive squares, a^2 and $(a+1)^2$, but it has not been possible to prove the theorem yet.

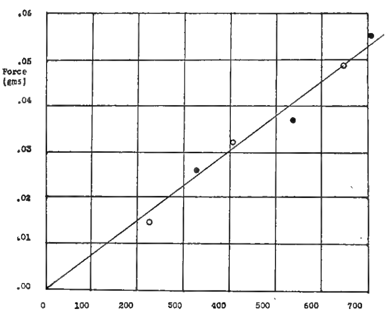
29. Absorption of X-Rays. T. M. Hahn, University of Kentucky. Absorption coefficients of paraffin and elements 6, 13, 29, 47, 73, 74, 78 and 82 were measured for the wave length region, 230 to 140 x-units. It was shown that the electronic scattering ó can be accurately found by plotting $\mu a/Z$ against Z for constant λ; experimental values of ó agree with the Klein-Nishina scattering formula rather than with the Compton or Breit and Dirac formulas. An anomaly in the value of $\mu a/Z$ for hydrogen is attributed to either classical scattering by the hydrogen electron, or excess absorption by the hydrogen electron in a combined field due to carbon and hydrogen nuclei, or to experimental error. A small inverse discontinuity was observed in μm for silver at 235 x-units. A value of 2.50 was obtained for the exponent of λ, and 3.18 for the exponent of Z in the equation

$$\mu a/Z = Ck\ \lambda^{2 \cdot 50}\ Z^{3 \cdot 18} + (\acute{O}/\acute{O}_o)\acute{O}_o$$

30. Methods of Solving Optical Problems. Bertrand P. Ramsay, University of Kentucky. Three distinct mathematical processes may be employed for the solution of optical problems: the methods of geometrical optics, the method of diffraction, and the method of interference. The principal mathematical relations employed by the respective methods are Snell's law and the laws of reflection and refraction, the Kirchhoff-Voigt complete diffraction equation, and Airy's interference equation. Owing to the nature of the assumptions involved, the degree of mathematical intricacy required, and the approximations inherent in physical apparatus, the three methods are not equally applicable in all cases. The prism formulas are calculable, for instance, by the methods of geometrical optics; and the optical properties of prisms can be determined by diffraction processes. A complete study of the prism has been made, however, by treating it as an interferential device. In conclusion, it is noted that a common ambiguity, which arises in defining the term, is eliminated when "interference" and "diffraction" are considered not as distinct phenomena, but as distinct methods of solving optical problems.

31. Magnetic Force of Moving Charges. Forrest F. Cleveland, University of Kentucky. The standard equation for the magnetic force between current elements, when applied in the customary manner to the calculation of the forces in a rectangular circuit three sides of which are mechanically separable from the other side, leads to the result that the three-sided part **lifts itself.** This is contradictory to the well-established law of action and reaction. If the equation be applied in a manner consistent with the law of action and reaction, it leads to the result that action and reaction **are not equal,** for the mechanically separable parts. Ampere's force equation, on the other hand, predicts equality of action and reaction for the separable parts.

To test these contrary predictions, first the single side, and then the three sides of a rectangular circuit were attached to the arm of a balance, and the forces measured. Action and reaction **were equal and opposite.** Thus one has strong indication of the incorrectness of the standard force equation for partial circuits, and equally strong indication of the validity of Ampere's equation for such circuits. Both equations, as is well known, yield the same results when at least one of the interacting parts is a closed circuit.



32. A Biographical History of Physics. Norman E. Dodson, Berea College. The paper explains the reasons for the composition of 80 short biographies of famous physicists, from Archimedes and Aristotle to Einstein, Millikan and other moderns. The study of the discoveries of these men is made more interesting by a knowledge of their personalities; hence a book such as is proposed should be useful in connection with physics teaching. The biographies will be in chronological order, with a portrait of each subject. A bibliography of publications in which biographies are found, is to be appended.

33. A Religious Philosophy in an Age of Science. W. G. Ross, Berea College. This paper is due in part to two types of conversations during the past few years, (1) conversations with many scientists in their unscientific as well as their scientific moments, and (2) conversations with many people who say they have been disturbed, even upset, by the claims of some scientists and the criticisms they have directed against religion and religious ideas. But the paper is also the result of studying some recent literature dealing with the topic under discussion, such books as are mentioned later.

For the purposes of this discussion the subjects of religion and science will be considered in terms of conflict—not to intensify the conflict but to locate some of its subtler causes. The terms 'scientist' and 'theologian' will be used as tho they designated two distinct species, which they do not. There are certain very impressive common denominators in the two groups. The remainder of the discussion will be presented in semi-outline form, and for convenience the leading statements will be numbered.

1. Scientists ordinarily are not qualified to discuss religion at length because they don't seem able, except in extremely rare instances, to do so 'scientifically'.

2. Most specialists in religion are not qualified to pass judgment on scientific method and the results of scientific method as practiced. This is partly due to the fact that the pendulum has swung from the extreme of intemperate criticism in the early days (of Galileo, Spinoza, Darwin) to the extreme of sentimental hero-worship on the part of many liberal theologians. I am speaking of religious weaklings who grovel about the tables of scientists looking for crumbs of confirmation of their own ideas, timorously held. They sing the praises of, say, Eddington because they think he has shown that belief in God is again 'respectable'.

3. The faults and shortcomings of scientists are often very much like the faults of theologians. They are not so much the faults of one group or the other as they are fundamental 'faults' of homo sapiens. Most people are often rash and reckless in what they reject and naive or servile in what they accept . Thus it has been that both groups have tended to take such attitudes and actions toward each other as dogmatism, peremptory rejection, intemperate criticism, and resentment. These are not limited to the two groups mentioned, but they, as groups, must learn what these things signify and what they do.

4. What does the scientist believe to be his most unassailable position? Undoubtedly it is his method. In other words, it is believed by the scientist that his method will vindicate itself. But to speak of the scientific method as one which people will adopt and use on any extensive scale is like talking of the Messianic Age. In fact, the religious pronouncement, "Behold, I send you forth as sheep among wolves" can be said to the honest proponent of the scientific method as well as it was to the ancient Galileans, especially when the scientist encounters the wolf of human selfishness and the hydraulic brakes of mortal inertia.

5. Another localization of the conflict is the realm of paradox. Religion seems to thrive on paradoxes. Some religionists have been known to say the whole world is paradoxical. "Whosoever will save his life shall lose it," "He that is greatest among you shall be your servant," "The kingdom of heaven is like a little child," et al.

A friend of a scientific turn once asked, "Do you suppose the time will ever come when we can talk in exact terms instead of paradoxes?" I do not know, but I do know that the vein of quartz which will turn the point of any paradox is literal-mindedness. I am, therefore and hereby, suggesting a few paradoxes for the relation they may have to the subjects of science and religion. Any of them, of course, can be argued about at length: There is nothing that a determinist resents more than a restriction of his freedom. What the lay proponents of freedom of choice want most is some sort of an authority. The freest religious spirits today generally believe in determinism thruout the entire natural order. Many modern scientists have felt free to believe in determinism.

6. The literature on the subject is varied, illuminating, and yet, taken together, perhaps confusing. E. W. Barnes, in "Scientific Theory and Religion," is a thorogoing theist. Bernhard Bavink, in "The Natural Sciences" and "Science and God," is perhaps a pantheist. Walter Lippman, in "A Preface to Morals," speaks of the passing of authority and tries to analyze the manner in which the 'acids of modernity' have

eaten away the once solid structure of authority. W. E. Orchard, in "From Faith to Faith," tells the story of his conversion and complete submission to the authority of the Catholic Church, to which he went from Protestantism.

Many lesser books discuss science and religion, most of them saying that "there is really no conflict". This blinks some of the difficulties, but does suggest the question, "What do scientists think about religious questions?" Some time ago two hundred members of the Royal Society were questioned on six items. Their replies have been classified in "The Religion of Scientists" by C. L. Drawbridge (Macmillan, 1932). The six questions were: (1) Is there a spiritual domain? (2) Is man in some degree responsible for his acts of choice? (3) Is belief in evolution compatible with belief in a Creator? (4) Do you think that science negatives the idea of a personal God as taught by Jesus Christ? (5) Do you believe that personalities of people exist after the death of their bodies? (6) Do you think that the recent remarkable developments in scientific thought are favorable to religious belief? To the first the answers were mostly yes, to the second mostly yes, the third mostly yes, the fourth mostly no, the fifth about even, the sixth mostly yes.

7. Immediately that introduces the question and problem of authority. Whence do we derive authority? Whence does religion derive its authority? and other such questions. This may represent a paradoxical situation in that such questions seem so vital in a day when so much is being written concerning the so-called passing of authority, when so many people are asking, "How does one know what to believe?"

8. Before leaving the subject of authority, I should like to combine it with item 8, calling item 8 "Use of texts as substitutes for authority." Here are two examples which are interesting if not amusing: I have heard scientists attack religion and theology, then, in expounding their own positions, quote some phrase of classical religion as a text. Again, I have heard representatives of religion denounce science and

yet enthusiastically quote some scientist (usually Eddington) that seems to verify belief in the life of the spirit.

But the outstanding texts used by various "sides" are: By scientists, "Know the truth and the truth shall make you free." (John 8:32) By representatives of religion, "Canst thou by searching find out God?" (Job 11:7) When anyone uses a text he tacitly adorns it with at least the cosmetic appearance of authority. But the interesting thing about the two texts quoted is not that they both come from the Bible but that when used they are almost invariably misused. "Know the truth . . . . " (not "Seek . . . " as it is so often misquoted) means, in the original context, a certain kind of truth, namely the truth about Christ. "Canst thou by searching . . . ." are the words of a critic of Job, a critic who, later in the book, is condemned for a false defense of God!

9. The last item concerns positive statements. Usually we might think of positive statements as those contained in creeds, dogmas, etc. If we describe, in a sentence, an age of science it might be something like this:—an age which is concerned with the "causes of sensible effects" (Newton), with the observed phenomena of nature, an age which professes to take no stock in a priori certainty. It has therefore scared many people out of attempting the adventure of positive statement. Scientists such as Galileo and Astruc feared to make positive statements because of opposition from representatives of religion. Now, it seems, representatives of religion fear to make positive statements because of scientists.

In the first place, absolute certainty is not to be had.

In the second place, it is not true that all religious experience is produced by and tied to some antiquated authority.

In the third place, we are just now at a place when we can begin abolishing fear, timidity, and negative dogmatism, and again set sails for the adventure of positive statement. And these positive statements will gather around two great nuclei: (1) Man's sense of God. (2) Man's struggling spirit.

Man will always have a religious philosophy, whether it be because he is a nuisance in his own search for truth or truths or because he really does have dim apprehensions of truth or truths beyond the mortal pale, or beyond the "observable phenomena of nature".

34. **Report on the Meeting of the Western Division of the American Philosophical Association Held at Bloomington, Indiana, March 29-31, 1934.** John Kuiper, University of Kentucky. The papers delivered at the meeting were briefly reviewed. Some controversial issues in Professor Swenson's paper on "What is Wrong with Current Systems of Symbolic Logic" were discussed at considerable length. The nature of logical systems based exclusively on truth-functions was clarified, and the System of Material Implications was defended against the main attack of the critic. The matrix method of proof was presented to show more clearly the characteristics of contemporary logical procedure.

35. **The Size and Shape of Molecules.** Edward Mack, Ohio State University. The investigations which organic chemists have been conducting for the past one hundred years have resulted not only in the development of methods of analysis and synthesis of organic molecules, but have also brought forth some very definite pictures of the structure of the molecules, of how the atoms within the molecule are joined together one to another in various skeletal shapes and various spatial configurations. It is interesting to apply some of the new physical methods to a study of the same problems to determine to what extent the reasoning of the physicist and the logic of the chemist check in leading to the same conclusions regarding molecular structure.

The most powerful tool, and the most useful in this connection, which the physicists have developed, is the x-ray analysis of crystal structure. With it one can show that the structures of such molecules as benzene, palmitic acid, hexamethylene tetramine, cellulose, certain proteins, etc., are indeed what the chemist had already deduced. Another interesting approach to the problem is by means of the oil film method, developed intensively in this country by Dr. Langmuir and Dr. Harkins. From an examination of the area of spread of various animal and vegetable oils on a water surface, one can calculate the length and cross-sectional areas of these long stick-shaped molecules, as they stand oriented in the surface.

Among several other methods which have been applied to this type of study, a kinetic method involving an experimental determination either of diffusion coefficients or viscosity coefficients may be mentioned. It permits one to calculate the average collision area of a molecule; and then, in combination with some scheme for obtaining the average cross-sectional area of models made to scale, such as a shadow method, it is possible to reach definite conclusions about the shape of the molecules in question. The general agreement between results obtained by chemical and physical methods is strikingly good.

THE KENTUCKY ACADEMY OF SOCIAL SCIENCE

This affiliated organization met (in the Woods-Penniman Building) as the Division of Social Sciences of the Kentucky Academy of Science, with Mr. W. J. Moore presiding, Dr. Esther Cole as secretary, and 22 members present. The following papers were presented:

1. **A Progress Report on F-6, "Farm Mortgages, Land Values and Tax Delinquencies" in Kentucky.** C. J. Bradley, University of Kentucky. The plan was described of the proposed survey as a part of a general survey which is to cover the whole United States.

2. **Rural Families on Relief.** Merton Oyler, University of Kentucky. The plan was described for a survey of 247 families on relief, in Knott, Madison and Todd counties.

3. **The Rural Housing Survey in Kentucky.** Mrs. R. P. Lorch, University of Kentucky. This was a joint project of the Bureau of Home Economics, U.S.D.A., and the Division of Agricultural Engineering of the College of Agriculture. Bourbon, Boyle, Calloway, Fayette, Fleming, Hardin, Hickman, Knott, Ohio, Oldham, Shelby and Simpson counties were

studied. In the 22,321 farm homes studied were 12,048 white owners, 9,028 white non-owners, 334 non-white owners, and 551 non-white non-owners. In construction, 62% of the houses were frame, painted; 24% frame, unpainted; 8% log; 0.5% stone, and about 0.12% concrete. About half were one story. In age, 24% were more than 50 years old; 33% from 25 to 49 years; 27% from 10 to 24 years, and 13% were built within the last 10 years. Sixty-five per cent needed painting, 38% needed foundations repaired or replaced, and 40% needed roofs repaired or replaced. Kerosene or gasolene lamps were used by nearly 90% of the families; washboards by 63%, and only 7% had water piped into the house. The engineers estimated that adequate housing would cost $22,500,000.

4. **County Jail Financing**. C. M. Stephenson, University of Kentucky. The fees and expenses allowed jailors, by statute, and the amounts actually collected and retained, in 36 counties, were compared. Two important findings were that detailed reports of receipts and expenses were not submitted, in most counties, and such reports as were made often were either too much condensed to be of much value, or the figures were so obviously padded as to be practically worthless. Expenses tended strangely to fluctuate up or down, or to disappear, as receipts went up or down, the idea apparently being to so doctor them that no excess earnings over $5000 might remain, to revert to the county, or as little as possible. The study shows that the earnings of jailors and sheriffs may be a fruitful field for further investigation and possible litigation to recover money unlawfully retained by these officers.

5. **Welfare Work in Kentucky Municipalities.** Harry R. Lynn, University of Kentucky. Discussed by Mr. R. F. Terrell.

6. **Forces Limiting Recovery.** Rodman Sullivan, University of Kentucky. The following were discussed: (1) The decline in the rate of increase of population, which ends expansion of the market for producer's goods. (2) The correspondingly increased number of aged dependents. (3) The increase in organized crime. (4) Payments to veterans. (5)

Competition in armaments, among nations. (6) Waste of natural resources. (7) Excessive debt, unwisely contracted. (8) Decreased foreign trade. (9) The spirit of nationalism which leads to the enactment of tariffs, quotas and embargoes. No way to counteract these influences is suggested, but the author thinks that maintenance of an attitude of "frantic search for a magic formula" to restore prosperity is detrimental to the best interests of the country.

7. Comment on Professor Sullivan's Paper. Charles J. Turck, Centre College. A planned society may be the remedy, provided the planning is for the good of the largest number. We have always had a planned society, but heretofore the planning was for the advantage of the upper ten per cent. That should be changed.

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TRANSACTIONS

of the

Kentucky Academy of Science

Affiliated With the A. A. A. S.

VOLUME SEVEN

Twenty-Second, Twenty-Third, and
Twenty-Fourth Meetings
1935-1937

Lexington, Kentucky
1938

The Kentucky Academy of Science

Its Objectives:

To correlate the science programs of the respective colleges with

1. One another
2. With industry
3. With the scientific agencies of the state

To Make the Results of Their Work Available

All Science Is One—All Scientists Should Be One

The Academy should therefore enroll for an active part in its activities: Teachers of sciences, Professors, Geologists, Physicians, Conservationists, Technical workers, Serious amateurs.

TRANSACTIONS

OF THE

KENTUCKY ACADEMY OF SCIENCE

AFFILIATED WITH THE A. A. A. S.

VOLUME SEVEN

TWENTY-SECOND, TWENTY-THIRD, AND
TWENTY-FOURTH MEETINGS

1935-1937

This Volume was Edited by

A. M. PETER and
THE PUBLICATIONS COMMITTEE
Assisted by Ethel V. T. Caswall

LEXINGTON, KENTUCKY

1938

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Kentucky Academy of Science

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1934-1935

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Vice-president, J. S. McHargue, Experiment Station, Lexington.
Secretary, A. R. Middleton, University of Louisville.
Treasurer, W. S. Anderson, Experiment Station, Lexington.
Representative in the Council of the A. A. A. S., A. R. Middleton.

1935-1936

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1936-1937

President, Robert T. Hinton, Georgetown College.
Vice-president, L. Y. Lancaster, Western State Teachers College, Bowling Green.
Secretary, A. R. Middleton, University of Louisville.
Treasurer, Alfred Brauer, University of Kentucky.
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AFFILIATED ORGANIZATIONS

Kentucky Academy of Social Science
Kentucky Junior Academy of Science
Kentucky Ornithological Society
Kentucky Psychological Association
Kentucky Section, American Association of Physics Teachers
Kentucky Section, Mathematical Association of America
Kentucky Section, American Chemical Society.
Louisville Astronomical Society

In Memoriam

Theodore B. Beust,	1871—1937
C. E. Caldwell,	—1937
Daniel Joseph Healy,	1873—1934
Victor Emmanuel Muncy,	1860—1934
L. Otley Pindar,	—1936
Frank Lewis Rainey,	1867—1936
Elmer Ellsworth Snoddy,	1863—1936

FRANK LEWIS RAINEY, SC.D., LL.D., 1867-1936

President of the Kentucky Academy of Science

1929-1930

PRESS OF
THE · KENTUCKY · KERNEL
UNIVERSITY · OF · KENTUCKY
LEXINGTON

MINUTES OF THE TWENTY-SECOND ANNUAL MEETING

The twenty-second annual meeting of the Kentucky Academy of Science was called to order by the President, Dr. A. M. Peter, at 2 p. m. on May 3, 1935, in Room 111, McVey Hall, University of Kentucky.

The President introduced Dr. Howard E. Enders, Dean of the School of Science, Purdue University, official representative of the American Association for the Advancement of Science and of the Indiana Academy of Science. Dr. Enders spoke briefly on the organization and work of the Junior Academies.

The Secretary's report, which showed a total membership of 235, composed of 198 active, 21 corresponding and 16 honorary members, was read and approved.

The Secretary made his report as Representative of the Academy on the Council of the A. A. A. S. and in the Academy Conference of the A. A. A. S. The principal item of interest to the Kentucky Academy was the decision of the Council of the A. A. A. S. to discontinue rebates to the Academy on joint memberships.

Treasurer W. S. Anderson read his report which showed a balance of $247.65. He then requested that he be released from the duties of Treasurer.

The Auditing Committe reported that they had examined the accounts of the Treasurer and found them correct.

The Membership Committee recommended 33 persons for membership in the Academy. They were unanimously elected.

Dr. Buckner read resolutions on the deaths of Dr. D. J. Healy and Mr. V. E. Muncy and they were unanimously adopted and made part of the min utes.

The report of the Executive Committee was approved.

The following amendments to the constitution were adopted:

To Article III, Paragraph 1, was added "Emeritus members, fellows, and emeritus fellows."

"Article V. Executive Committee. The Executive Committee shall consist of the President, Vice President, Secretary, Treasurer, President of the Preceding Year, and the Chairman of the Committee on Junior Academy. The Executive Committee shall direct the affairs of the Academy during the intervals between regular meetings, except those duties assigned to the Council, and shall fill all vacancies occurring during such intervals."

"Article VI, Affiliation of Scientific Organizations. Any scientific organization in the State, in a field of science recognized by the American Association for the Advancement of Science, may affiliate with the Kentucky Academy of Science upon application approved by the Executive Committee and a three-fourths vote of the active members voting at a regular meeting of the Academy."

"Aricle VII, Council. The Council shall consist of the Executive Committee and one member elected from each affiliated organization. The duties of the Council shall be (1) to pass upon all matters pertaining to the relation of affiliated organizations to the Academy; (2) to serve on the Programme Committee for the annual meeting, and (3) to promote the interests of the Academy."

The Article on Standing Committees was redesignated Article VIII, and amended as follows: to the first paragraph was added the word "annually" in place of the word "permanently." The word "permanently' was also substituted for the word "annually" in the third paragraph. The fourth paragraph was adopted as follows: "A Committee on Junior Academy, composed of five members, appointed permenently by the President." The other three standing committees authorized by this article are Committee on Membership, Committee on Publications, and Committee on Legislation. The first of these to consist of 3 members, the second of the President, the Secretary and a third member chosen annually by the Academy, the third consists of 3 members. The members of the Committee on Membership, the Committee on Legislation, and the Committee on Junior Academy are appointed permanently by the President.

The article on meetings was redesignated "Article IX—Meetings." The first paragraph was changed to read: "The regular meetings of the Academy shall be held at such time and place as the Executive Committee may select. The Executive Committee may call a special session, and a special session shall be called at the written request of twenty members."

The Article on publications was redesignated "Article X—Publications."

The article on amendments was redesignated "Article XI—Amendments."

Article V of the By-Laws was amended to read "V. The initiation fee for active members shall be one dollar, except that a member of an affiliated organization may join without payment of an initiation fee. Annual dues of local and national members shall be one dollar. Life membership shall be twenty dollars."

Section XI of the By-Laws was amended to read: "XI—The program committee shall consist of the Council of the Academy and the Secretaries of the divisions. They shall serve from one annual meeting to the next."

The report of the Committee on Junior Academy was read by Dr. Schnieb and approved.

The application of the Kentucky Ornithologcial Society for affiliation with the Kentucky Academy of Science was approved.

Reognition of the valuable work done for the Junior Academy was accorded Dr. Peter thru the presentation to him of a pin.

The meeting the adjourned until 9 a. m., May 4.

The second session was called to order at 9 a. m., Saturday, May 4, by the Vice-President, Dr. McHargue, in the absence of the President.

The nominating committee reported as follows:

Dr. J. S. McHargue, President; Dr. W. R. Hutcherson, Vice-President; Dr. A. R. Middleton, Secretary; Dr. Alfred Brauer, Treasurer; Dr. A. M. Peter, President Emeritus and Editor of The Transactions; Dr. A. R. Middleton, Representative on the Council of the A. A. A. S.

A ballot was cast and these persons were duly elected to the offices designated.

The report of the Resolutions Committee was read and approved.

Prof. Herndon, of Eastern State Teachers College, Kentucky, invited the Academy to hold its next annual meeting at that institution. The Academy voted its appreciation and referred the invitation to the Executive Committee.

The meeting then adjourned.

Austin R. Middleton, Secretary.

REPORT OF MEMBERSHIP COMMITTEE

Your Membership Committee recommends the following candidates for membership in the Academy:

Dr. Richard H. Weaver Dept. Bacteriology, University of Kentucky, Lexington.
Leonard R. Crow, Educational Electric Mfg. Co., Terre Haute, Indiana.
Claybourne Stephens, Jr., Prestonsburg, Ky., Chem-Biol. Eastern State, teaching Gen. Sci. at Martin, Kentucky.
Miss Alice Gossett, Teacher Sci., Shawnee High School, Louisville.
Dr. Lawrence M. Baker, Assoc. Prof. Psychology, Berea College.
Dr. Hugh Mahaffey, M. D. Richmond, Ky.
Dr. T. J. Turley, Dentist, Richmond, Ky.
Miss Emily Hess, Burnham Hall, Richmond, Ky.
Miss Virginia Lee Smith, 2110 Cherokee Parkway, Louisville, Ky.
Mr. J. B. Scearce, Junior at Eastern State T. C., 444 Oak St. Richmond, Ky.
Mr. Bertrand P. Ramsey, Physics Dept. University of Kentucky, Lexington.
Miss Charlie Anna Burnfin, Biology, Berea College.
Mr. Charles Jackson Chance, Biology, Berea College.
Mr. Henry G. Martin, Biology, Berea, College.
Dr. Raymond Millard Cable, Assoc. Prof. Biology, Berea College.
Mr. Edward Batts, Graduate Student, University of Louisville.
Mr. Oscar Steinberg, Graduate Student, University of Louisville.
Mr. Raymond F. Woerth, Berea College.
Mr. T. M. Hahn, Asst. Prof. Physics, Univ. of Ky., Lexington.
Dr. M. L Billings, Dept. Psychology, Western State T. C., Bowling Green, Ky.
Mr. Guy Forman, Dept. Physics, Western State T. C., Bowling Green, Ky.
Dr. C. P. McNally, Dept. Chemistry, Western State T. C., Bowling Green, Ky.
Dr. J. T. Skinner, Dept. Chemistry, Western State T. C., Bowling Green, Ky.
Dr. H. L. Stephens, Dept. Botany, Western State T. C., Bowling Green, Ky.
Mr. J. R. Whitmer, Dept. Physiology, Western State T. C., Bowling Green.
Mr. B. C. Cole, Dept Bacteriology, Western State T. C., Bowling Green.
Mr. W. B. Youmans, Dept. Biology, Western State T. C., Bowling Green.
Mr. Marvin Baker, Dept. Chemistry, Western State T. C., Bowling Green.
Dr. R. J. Griffin, Dept. Geography and Geology, Western State T. C.,
Mr. Charles Robert Allen, Biology, Bowling Green, Ky., High School.
Mr. J. S. Jackson, Biology, Bowling Green, Ky., High School.
Miss Jennie Miller Orr Hardinsburg, Ky.

REPORT OF THE COMMITTEE ON NECROLOGY

Since the last meeting of the Kentucky Academy of Science, death has claimed two valued members, Daniel Joseph Healy, and Victor Emmanuel Muncy.

Daniel Joseph Healy (1873-1934), for many years a distinguished Lexington physician and surgeon and research bacteriologist of the Kentucky Agricultural Experiment Station, was a charter member of the Kentucky Academy of Science and until his death, November 24, 1934, took an active and enthusiastic interest in its organization and meetings.

Victor Emmanuel Muncy (1860-1934) an alumnus of the A. and M. College of Kentucky, taught for some years in that institution, after which he effectively served for many years as Dean of Mechanical and Electrical Engineering at the Ohio Mechanics Institute, Cincinnati. He was a highly esteemed member of the Kentuky Academy of Science from 1932 until his death, October 27, 1934.

The loss of these members will be keenly felt by the Kentucky Academy of Science and by those associates and colleagues who have been stimulated and encouraged by the friendship and personalities of these cultured and refined gentlemen. As an expression of sorrow and acknowledgement of loss, be it resolved that these resolutions be made a part of the permanent records of the Academy.

G. DAVIS BUCKNER,
Committee.

REPORT OF THE RESOLUTIONS COMMITTEE

The Kentucky Academy of Science desires to express its apprecaition of the services of those who have assisted in starting the Junior Science Bulletin. This new periodical has taken a definite place among the activities of the Academy, and is a valuable aid in stimulating the interest of the young people of the state in science. In particular the Academy expresses its thanks to Dr. Anna A. Schnieb for her activities in initiating and carrying the Bulletin to success.

The Kentucky Academy of Science desires again to call the attention of all scientific organizations in the state to the importance of affiliation with the Academy of Science. It urges the few societies which have not yet done so, to consider the desirability of being formally represented in this body so that the Academy of Science may speak unitedly on any matter directly concerning the welfare of science.

A. J. OLNEY
V. F. PAYNE
J. B. MINER, Chairman.

JUNIOR ACADEMY

Second Annual Meeting, 1935

The second annual meeting of the Junior Academy of Science was held May 4, 1935, in the Museum Building, University of Kentucky. Following registration and the study of the club exhibits, the meeting was called to order by Susie Bullock, president. The roll call by clubs was: Anchorage, Bellevue, Buena Vista, Camp Dick Robinson, Fern Creek, Harrodsburg, Kirksville; Red House, St. Catherine Academy, Shawnee, Louisville, Speedwell, Union City, Waco, White Hall. The guest speaker Dr. Funkhouser, spoke on "Tropical Jungles." At the business session of delegates the following officers were elected: President, Margaret Van Arsdall, Harrodsburg; Vice-President, Claude Erd, St. Catherine Academy; Secretary, Mavoreen Long, Newby; Treasurer, Ernest Harris, Union City. Prizes were awarded as follows:

Best exhibit: Class A, St. Catherine Academy; honorable mention, Harrodsburg High School; Class B: White Hall High School.; Union City, honorable mention.

Largest percentage of membership present: Newby, Union City, Waco, White Hall.

Best contribution to Junior Science Bulletin: Thelma Roop, Shawnee High School; Joyce Cotton, White Hall.

Largest percentage of pins owned: St. Catherine Academy.

Best discussion: Class A, St. Catherine Academy; Class B, Anchorage High School.

Attendance at meeting, 300.

PAPERS PRESENTED AT THE GENERAL SESSIONS

Organization and Work of the Junior Academies. Howard E. Enders, Purdue University.

Dynamic Equilibrium and the Business Cycle. L. S. O'Bannon, University of Kentucky.

The Phosphatic Limestone of Kentucky. A. M. Peter, University of Kentucky. (President's Address)

THE PHOSPHATIC LIMESTONE OF KENTUCKY. (President's Address) A. M. Peter, University of Kentucky. What usually is considered good limestone, suitable for building, making roads and for burning into lime, consists, almost wholly of calcium carbonate or of the carbonates of calcium and magnesium. The percentage of phosphate present usually is negligible. Indeed, phosphate seldom was mentioned in the old chemical analyses of limestone.[1] Accordingly, certain early observations of the presence of phosphate in Kentucky limestone, deserve to be reviewed because of their historical interest.

Eighty-eight years ago, in March, 1847, as shown by the laboratory record in my possession, Dr. Robert Peter, Professor of Chemistry and Pharmacy in the Medical Department of Transylvania University, tested a specimen of fossiliferous limestone from the banks of Elkhorn Creek in Franklin County, and found a notable quantity of phosphate. He did not estimate the percentage. This is the earliest record I have found which shows that some limestone in central Kentucky contains more than the usual small percentage of phosphate. Apparently, this observation was not published or followed up. Presumably, Dr. Peter was too much occupied with his work in the medical school to do anything more about phosphatic limestone at that time, but in latter part of 1848 and early 1849 he made quantitative analyses of "blue limestone from Mr. Clarke's well near the Medical Hall,"[2] and was astonished to find in some specimens as much as 3.3 percent of phosphorus pentoxide, equivalent to 7.2 percent of tricalcium phosphate. This finding was so incon-

1 Beck, Lewis C., Natural History of New York, Part III, Mineralogy, pp 67-82. Albany, 1842. Hitchcock, Edward, Geology of Massachusetts, Vol. 1, pp 80 and 81, 1841.

2 This building was on the northwest corner of Broadway and Second Street, Lexington, facing Second. It was burned in 1863 while occupied as a Federal hospital.

sistent with the current knowledge of the composition of limestone, that the Doctor tested his samples in two or three different ways and even separated phosphoric acid in the pure state, to make sure that he really was estimating phosphate.

Altho Robert Peter was a doctor of medicine, teaching in the Medical Department of Transylvania University, he was much interested in agriculture and in geology. He saw the connection between the fertility of the soil of the bluegrass country and the nature of the limestone from which it had been formed. The bearing of his discovery upon local agricultural conditions accounts for his having reported it in an agricultural journal, "The Cultivator," of Albany, New York.[3] In this paper he suggested that the soil of the bluegrass country owes its enduring fertility, in great measure, to its large content of phosphate derived from the limestone from which the soil was formed. He also suggested that lime made from this stone should be better for agricultural use than ordinary lime, because of its phosphate content.

The paper reports the analyses of two samples of limestone. The one that showed the larger percentage is reproduced below, just as it appears in the "Cultivator." In the note book the specimen is described as "Blueish-gray, crystalline rock containing few fossils."

"Specimen No. 1, is of the hard gray limestone; it was dug out of a well in the City of Lexington; it contains geodes lined with brown spar, pearl spar, calc spar and fluor spar and the usual fossils; its specific gravity is 2.45 in a dry specimen. On analysis it was found to be composed of the following materials; viz.

Carbonic acid	36.675
Phosphoric acid	1.350
Sulphuric acid	.807
Lime	47.046
Magnesia	.900
Alumina and oxide of iron	9.880
Fine sand and silicates	1.790
Moisture and loss	1.552
	100.000

"In addition to these ingredients, potash and soda were obtained from the limestone, whenever the proper processes were employed; in one case as much as 0.0487 per cent. of patash; in another 0.0058 per cent. * * * * Some specimens appear to contain a larger proportion of phosphoric acid[4] than is stated above; one analysis gave me 2:57 per cent as estimated by the pre-

3 "Limestone Soil of Kentucky. Remarks on the agricultural value of the Blue Limestone of Kentucky; with its analysis: By Robert Peter, M. D., Professor of Chemistry in the Medical Department of Transylvania University, Lexington, Ky." The Cultivator, Albany, April, 1849. pp 105-107. New Series Vol. 6, No. 4.

4 In the old nomenclature, phosphorus pentoxide was called phosphoric acid. This usage still holds in the commercial fertilizer industry.

cipitated phosphate or iron.[5] * * * * It must be evident from the foregoing facts, that the Blue Limestone of Kentucky * * * * will be a valuable agricultural resource, when the soil begins to show the inevitable consequences of the constant exportation of its products."

Dr. Robert Peter seems to have been the first to report the large phosphate content of the blue limestone of central Kentucky and the correspondingly large phosphorus content of the soil of this region, formed from the limestone. He seems not to have sought further for phosphatic limestone at this time and his later analyses made for the State Geological and Agricultural Surveys under Owen and Shaler do not show percentages larger than about 2 percent of tricalcium phosphate, until 1876. On September 5 of that year, however, while driving on the Newtown road, from his home to his laboratory in Morrison College, Lexington, he noticed a peculiar granular piece of stone among limestone which had been taken from a small quarry nearby and dumped on the roadside to be used for mending the road. This specimen, on analysis, yielded 31.8 percent of phosphorus pentoxide, equivalent to about 69.5 percent of tricalcium phosphate. The stone contained, also, a notable proportion of fluoride. The writer assisted in making this analysis.

The sample was described as "A somewhat friable rock of bluish-gray color, brownish-gray on weathered surfaces, containing many microscopic marine univalve shells.[6] The following is the chemical analysis.[7]

"No. 1778. Phosphatic Limestone, McMeekin quarry, Fayette County, Ky.

Composition, dried at 212° F.	Percent
Tricalcium phosphate, calcium fluoride, iron oxide and alumina	85.27
Calcium carbonate	9.18
Magnesium carbonate	0.37
Silica and insoluble matter	4.78
Alkalies, organic matter, etc., not estimated	0.40
	100.00
Phosphorus pentoxide	31.815

Equivalent to 69.48 percent of tricalcium phosphate."

Later, many other samples from this quarry were analyzed, and it was estimated that stone from the whole 7-foot vertical thickness would average between 10 and 11 percent of tricalcium phosphate. Average samples representing a layer about 1 foot thick gave 21 percent of phosphorus pentoxide, equivalent to 45.8 percent of tricalcium phosphate. The quarry has not been worked for many years. Its site is on the west side of the Newtown road, about

5 Examination of the original notes suggests that the percentage, 1.35, is only about one-third of the percentage actually present in this sample. The figure represents the P_2O_5 in the ferric phosphate precipitated from acetic acid solution, by the iron present in the sample. Dr. Peter assumed that the stone contained enough iron to combine with all the phosphoric acid, but that is not true in these phosphatic limestones. The probability is that the larger part of the 9.88 percent of "alumina and oxide of iron" was tricalcium phosphate, and that the stone contained two or three times as much phosphate as was stated in the analysis.

6 Later identified as *Cyclora minuta*.

7 Ky. Geological Survey, Vol. A. Chemical Analyses, Part 1, p 246.

4 miles from Lexington, on Coldstream Farm, at the top of the hill southwest of the entrance to the Municipal Airport.

This discovery by Robert Peter led to an extended study by the Kentucky Geological Survey and other agencies. It was found that about 40 feet in thickness, of the upper part of the Lexington (Trenton) limestone is highly phosphatic. These layers come to the surface over a large area in the central part of the Bluegrass region. In 1913, Arthur Miller named this geological division Woodburn after the Alexander estate in Woodford county. The whole thickness is not exposed in any quarry, but small quarries and railroad cuts expose parts, at many places. One of the best is in a railroad cut at Versailles. This section was sampled for analysis by that careful and experienced geologist, Augustus F. Foerste, for the Kentucky Geological Survey. The analysis, made by Dr. J. S. McHargue, gave the following results.*

Phosphatic Limestone. Analysis. Percent.

Part of face averaged	Tricalcium phosphate	Calcium carbonate	Magnesium carbonate
Upper 9½ feet	6.1	83.7	6.2
Next lower 7 feet	9.4	85.6	6.6
Next lower 2½ feet	55.5	32.6	1.8
Next lower 8 feet	3.1	89.0	5.9
Calculated average for the whole 27 feet	10.6	81.0	5.8

Thus, if stone from the whole thickness were ground for agricultural use, a ton would contain 212 pounds of tricalcium phosphate and have a neutralizing value equivalent to about 1760 pounds of calcium carbonate.

The analyses in full are given in the following table. This is the most careful sampling we have of the formation.

Phosphatic Limestone at Versailles. Analyses of Average Samples. Percent.

	Upper 9½ feet	Next 7 feet	Next 2½ feet	Lowest 8 feet
Moisture at 100° C.	0.20	0.00	0.18	0.06
Ignition (carbon dioxide, &c)	37.90	38.54	15.40	40.32
Insoluble in acid	6.58	5.68	2.80	3.96
Alumina	0.56	0.42	0.70	0.19
Ferric oxide	0.80	0.72	1.12	0.64
Calcium oxide	46.87	47.94	50.96	49.84
Magnesium oxide	2.95	3.14	0.86	2.81
Phosphorus pentoxide	4.30	4.30	25.40	1.40
Sum	100.16	100.74	97.42	99.22

The iron was in the ferrous condition. Fluoride was present in all the samples.

* Ky. Geol. Survey, 4th Series, Vol. 1, p 381. Frankfort. 1913.

An excellent face of the phosphatic limestone is the quarry of the Fayette Rock Company, on the Liberty road just east of Lexington. Here a vertical thickness of about 20 feet is worked for crushed stone. Samples from different parts of this face, analyzed by the State Highway Department, gave the following results:

		Top	Middle	Bottom
Phosphorus pentoxide	percent	0.46	4.40	1.87
Equivalent to tricalcium phosphate .	percent	1.00	9.60	4.10
Calcium carbonate	percent	96.40	83.50	87.40

The operations of this company give a good opportunity to learn what can be expected from grinding the phosphatic limestone on a commercial scale. In this plant, stone from the whole 20 foot face is crushed for use in road building and in making concrete. It is necessary to screen out the dust from the crushed stone, and this may be disposed of for agricultural use. The writer recently analyzed three samples of this dust, ground in different years. The results are as follows:

Analyses of Ground Limestone. Fayette Rock Co. Percent.

Produced in	1932	1933	1934
Phosphorus pentoxide	5.3	5.2	6.8
Equivalent to tricalcium phosphate	11.6	11.4	14.8
Neutralizing value as calcium carbonate	85.8	88.1	81.7

So it appears that a ton of this ground stone contains two or three hundred pounds of tricalcium phosphate. It is surprrising that the remarkable store of a valuable fertilizer contained in the phosphatic limestone has not been exploited by enterprising farmers on the less phosphatic soil of the state, and by those who are promoting good farming. I know of no instance in which experiments with the phosphatic limestone have been made on soil that was both acid and deficient in phosphate. It is true that much phosphatic limestone dust is used by farmers, for its neutralizing value, but I am told that little, if any, goes to parts of the state where the soil is deficient in phosphate and also acid. It seems to me that the principal use of this kind of limestone should be in Eastern Kentucky, within hauling distance of the phosphatic deposits, where most of the soil is acid and deficient in phosphate. Theoretically, a moderate application of this kind of stone to an acid soil deficient in phosphate would both reduce acidity and supply needed phosphate, to be rendered soluble by the soil acid.

While we have no direct experiments with the phosphatic limestone, certain long-time experiments with limestone and phosphate rock, on the soil fertility fields of the Station seem to support the theory that phosphatic limestone would be effective as a source of phosphate on acid low-phosphate soil. The following results are from bulletins of the Experiment Station. Limestone and rock phosphate were applied each four years, in a crop rotation. The figures show the average increase in yield over the untreated plots.

Increase in Yield of Corn at the Soil Fertility Fields, from Application of Limestone and Tennessee Rock Phosphate, and Limestone and Superphosphate.

Field	Number of crops averaged	Limestone and Rock phosphate	Limestone and Super-phosphate	Soil tests Acidity	Soil tests Easily soluble phosphorus
		Bu per A	Bu per A	pH*	Lbs per A
Berea	17	18.3	18.7	4.5	880
Fariston	14	20.0	35.2	4.5	820
Greenville	16	16.2	19.6	5.5	660
Mayfield	16	11.9	8.8	4.9	960
Average of 63 crops on 4 kinds of acid, low-phosphate soil		16.6	20.9		

* pH is a measure of acidity. A neutral soil is pH 7. The smaller the pH value, the stronger the acidity. Most of our crops do best at about pH 6.

So it appears that limestone and rock phosphate, applied separately to acid soil, produced nearly as good yields of corn as limestone and superphosphate. Is it not reasonable to anticipate a similar result from phosphatic limestone, an intimate mixture of phosphate with limestone?

I think that we have in this formation about Lexington a more valuable resource than is now realized, for the farmers of Eastern Kentucky. We seem to have in this material just what is lacking in acid, low-phosphate soil but a demonstration is needed. Perhaps some enterprising member of this Academy will start the good work.

PAPERS PRESENTED AT DIVISIONAL MEETINGS

DIVISION OF BIOLOGICAL SCIENCES

J. Holmes Martin, Chm. L. Y. Lancaster, Sec.

THE LEAF-CUTTER ANTS AND THEIR ACTIVITY. Austin R. Middleton, University of Louisville. One of the pests of tropical and sub-tropical regions is an insect that attacks, without discrimination, any plant with a woody stem, from hibiscus hedges to tree ferns, banana palms and the great ceiba tree. The organism is a colonial insect and the colony consists of four castes: minims, workers, soldiers, and sexual individuals. They are the leaf-cutter ants.

These insects build nests consisting of underground passages and chambers. The galleries in these nests range from an inch to fifteen inches in diameter and some of the chambers are very large. The excavated soil is dropped on the surface around the entrances to the nest and in this manner the earth surface over the nest is built up into a low, broad mound. The particular nest upon which this study was made had a mound over it approximately fifteen feet in diameter with a maximum elevation of about one foot.

In opening one of these nests one must guard himself against the annoying bite of the soldiers which, tho not poisonous, draws a drop of blood. Once the mandibles are fastened in the skin, the insect never lets go its hold. In plucking them off the head is left attached to the skin. A more serious danger is that there are abandoned galleries and chambers in the nests and these are frequently preempted as dens by poisonous snakes and other reptiles.

The workers as soon as the colony is started, begin cutting the mesophyll from the leaves of the shrubs growing over the nest and of those surrounding it, thus killing the plants and leaving the mound surface exposed. They next begin to travel a distance away from the nest to cut segments from the leaves of more distant shrubs, bushes and trees. In doing this, subsequent workers follow the trail blazed by the pioneer explorers. While these insects have eyes, it is probable that scent plays the more important role in this process since it was observed that workers caught on the runway in a rain frequently became confused and permanently lost the trail. Further, on one occasion, the observer was smoking a cigarette beside the runway and when a whif of smoke drifted down on it, the workers immediately became entirely confused, wandered off the runway in every direction and failed to find their way back to it.

This constant use of the same paths results in the development of curved-bottomed runways at least four inches wide, hard-packed from constant traffic and quite smooth. Many of these runways extend for considerable distances from the nest. The particular runway of the nest involved in this study measured two hundred and eight and one-half feet in length. Runways at least a half-mile in length have been reported by others. The runwways are not straight but wander off into the jungle to the base of some plant up which the workers travel to the topmost leaves.

These insects seem to have no preference for any particular kind of leaf. They were observed taking segments from the leavs of ferns, banana palms, ceiba trees and, indeed, practically every type of woody plant in the jungle. In 1933 Dr. H. E. Enders, Dean of the School of Science of Purdue University, timed the workers in the cutting of the leaf segments and found that it took one minute to cut a segment about the size of an American dime. This is the size of the segments usually carried. These leaf segments are not used as food. They are chewed to a pulp by the minims and this pulp becomes a culture medium in which grows a fungus, upon which the insects feed.

The Specific Problem. The present study is an attempt to determine the destructiveness of these insects, their work-efficiency and whether there are rhythms in their work-activity.

Technique. A large nest, beside the trail to the swimming pool in the Tela River, near the Lancetilla Agricultural Experiment Station of the United Fruit Company, was selected for this study. A curved twig was set up, arching over the selected runway, about fifteen feet from its entrance into the nest. This was necessary since workers carrying loads frequently collide with other individuals leaving the nest and as a result get their direction reversed and this plan was found effective in keeping an accurate record of the number actually entering the nest. The counts were made for successive fifteen-minute periods and a comptometer was used, one person making the count and another doing the timing and recording the figures.

Records. The first count was made on August 6, 1934, and covered the successive fifteen-minute periods from 7:10 a. m. to 6:55 p. m. of that day. Figure 1 is the graph of the totals for each of the twelve hours involved. It was at 6:12 p. m. that the incident of the cigarette smoke recorded above occurred. Heavy rain started at 6:55 p. m. and by 7:10 p. m. the runway was deserted, the workers dropping their loads and scurrying under fallen leaves and debris beside the runway if they were not close enough to gain the entrance into the nest. The hour during which there was the greatest activity was between 3:10 p. m. and 4:10 p. m. During that hour, 3,213 loaded individuals entered the nest. However, the previous hour was one of marked activity also. During it, 3,193 loaded individuals entered. Reference to Figure 1 shows that marked activity occurred from ten o'clock in the morning until six o'clock

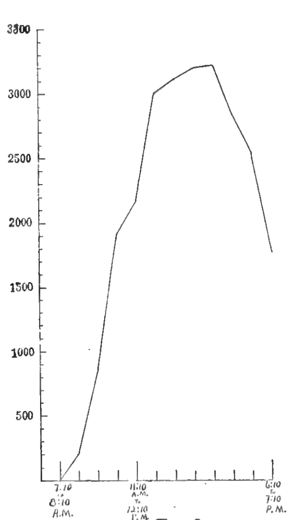


Fig. 1.

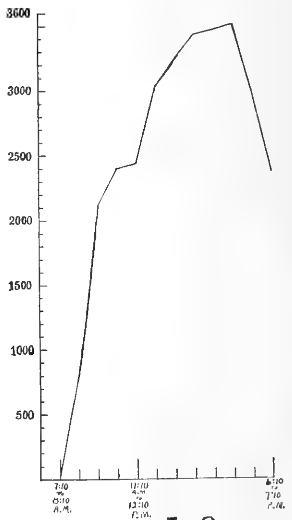


Fig. 2.

FIGURE 1. Activity over one runway from 7:10 a. m. until 7:10 p. m. of August 6, 1934. The ordinates show number of loaded individuals entering the nest. The abscissae represent the consecutive hour periods. Marked activity occurred between 8:10 a. m. and 6:10 p. m.

FIGURE 2. Activity over one runway from 7:10 a. m. until 7:55 p. m. of August 15, 1934. The ordinates show number of loaded individuals entering the nest. The abscissae represent the consecutive hour periods. Marked activity occurred, as in Figure 1, between 8:10 a. m. and 6:10 p. m. The change in the character of the leaf segments brought to the nest occurred about 11:40 a. m.

in the evening of this day. That activity had begun to slacken as early as 4:40 p. m., however, is shown by the following successive fifteen-minute counts from that time until 6:55 p. m., i. e., 707, 653, 646, 651, 627, 615, 615, 615, 537. The total number of loaded workers entering the nest over the single runway, during these eleven hours and forty-five minutes, was 24,827. This is at the average rate of 2,113 per hour.

A second count was made on August 15, 1934, which covered the successive fifteen-minute periods from 7:10 a. m. until 7:55 p. m. Figure 2 is the graph of these counts plotted from the totals per hour. The hours during which there was the greatest activity were 2:10 to 3:10 p. m. with a total number of loaded workers entering the nest of 3,435; 3:10 to 4:10 p. m. with a total number of loaded workers entering the nest of 3,465; and 4:10 to 5:10 p. m. with a total number of 3,507 loaded workers entering the nest. It should be again pointed out that this is the record of the activity over only one of the five runways of this nest. These hours of greatest activity correspond quite well with those of the previous count, made nine days earlier. The total number of loaded workers entering the nest during the twelve hours and forty-five minutes of this count was 30,630. This is at the average rate of 2,402 per hour.

Between 10:40 and 11:40 a. m. of this second count leaves apparently became scarce on the plant being stripped, since, at the beginning of this period, the transported leaf segments were quite veiny and after this leaf segments being carried in were from a differnt species of plant.

The third count was made during the successive twenty-four hours from 7:10 P. M. of August 19, 1934, until 7:10 p. m. of August 20, 1934. Figure 3 is the graph of the activity during these twenty-four consecutive hours, plotted from the totals per hour. During the forenoon of August 20th, the number of loaded workers entering the nest over the single runway was: 1,341, from 7:10 to 8:10 a. m.; 2,587, from 8:10 to 9:10 a. m.; 4,356, from 9:10 to 10:10 a. m. and this was the hour of greatest activity of the whole twenty-four. From this time there was a steady decrease of activity during the afternoon to a total of 1,932 loaded workers entering the nest over the single runway from 5:10 to 6:10 p. m. During the hour 6:10 to 7:10 p. m. only 848 loaded workers entered the nest over this runway, but a shower occurred from 6:10 to 6:25. There had also been rain from 3:55 to 4:10 p. m. and during the hour from 3.10 to 4:10 only 2,713 loaded workers had entered the nest over this runway. The period of greatest activity was from 8:10 a. m. to 6:10 p. m. as in the previous two counts. The total number of loaded workers entering the nest over the single runway between 7:10 a. m. and 7:10 p. m. was 33,462. This is at average rate of 2,788.5 per hour.

The hours from 7:10 p. m. of August 19th to 7:10 a. m .of August 20, 1934, present a different picture. During the first of these hours 2,088 loaded individuals entered the nest over the single runway; the next hour that total was 1,198; the next, 1,054. From this time on there was an irregular but definite decline in activity with only 240 loaded individuals entering the nest over this single runway between 4:10 and 5:10 a. m. This was followewd by a total of but 22 between 5:10 a. m. and 6:10 a. m. and 16 between 6:10 and 7·10. The total number entering the nest from 7:10 p. m., August 19th to 7:10 a. m., August 20, 1934, was 9,406. This was an average of only 784 per hour in contrast with 2,788.5 for the succeeding twelve hours.

Thus, in this particular nest, there is definite evidence of a periodicity of activity on the part of the workers. There is a practical cessation of activity between 5:10 and 7:10 a. m. During the first count only 16 individuals entered the nest from 7:10 to 8:10 a. m.; on the second count, only 26 entered the nest; and on the third count, only 341 entered the nest during that hour, with totals for the two preceding hours significantly low, as shown in the preceding paragraph. The period of greatest activity was between 8:10 a. m. and 6:10 p. m. on all three counts. The relation of these periods of activity is shown graphically in Figure 4.

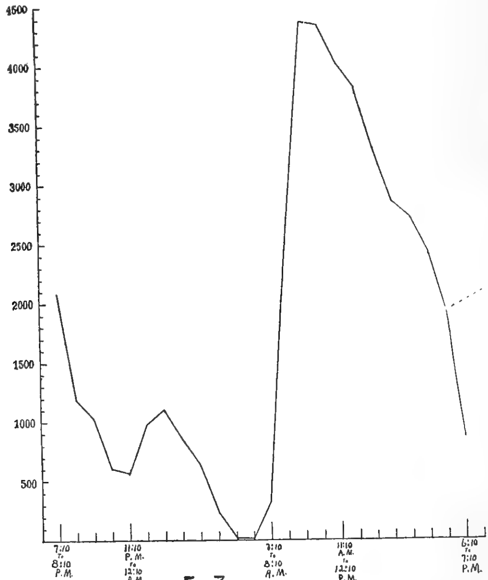


Fig. 3.

FIGURE 3. Activity over one runway from 7:10 p. m. of August 19, until 7:10 p. m. of August 20, 1934. The ordinates show number of loaded individuals entering the nest. The abscissae represent consecutive hour periods. During this count marked activity occurred between 8:10 a. m. and 6:10 p. m. of August 20, 1934. The time when a shower occurred is indicated by a dotted line. One may, perhaps, infer that if rain had not occurred at 6:10 p. m. of August 20, 1934, the direction of the graph would have been that indicated by the dotted line, thus corresponding with the activity of these hours of the evening of the 19th. This graph shows that activity is approximately only one-third as great during the night as during the day, and that there is an almost complete cessation of activity between 5:10 and 7:10 in the morning.

Work Efficiency. It was decided to determine the average weight of the workers and that of the load carried by each worker. The workers were collected in erlenmeyer flasks which had been plugged with absorbent cotton and dried in a laboratory oven and a desicator and then weighed on accurate chemical balances in the Soil Research Laboratory of the United Fruit Company. The capturing of the workers off the runway required the cooperation of two persons, one of whom lifted the worker and his load off the runway with a pair of fine forceps; the other opened the flask for the reception of the worker and load and replaced the cotton plug immediately the insect and load were in the flask.

The first lot of workers and their loads collected numbered 379 and with them were three minims. The weight of the empty flask was 53.0343 grams.

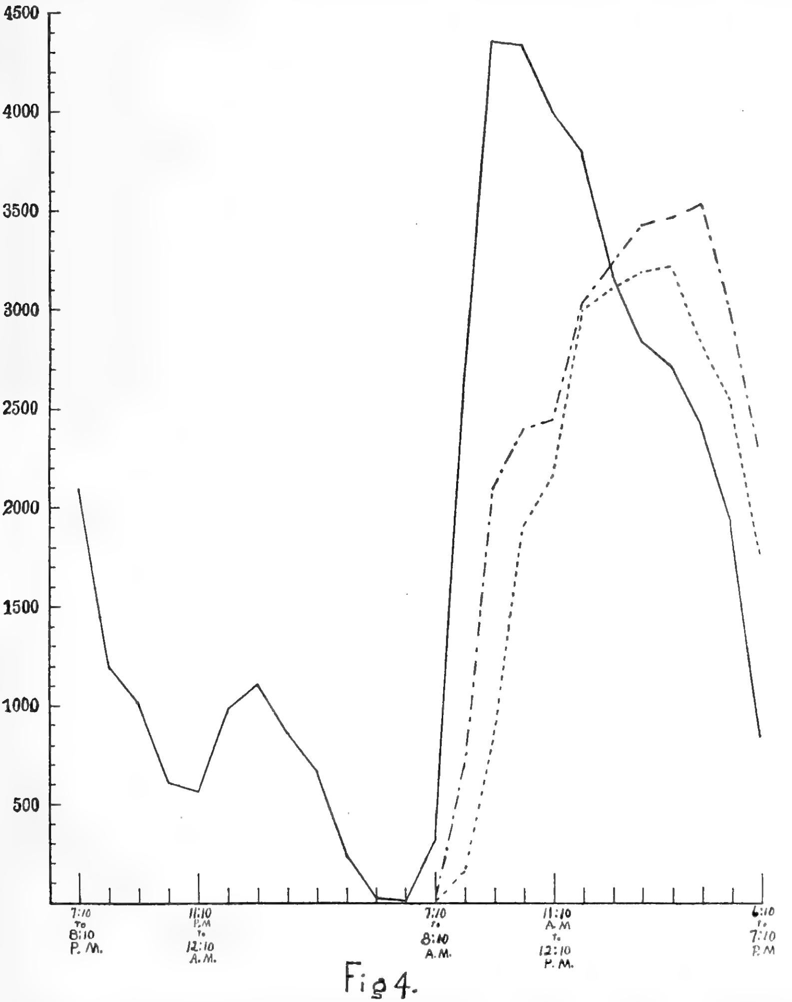


FIGURE 4. Activity over one runway during each of the three counts. The ordinates show number of loaded individuals entering the nest. The abscissae represent the consecutive hour periods. The dotted line represents the count of August 6, 1934; the dot-and-dash line, that of August 15, and the continuous line that of August 19-20. This graph shows the correspondence of the periods of greatest activity.

The weight of the ants, loads and flask was 62.2815 grams. After this last weight had been determined the ants were removed from the flask and the weight of the flask and leaf segments was determined. It was found to be 59.6128 grams. By subtracting the weight of the leaf segments and flask from that of the ants, loads and flask the weight of the ants was found to be 2.6687 grams. Among these ants were found three minims, which have the interesting habit of going out along the runway from the nest, climbing on a leaf segment and being carried back to the nest. A number of minims were, therefore, carefully weighed and their average weight found to be 0.00504 grams. Three times this weight was therefore deducted from the total weight of ants and the weight of the workers was thus determined as 2.6536 grams. The average weight of these 379 workers was, consequently, 0.0070 grams.

When the weight of the flask was subtracted from that of the loads and flask, the weight of the leaf segments was found to be 6.5785 grams. Therefore the average weight of a leaf segment was 0.0173 grams. When the average weight of each leaf segment was divided by the average weight of a worker it was found that each of these 379 workers carried, on the average, a load of 2.48 times its own weight.

The second collection made numbered 589 workers and their loads. The weight of the ants, loads and flask was 68.3582 grams. The weight of the empty flask was 54.3705 grams. The weight of the loads and flasks was 64.0779 grams. From these figures it follows that the weight of the ants was 4.2803 grams. The weight of the loads as 9.7074 grams. When the weight of the minims present was deducted from that of the ants the net weight of the workers was found to be 4.2769 grams. The average weight of each worker was 0.0073 grams. The average weight of each leaf segment was 0.0165 grams. Consequently each of these 589 workers carried an average of 2.26 times its own weight.

The total number of leaf segments and workers in both flasks was 968. The total weight of leaf segments in both flasks was 16.2859 grams. The total weight of the workers in both flasks was 6.9305 grams. From these computations it follows that the average weight of each of these 968 workers was 0.0072 grams and the average weight of each of the 968 leaf segments was 0.0168 grams. In other words, each of these workers carried a load averaging 2.33 times its own weight.

During the twenty-four hours of the third count of worker activity 42,868 leaf segments were carried into the nest. If the average weight of each of these leaf segments was 0.0168 grams then the total weight of leaf segments carried into the nest over the one runway was 720.2 grams, or more than a pound and a half. Further, if there was an equal activity over each of the five runways of this nest, as seemed to be the case, the total weight of leaf segments carried in during the twenty-four hours was 3,601 grams. For a thirty-day period, at this rate, the total weight of leaf material carried into the nest would be 108,030. grams, or about 238 pounds.

It seemed of interest to time the speed of the loaded worker in traveling toward the nest. To do this a course of ten feet was measured along the runway and the time required to travel that distance by fifteen loaded workers (seven of which carried one minim each and one carried two minims in addition to the leaf segment) was determined. The swiftest individual traversed it in two minutes and seven seconds; the slowest, in three minutes and forty-four seconds, and his latter was the one carrying two minims. The average time required for each worker was two minutes and thirty-three seconds, or at the rate of one mile in twenty-two hours, twenty-six minutes and twenty-four seconds. The time of five unloaded workers leaving the nest was also clocked. The fastest traveled at the rate of one minute and fifteen seconds per ten feet. The average speed was one minute and nineteen and one-fifth seconds per ten feet. This is at the average rate of one mile in eleven hours, and thirty seven minutes.

The minims have already been mentioned, as well as their function of chewing up the leaf segments to a pulp. The average weight of a minim is 0.00504 grams. Some idea of the amount of work done by these minute creatures can be gained when our estimate of 3601. grams of leaf material carried into the nest per day is recalled.

The average weight of excavator-workers, 750 of which were weighed, was found to be 0.00349 gram. In other words, the workers are approximately half the size of the foragers.

Light for night counting was provided by a large kerosene lamp. The use of this artificial illumination produced no observable effect upon the activity of the workers. During the night there is quite a heavy dew which drips from the trees in the jungle, and it was necessary to protect the lamp under a canopy of banana leaves.

Meteorological Conditions, 1934

Date Aug.	Maximum Temperature Farenheit	Relative Humidity 6 a.m.	1:30 p.m.	5 p.m.	Mean	Rainfall inches	Hours of sunshine	Total Activity
6	88.0	95	80.0	73.0	82.7	0.13	9.0	24,827
15	89.5	98	68.3	80.0	82.1	0.00	9.5	30,630
20	90.0	95	74.0	80.0	83.0	0.15	9.0	33,462

The question as to the possible effect of meteorological conditions upon worker activity next obtrudes itself. The table shows that an increase in temperature is accompanied by an increase in total activity. It further shows that the difference of 1.5 degrees between the temperatures of August 6th and August 15th was accompanied by a greater increase in activity, i. e., 5,803, than that which accompanied the difference in temperature of 0.5 degree between the temprature of August 15th and August 20th, i. e., 2,832. The maximum temperature alone is given in the table since the significant activity occurs during the daylight and these temperatures obtain then. The minimum temperature occurs during the night. On the night of August 19th-August 20th it was 71 degrees and during that period, i. e., from 7:00 p. m. until 7:00 a. m., only a total of 9,406 loaded workers entered the nest over the single runway. This tends to corroborate the above interpretation.

The significance of humidity is difficult to interpret. On all three occasions, however, the maximum humidity was at 6 a. m., the lowest at 1:30 p. m., and higher again at 5:00 p. m. The periods of greatest humidity thus correspond with those of least activity in all three counts, while those of least humidity correspond with those of greatest activity.

Discussion

There are only a few representatives of the leaf-cutter ants in this country and they are found in the south-western section. These insects, as stated above, show no preference for any particular plant and those in this country have so far shown no predilection for the foliage of crop plants. However, should there appear here a variety which became adapted, let us say, to the cutting of cereal foliage the damage they might wreak becomes immediately apparent.

Ecology Of Ailanthus Altissima Thickets. P. A. Davies, University of Louisville. Thickets of *Ailanthus altissima* (tree of heaven) are characterized by a large number of adventitious shoots from the roots of trees the trunks of which have been destroyed. The area of a thicket and the number of living shoots depend upon the original number of trees, the extent of the original root growth, the age of the thicket, and the distribution of growth-promoting substances. The smallest thickets are composed of shoots from a single root system. The largest thicket observed occupied almost half an acre and contained the stumps of 32 trees.

Root growth is spreading and shallow, even in old trees. The horizontal roots send up many small roots which penetrate the surface foot of the soil. From these adventitious shoots arise. The number and the distribution of shoots in a thicket indicate that the extent of the root system depends upon the age of the original system.

The table shows quadrat counts of five thickets, over a period of five years. The mother trees were destroyed in the fall of 1928. The number of living shoots decreases with the age of the thicket. Advantageous position of surviving shoots indicates that survival was due to dominance over the distribution of the seasonal growth-promoting substances from the original root system. Shoots situated farther away from the taproots were gradually deprived of the necessary growth-producing substances and so decreased in number as those advantageously situated increased in size.

Thicket number	Average number of living shoots				
	1929	1930	1931	1932	1933
1	20.7	14.0	16.3	9.2	12.3
2	23.1	13.1	13.1	9.1	6.2
3	15.3	9.4	15.2	9.3	10.2
4	17.5	6.7	10.2	7.0	7.1
5	49.4	20.3	18.3	13.2	10.5
Average	25.7	12.7	14.6	9.6	9.3

STUDIES ON FORBESICHTHYS PAPILLIFERA, A CAVE FISH. Jennie Miller Orr, Wesern State Teachers College. Master's thesis.

Contents: Introduction. Review of literature. Description. Habitat and environmental relations. Food. Comparative study of the eye. Effect of light on behavior. Summary. Charts and diagrams. Preserved specimens.

AN EFFICIENT RESIN-TAR OIL SPREADER FOR NICOTINE. C. O. Eddy, Ky. Agricultural Experiment Station. This highly efficient, very cheap spreading and wetting agent contains more than twice as much of active ingredients as the liquid soap spreaders and is four to eight times as efficient. One part of the resin-tar oil spreader in 1,000 to 2,000 parts of a contact spray spreads on nasturtium leaves and wets aphids.

Resin-Tar Oil Spreaders	Formula 1 Spreads 1 - 1000	Formula 2 Spreads ¾ - 1000
Water	10.00	10.
Potassium hydroxide (92.2 flakes)	8.25	9.
Destructively distilled pine tar oil (sp. gr. 1.035)	66.75	41.
Ethyleneglycolmonoethyl ether	..	10.
Resin (Saponification number 170)	15.00	30.
	100.00	100.

Dissolve the potassium hydroxide in the water and add the other ingredients in the order given. When all have been added, heat until the solution is clear. The water content must not be reduced by heating.

Coverage for Formula 2 may be increased to 1—2,000 by increasing the ethyleneglycolmonoethyl ether to 15 percent and the resin to 50, 60, or 70 percent. The tar oil is decreased as the solvent and resin are increased. The potassium hydroxide cannot be increased. With some combinations 8.5 percent potassium hydroxide is the maximum amount that can be used.

Resin-tar oil spreader has a lower pH value than oleate and cocoanut oil soaps. Formulas 1 and 2 are approximately neutral and are suitable for use with nicotine for proprietary mixtures. When 50, 60, or 70 percent resin is used in Formula 2, there is an excess of resin that is not saponified. These mixtures are slightly alkaline on dilution. They may be used with rotenone and pyrethrum for proprietary mixtures.

AN IMPROVED LIQUID OLEIC ACID SPREADER. C. O. Eddy, Ky. Agricultural Experiment Station. The spreader contains nearly twice as much oleic acid and is twice as efficient on aphids and on nasturtium leaves as commercial liquid potassium oleate. The formula is: water, 5.0; potassium hydroxide (92.2 flakes), 7.4; ethyleneglycolmonoethyl ether, 1.5; isoamyl alcohol, 3.0; phenol (85% pure), 15.0; oleic acid, 63.1; resin (variable), 5.0. Dissolve the potassium hydroxide in the water and add the other ingredients in the order given. If a precipitate forms when the phenol is added, agitate well until dissolved. Apply heat when mixing is completed until the solution is clear. The water content must not be reduced by heating. Increase the resin to 10 or 15 percent, if the diluted mixture is not uniform or if a precipitate forms after standing for a few weeks. A precipitate forms more readily with some lots of oleic acid than with others.

Before dilution, Oleate Spreader is acid, since enuf alkali is provided to saponify only slightly over half the oleic acid. When diluted, it is neutral or slightly alkaline. This makes Oleate Spreader a good carrier for pyrethrum, rotenone and other poisons requiring a neutral or acid carrier. It is suitable for making proprietary mixtures with them. It is a good spreader for nicotine when both are supplied separately, but is not suitable to use with nicotine for proprietary mixtures. The increased efficiency and increased cost of Oleate Spreader over potassium oleate are proportional, so the advantages are: (1) saving on shipping, handling and container cost; (2) production of a neutral or only slightly alkaline spreader on dilution; (3) having a suitable carrier for rotenone and pyrethrum for field use and for proprietary mixtures.

WINTER FEEDING CATTLE ON AN OREGON RANCH. G. Davis Buckner and Amanda Helen Harms, Ky. Agricultural Experiment Station. A grass which grows to the height of 7 feet near Paisley, Oregon, commonly known as Sugar Grass, Prickle Fescue or Sprangle Top, *Fluminea festucacea* (Willd.) Hitchc., is harvested in the summer and stacked for the winter feeding of cattle driven in from the prairie. The chemical analysis was somewhat similar to that of corn fodder, timothy hay and bluegrass, tho comparatively low in phosphorus and protein. On this grass the cattle survive severe winters when the temperature varies from 10 degrees above to 40 degrees below zero. The cattle consume approximately 1½ tons per head during the winter. When winter breaks the cattle are driven to the plains for fresh herbage, which is supplemented by concentrates to fatten them for market. The vacated valley used for wintering the cattle is then flooded to an average depth of two feet with water from the Chewaucan River and immediately thereafter the grass starts growing again.

TWIN INSECT EMBRYOS EXPERIMENTALLY PRODUCED. Alfred Brauer, Univ. of Ky. Twinning, altho common in vertebrates, among invertebrates is restricted to the Echinoderms, Annelids and certain Arthropods. It is practically unknown in the invertebrates having a determinate cleavage. Since insects have a highly determinate development twinning is rare, if not entirely unknown.

Brauer and Taylor, '34, by means of thermo-cautery and by hairloop consriction experiments, showed that in the egg of *Bruchus quadrimaculatus* (cow-pea weevil), specific values of egg parts are determined during the first 6½ hours after laying. Determination of values during this time spreads from the posterior egg pole toward the anterior pole. Constriction or cautery of the anterior ¼ of the egg, prior to 6½ hours, results in the development of essentially complete embryos in the posterior part of the egg. A large percentage of the embryos developing after this treatment are twins or conjoined monsters, developed from a double or bifid embryonic axis. Three types of such twins were shown: (1) conjoined monsters the pairs of which lie at different levels; (2) bifid monsters, and (3) almost complete twins. The significance of this work, aside from its unusual nature, is that it suggests the formation of a physiological axiate pattern in the egg hours before a visible, morphological pattern of an embryonic axis arises. It may be possible to demonstrate such a pattern in this egg.

TRANSPLANTATION EXPERIMENTS ON THE FORELIMB RUDIMENT IN AMBLYSTOMA MICROSTOMUM. Harvey B. Lovell and E. Batts, Univ. of Louisville. A disk of tissue 3 to 3½ somites in diameter was excised from the region of somites 3 to 5 and implanted upon the opposite flank with the dorsoventral axis inverted. Operations were performed upon larvae at stages 27 to 37. All the resulting grafts which were made before stage 32 except one developed into harmonic right limbs with all axes agreeing with their new environment; that is, the dorsoventral axis in larvae younger than stage 32 was still labile and had been reoriented by the surrounding tissue.

Stage 32 proved to be a transitional stage in the determination of the dorsoventral axis. Seven grafts developed in agreement with their new environment, whereas five retained their original capacities and formed inverted left limbs. At stages 33 to 37 all the grafted limbs retained their original potencies and became inverted limbs of the opposite asymmetry. At the time of the operation the dorsoventral axis had been firmly established and had therefore not been influenced by changes in its orientation.

To summarize: in *Amblystoma microstomum* the dorsoventral axis of a forelimb bud 3 to 3½ somites in diameter is determined by stage 33.

THE DETERMINATION OF BROOD SIZE IN THE WATERFLEA, *Moina macrocopa*. L. A. Brown, Transylvania College[1]. The number of parthenogenetic eggs to be produced by *Moina macrocopa* females at the end of each adult instar is substantially fixed by the beginning of the last fourth of the instar. During the preceding fourth, the females are very sensitvie to food concentration. The data indicate that if animals are removed from a food of normal strength 22 hours before egg-laying (mid-point of an adult instar at 21°C.) and placed in clear pond water they produce broods averaging 12 in number. If the transfer from plentiful food to a starvation diet is deferred 11 hours (beginning of final fourth of the instar) they produce broods averaging 28 in number. Maximum brood size under the food conditions existing in the experiment was 30. Conversely, if females reared under scanty food conditions until the middle of the instar are given normal food they produce broods averaging 26, but if they are reared under poor food conditions until the beginning of the final fourth of the instar before a plentiful diet is given, the brood size is limited to 9. Hence this period, 16.5 $\pm$ 5.5 hours (21°C.) before egg laying, is a critical time for the determination of the number of young to be produced. Another critical period during the instar occurs 4 hours before the eggs are laid. At this time the sex of the eggs is unalterably fixed[2]. The number of young is determined well in advance of the time when the sex of these young ceases to be amenable to control.

1 Work done jointly with Dr. A. M. Banta, Brown University, at the Department of Genetics of the Carnegie Institution of Washington.

2 Banta, A. M., and L. A. Brown, 1929. Proc. Nat. Acad. Sci., 15: 71-81.

Exogenous Pigmentation In Trematodes. R. M. Cable, Berea College. A snapping turtle examined during the summer of 1934 was found to harbor orange-yellow telorchiid trematodes. The turtle had been kept in a tank along with other specimens of *Chelydra serpentina,* some of which laid eggs. It was determined that the turtle examined had eaten a number of the eggs and that the egg pigment had been absorbed by the intestinal mucosa as well as by the trematodes present. The pigment was dissolved and removed by the alcohol in preparing permanent slides of the flukes. The species was identified as *Telorchis lobosus* Stunkard, without difficulty. Since pigmentation has been used in characterizing certain species of trematodes, it is obvious from the above observations that errors may have been made unless pigment was uniformly present and all possibility of its exogenous origin was excluded in species for which pigmentation is said to be characteristic.

Availability Of Different Phosphates To Turkish Tobacco In Greenhouse Tests. Chas. E. Bortner and P. E. Karraker, Ky. Experiment Station.

A Possible Instance Of Identical Quintuplets In Felis Domestica. Raymond M. Cable and John S. Bangson, Berea College.

The Skeleton Of Polyodon Spathula. H. B. Lovell and Oscar Sternberg, Univ. of Louisville.

DIVISION OF PHYSICAL SCIENCES

J. Stanton Pierce, Chm. T. C. Herndon, Sec.

An Economic Use For A Formerly Unimportant Kentucky Mineral. W. G. Burroughs, Berea College. Glauconite and glauconitic shale beds have been traced by the writer thru extensive areas in Madison, Jackson and Rockcastle counties, of Kentucky. Geologically, the beds are in the Waverly series. Mississippian system. The principal bed occurs four and one-half feet beneath the bottom of the Wildie sandstone. Another, thinner bed occurs about one foot beneath the Wildie. The beds range in thickness from a trace to about two feet. A thickness of five to ten inches is common. The glauconitic shale is soft, making it easy to excavate*. The following experiments were made by Mr. O. Finnell of Rockcastle County at the request of the author. They are the first and only tests ever made in Kentucky using glauconite as a fertilizer.

Finnell placed one bushel of glauconite shale in a barrel with fifty gallons of water. The mixture was allowed to stand five days, with frequent agitation. A tobacco bed 100 ft. x 12 ft. was divided into two parts. To one part, 40 ft. x 12 ft., forty gallons of the liquid were applied. The rest of the bed, 60 ft. x 12 ft., was not treated with the glauconite solution. Within five to six days there was a noticeable increase in the growth of the plants treated with the glauconite solution as compared with the plants in the rest of the bed which had not been treated. The total growth of the tobacco plants was about a third better than that of the plants not treated.

* A sample of this green shale, analyzed at the Experiment Station in 1935, contained 4.63 percent of K_2O and 0.08 percent of P_2O_5. A sample analyzed in 1930 contained 5.96 percent of K_2O. Neither sample contained carbonate or sulfate.

Experiments carried on during the dry year of 1930, also gave striking results. The glauconite solution was used on the entire tobacco bed and, to quote Mr. Finnell, he obtained "as fine a bed of tobacco plants as ever grew in Rockcastle County." He also applied glauconite shale in dry, pulverized form to the tobacco plants after they had been transplanted. Five hundred pounds were used per acre. With the shale, a home-made fertilizer was used, composed of ashes 4 parts and a 4-8-4 fertilizer, one part. To part of his tobacco field, where the soil fertility was equal to that of the land to which he applied the glauconie, same amount of the homemade fertilizer was applied as to the glauconated land, but without glauconite. The quality of the tobacco to which the glauconite was applied was about a third better than that of the tobacco to which no glauconite but only ashes and commercial fertilizer had been applied. The quality of the tobacco was very high. Glauconite also increased the yield. The glauconated land produced 1,049 pounds of tobacco per acre as compared with 725 pounds on non-glauconated land. The average yield for Rockcastle County this year of drouth was about 425 pounds.

Glauconite increased the growth and yield of corn. Where only dry glauconite was used as a fertilizer 40 bushels of corn were produced per acre as compared with 30 bushels on land of similar fertility but with no glauconite. These experiments have been carried on for the author for many years and have confirmed his belief in the value of Kentucky glauconites as a fertilizer.

Mechanics And Quanta. W. C. Wineland, U. of Ky. Introduced by F. W. Warburton. The failure of classical mechanics and electrodynamics when applied to problems of atomic radiation was pointed out, and the Bohr-Sommerfeld theory of the radiating atom was described as an addition of quantum ideas to the classical laws. The successes of this theory are listed, as well as the inherent structural weakness leading to its failure to predict the correct results in a number of problems. The fundamental ideas underlying Schroedinger's equation of wave mechanics were developed, and the significance of the wave functions and energy parameter appearing in this equation was indicated. The advantages of this theory over the older theories were pointed out, and some of the newer developments mentioned. The form of the equation of continuity, which demands conservation of charge, was shown to be retained in the new theory.

An Improved Vacuum X-Ray Spectrometer. O. G. Koppius, U. of Ky., Introduced by F. W. Warburton. A vacuum-grating x-ray spectrometer was designed to study the absorption coefficients of gases for soft x-rays. The x-rays from the metal tube were collimated by two slits and the beam was diffracted by a glass grating. The diffracted ray passed thru a special absorption chamber containing the gas under investigation, separated from the main apparatus by two windows covered by thin films. Finally, the intensity of the x-ray beam was measured by observing the ionization current. The electrometer tube was a F. P.—54 Pliotron and an amplifier having a current sensitivity of 10^{-15} ampere/millimeter.

LINEAR TIME SWEEP FOR A CATHODE RAY OSCILLOGRAPH. W. A. Bruce, U. of Ky. Introduced by F. W. Warburton. The cathode ray oscillograph was described and some problems in its application mentioned. A time sweep for the electrostatic plate deflector was considered, designed so that electric phenomena of an oscillating nature can be virtually held in place by causing the electron beam to trace over and over its path, and leave a stationary impression on the flourescent screen. The charging of a condenser thru a vacuum tube is used to trace the wave across the screen and the disharge of a gas-filled glow tube in discharging the condenser and returning the wave to the starting point.

PHYSIOGRAPHIC HISTORY OF THE BEREA REGION, KENTUCKY. Warren James Souder, Berea College. The Berea Region, with the town of Berea in its center, is in the southeastern part of Madison County. Berea is in north latitude 37° 34′, west longitude 84° 17′. Three of the physiographic regions of Kentucky are represented: the Mountains, the Knobs, and the Bluegrass.

The country rock ranges from the Ordovician to the Pennsylvanian, inclusive, and consists of conglomerates, sandstones, shales and limestones. Being on the east flank of the Cincinnati Arch, the strata dip to the southeast. Local anticlines and synclines, to a large degree, determine the position of valleys and hills. Thus, the ridge on which Berea is built, is synclinal in structure. Pilot Knob has resisted erosion because it is in a structural basin.

Faulting has occurred at several places. Joe Lick Knob is in a gravity fault block. Two sets of folds and joint planes are represented, one of which strikes northeast by southwest and the other, northwest by southeast. The major valleys are in the direction of northeast by southwest and the minor, tributary valleys, northwest by southeast.

Four distinct, well-defined erosion levels are present. The uppermost is represented by the Cumberland Plateau and the higher knobs which are its "outliers." This level is the Cretaceous peneplane, elevated 1400 to 1550 feet above sea level. It is well defined from the next lower or second peneplane, of early Tertiary age. It is locally called the Lexington peneplane. This is about 1000 feet above sea level over the entire region. The third erosion level is of Pliocene age, 59—70 feet lower than the Lexington peneplane level. The fourth is of Pleistocene age and is but 6-8 feet below the Pliocene erosion level. The streams now flow 3-4 feet lower than the Pleistocene level, with few or no flood plains. Flood-plain terraces, rock-defended alluvial terraces, rock terraces due to differential erosion, and rock terraces due to successive uplifts causing downward cutting of the rejuvenated streams, are represented in this region.

Drainage of the region is into the Kentucky and Cumberland rivers. The dominant drainage pattern is dendritic with local radial and checkerboard patterns. Several caves and rockhouses occur in the limestones of Mississippian age and the Pottsville conglomerate of Pennsylvanian age.

REPORT OF THE SYMPOSIUM: LECTURE DEMONSTRATION VS. INDIVIDUAL LABORATORY WORK. V. F. Payne, Transylvania College.

AMERICAN MATHEMATICAL ASSOCIATION, KENTUCKY SECTION

W. R. Hutcherson, Chm. A. R. Fehn, Sec.

On Matrices and their Minimum Equations. N. B. Allison, Univ. of Ky.
The Equation of the Straight Line, H. A. Wright, Transylvania College.
The Number and Reality of the Self-symmetric Quadrilaterals in and Circumscribed to the Triangular Symmetric Rational Quartic. Sister M. Domitilla Thuener, Villa Madonna College.
A Comparison of Methods of Determining the Meridian by Observations of the Sun and Polaris. D. W. Pugsley, Berea College.
Excluded Regions in Tracing Algebraic Curves. Walter L. Moore, Univ. of Louisville.
Report Concerning National Council of Teachers of Mathematics and Mathematical Association. Miss Buena C. Mathis, Bryan Station High School.
Some Applications of Mathematics to Genetics. John S. Bangson, Berea College.
Law of Mortality, D. E. South, Univ. of Ky.
On the Theorem of Hademard. R. V. Bennett.

AMERICAN ASSOCIATION OF PHYSICS TEACHERS, KENTUCKY CHAPTER

George V. Page, Pres. Bertrand P. Ramsay, Sec.

Demonstration of Alternating-current Phenomena. Leonard R. Crow, Educational Electric Manufacturing Company. By title.
Early Laboratory Methods. W. J. Craig, Western State Teachers College.
New Gadgets for Old Tricks. J. M. Saunders, Transylvania College.
Running the Laboratory on Very Little. Georgia M. Haswell, Union College.
Getting By on a Little Less. Olin B. Ader, Lindsay Wilson Junior College.
What the Laboratory is For. Effie Hughes, Paducah Junior College.
An Experiment with Students. F. W. Warburton, Univ. of Ky.
Whom the Laboratory is For. O. T. Koppius, Univ. of Kentucky.

DIVISION OF PSYCHOLOGY AND PHILOSOPHY

Differential Behavior Patterns of Dependent and Delinquent Children. Paul L. Hill, Psychology Department, Ormsby Village, Anchorage.
Modal Functions. John Kuiper, Univ. of Ky.
Research in the Undergraduate College. Anna A. Schnieb and Lloyd Murphy, Eastern State Teachers College.
The Relations Between Scholastic Discrepancy and Free Associations. Marjorie Powell, Univ. of Ky.
A Home Environment Scale. D. H. Mahoney, Univ. of Ky.
The Relation of the Refactory Phase to Musical Performance. Alexander Capurso, Univ. of Ky.

KENTUCKY ACADEMY OF SOCIAL SCIENCE

Charles J. Turck, President. J. W. Manning, Secretary

The Teaching of the Social Sciences in the Public Schools. L. G. Kennamer, Eastern State Teachers College.

A Social Science Curriculum for our Secondary Schools. Supt. Lee Kirkpatrick, Paris.

Discussion led by Jesse Adams, University of Kentucky; J. F. Dorris, Eastern State Teachers College; W. F. Nocifer, Asbury College; J. B. Shannon, Transylvania College; Amry Vandenbosch, University of Kentucky; and O. J. Jones, State Department of Education.

MINUTES OF THE TWENTY-THIRD ANNUAL MEETING 1936

The twenty-third annual meeting of the Kentucky Academy of Science convened in Snell Hall, Western Kentucky State Teachers College, Bowling Green, at two o'clock on the afternoon of May 8, 1936, President McHargue in the chair After appropriate remarks by the President, formally opening the sessions of the Academy, a most cordial address of welcome was delivered by Dr. H. H. Cherry, President of Western Kentucky State Teachers' College. Dr. J. S. Bangson responded appropriately.

Dr. Schnieb, Chairman, reported for the Committee on the Junior Academy. The report was approved and filed.

The reports of Dr. A. R. Middleton, as representative of the Academy on the Council of the A. A. A. S. and in the Academy Conference were read by him and approved.

The minutes of the twenty-second meeting of the Academy were approved as read.

The Auditing Committee reported that the accounts were in proper condition and that the items of the Treasurer's report were correct. The Treasurer's report was approved, showed a balance in the treasury of $54.23 for the fiscal year.

The report of the Membership Committee was approved and ordered filed.

The President announced the bequest by Dr. Pindar to the Academy and that the necessary steps had been taken for the Academy to qualify as legatee. He stated that Judge Samuel M. Wilson had tendered his legal services to the Academy without fee and that Judge Wilson deemed it advisable for the Kentucky Academy of Science to incorporate. The president then submitted for approval Judge Wilson's articles of incorporation which were unanimously adopted.

Colonel Lucien Beckner moved that the present constitution and by-laws of the Kentucky Academy of Science be adopted as the instrument of the corporation. This motion was unanimously approved.

Colonel Beckner then moved that a committee be appointed to study the constitution, by-laws and the articles of incorporation and report to the next meeting of the Academy the changes in our organic law necessary to conform it to the articles of incorporation. This motion was adopted.

Dr. McHargue read a most scholarly paper on "The Necessity of Some Minor Elements in the Economy of Plants and Animals," the president's address.

Prof. Gordon Ross, of Berea College, read a paper on "Theories of Mind."

At five o'clock the meeting adjourned to reconvene for a Get-Together Dinner in the Helm Hotel Coffee Shop at six o'clock p. m., at which Dr. Lancaster, of Western Kentucky State Teachers' College, presided. A round-table discussion of academy problems was held. The dinner meeting adjourned at 7:20 p. m. to meet in Snell Hall Auditorium at 7:30 to enjoy a concert by the

Girl's Glee Club and the Girls' Sextette of Western Kentucky State Teachers' College. The program merited the highest commendation.

At 8:00 o'clock p. m. Dr. McFarland of the University of Kentucky, introduced the guest speaker, Dr. Walter H. Bucher, Geology, University of Cincinnati, whose address "Measuring the Fourth Dimension," was a most interesting and informative historical review of the devices for measuring time and a deeply philosophical discussion of the significance of this "fourth dimension" for humanity.

The second session convened in Snell Hall, May 9, at 9 a. m.

The report of the secretary was approved.

The report of the Committee on Membership was approved.

On nomination by Colonel Beckner, Judge Wilson was unanimously elected to honorary membership.

The Nominating Committee presented the following nominations: President, Dr. R. T. Hinton, Georgetown College; Vice-President, Dr. L. Y. Lancaster, Western Kentucky State Teachers' College; Secretary, Dr. Austin R. Middleton, University of Louisville; Treasurer, Dr. Alfred Brauer, University of Kentucky; Editor of the Transactions, Dr. A. M. Peter, President Emeritus, Agricultureal Experiment Station, Univ. of Kentucky.

These persons were elected unanimously.

The report of the Committee on Emeritus Members, Fellows and Emeritus Fellows was presented by Dr. W. G. Burroughs, Chairman.

The report of the Resolutions Committee was adopted, except No. V, which was referred to the Executive Committee.

The meeting then adjourned.

Austin R. Middleton, Secretary

REPORT OF THE SECRETARY

Two meetings of the Executive Committee were held but no meeting of the Council.

The present membership of the Academy is 251, classified as: Active national members, including 2 life members, 89; active local members, 136; honorary members, 16; corresponding members, 10. It appears that almost 40 per cent of our active members belong to the A. A. A. S. (National members). Three members resigned during the current fiscal year.

Of the members, 83 owe one year's dues, 12 owe for two years, 4 owe for three years, and 2 owe for four years. The Treasurer is in no sense responsible for this circumstance. His work was excellent in every way during this, his first year in office.

The following divisions participated in the program of the 23rd meeting: Biological Sciences, Chemistry, American Association of Physics Teachers, Geology and Geography, Kentuky Section of the Mathematical Association of America and the Division of Psychology and Philosophy.

The Junior Academy was unable to meet with the Kentucky Academy because of the expense involved in the transportation of its members and exhibits. By authority of the Executive Committee, the Junior Academy held its third annual meeting at Transylvania College, April 25, 1936.

The following persons were elected to membership since the 22nd meeting:

Allen, Harry R., Experiment Station, Lexington .... Chemistry
Arnold, Clio, Sue Bennett College, London .... Psychology
Averitt, Paul, Univ. of Ky. .... Geology
Belcher, Robert Orange, student, Berea .... Biology
Birge, Grace Pitkin, graduate student, Univ. of Ky. .... Biology
Black, J. G., Morehead State Teachers College .... Math. & physics
Bradshaw, Aubrey S., Transylvania College .... Biology
Brend, Mary Agnes, graduate student, Univ. of Ky. .... Biology
Currie, John Will, Kentucky Wesleyan College, Winchester .... Biology
Dimmick, G. B., Univ. of Ky. .... Psychology
Forsee, Wm. T., Experiment Station, Lexington .... Chemistry
Foster, J. R., Univ. of Ky. .... Zoology
Gabbard, J. L., Univ. of Ky. .... Chemistry
Goodhue, Elva, Lindsey Wilson College, Columbia .... Chemistry
Haddix, Pryse, student, Berea College .... Physics
Hall, D. P., Brown Bldg., Louisville .... Physician, Biol.
Johnson, E. M., Experiment Station, Lexington .... Plant pathology
Kenyon, Jay B., Asbury College, Wilmore .... Biology
Ketron, C. V., teacher, Frankfort High School .... Mathematics
Krewson, Chas. F., Univ. of Ky. .... Chemistry
Lancaster, John W., student, Univ. of Ky. .... Biology
Lowenthal, Wm., graduate student, Univ. of Ky. .... Biology
Lyons, Malcolm, Experiment Station, Lexington .... Chemistry
Marks, Mary E., Western Kentucky Teachers College .... Geography
Maxson, R. N., Univ. of Ky. .... Chemistry
Mitchell, J. R., Univ. of Ky. .... Chemistry
Pardue, Louis A., Univ. of Ky. .... Physics
Prather, J. L., graduate student, Univ. of Ky. .... Biology
Ritcher, Paul O., Experiment Station, Lexington .... Entomology
Robinson, Lewis Cass, Univ. of Ky. .... Geology
Roper, E. A., graduate student, Univ. of Ky. .... Biology
Scherago, M. Univ. of Ky. .... Bacteriology
Scrutchfield, Bucher, Prestonsburg High School .... Biology
Spurlock, Levi, Eastern State Teachers College .... Chemistry
Stewart, O. J., Univ. of Ky. .... Chemistry
Thornberry, Halbert H., Experiment Station, Lexington .... Plant pathology
Todd, Harvis, Univ. of Ky. .... Physics
Waltman, C. S., Univ. of Ky. .... Horticulture
Webb, W. S., Univ. of Ky. .... Physics
White, M. M., Univ. of Ky. .... Psychology
Wilkes, Ella Ophelia, Morehead State Teachers College .... Biology
Young, David M., Univ. of Ky. .... Geology

A total of 42. All but 13 of these have qualified by payment of dues.

Austin R. Middleton, Secretary

REPORT OF THE TREASURER

Assets, all sources		Expenditures	
Forward from 1935	$251.20	Junior Academy	$126.95
Deposits	269.84	Other expenses	88.54
	$521.04		$215.49
		Balance	305.55
			$521.04

Approved by the Auditing Committee.

REPORT OF THE MEMBERSHIP COMMITTEE

Institutions in which the Academy had no members were canvassed for new members by letter, and the members of the committee personally canvassed their institutions. As a result, quite a list of new members has been added. This kind of activity should be continued. The committee also suggests that a Division of High School Science Teachers be established by the Academy.

REPORT OF THE COMMITTEE ON EMERITUS MEMBERS, FELLOWS AND EMERITUS FELLOWS

The committee recommended that the Executive Committee issue a call, before the next annual meeting, for nominations for emeritus members, fellows, and emeritus fellows.

REPORT OF THE RESOLUTIONS COMMITTEE

I. The Academy of Science is indebted to the Western State Teachers' College for the kindly hospitality which it has extended to this body. To President Cherry, Professor L. Y. Lancaster, to the Girls' Glee Club and Sextette, and to various other individuals the Academy is particularly obligated; their efforts to make our visit to Bowling Green a satisfying one have been most successful.

II. During the year the Academy has suffered the loss of a benefactor and friend, Doctor J. Otley Pindar. He was of that older fraternity of naturalists who follow their peculiar interests in an independent and original way which has been the very spirit of the academy of science everywhere. In lamenting the passing of the man, we take yet more sorrow from the passing of the fruitful scholar that he was. We cannot fail on this occasion to memorialize our great appreciation of the faith and confidence which Dotor Pindar must have had in the future of the Kentucky Academy of Science in making the generous bequest which he did. May we, the living, build into the Academy as much effort and as much faith as did Doctor Pindar who has gone.

III. The Kentucky Academy of Science has had the further good fortune to number among its members a certain few persons who owe their interest in science to having approached its borders thru the neighboring domain of philosophy. One such member, Doctor Elmer Elsworth Snoddy, ever zealous to bridge the gaps which seem to exist between theology, philosophy, and science, entered our ranks in the spirit of learning from any who could teach him, and to teach any who could learn from him. We the living had and have, much that we might have learned from his embassy among us. We regret his passing, and regret that much we might have learned from association with him is yet unlearned.

IV. The Academy accepts with much appreciation the recent services of Judge Samuel M. Wilson, Lexington, in the matter of preparing the necessary articles of incorporation for the Academy, by means of which this body is now enabled to accept financial standing and responsibility, particularly in the administration of bequests. The Academy suggests and recommends that the Executive Committee take steps toward offering to Judge Wilson honorary membership in the Academy, in which we honor not only the recipient, but the Academy.

V. The Academy urges the Executive Committee to make a study of the Constitution and Bylaws with the design of recommending certain amendments toward the following ends:

(1) that no office of the Academy shall be held by any member more than two years consecutively.

(2) that the committee consider the feasibility of permitting the Secretary to be reelected as often as a suitable incumbent can be induced to accept the responsibility of the office.

(3) a permanent secretaryship is not intended by the above, but a provision for reelection to this office.

VI. That the Executive Committee be directed to study and report upon the following matters of procedure and, in their discretion, to present the necessary amendments to the Constitution and Bylaws to effect desirable changes.

(1) Holding the annual meeting for the presentation of papers in October or November.

(2) Holding an additional Spring meeting for the purpose of conducting a field excursion each year to some place of special interest within the state, or elsewhere. No program of papers is suggested for this meeting other than an invitational program intended particularly to clarify the objectives of the excursion.

(3) A provision whereby regional meetings under the auspices of the Academy may be held in any number, at any time, and at any place by a sufficient number of interested members, and under necessary safeguards for insuring that there shall be no loss of unity or interruption to the free trade of ideas between sections of the state.

Signed P. A. Davies (by W. R. A.)

W. R. Allen

JUNIOR ACADEMY

3d Annual Meeting, 1936

The Junior Academy of Science held its third annual meeting on April 25, 1936, at Morrison Chapel, Transylvania College. Miss Margaret Van Arsdall presided. Over 300 were in attendance. The Junior Academy is now composed of 20 Science clubs, with a membership of 277 girls and 233 boys. New officers elected were: President, Morris Garrett, Richmond; Vice-president, Fannie Drew, Speedwell; Secretary, Perry Day, Bellevue; Treasurer, Glenn Padgett, Somerset. Prizes were awarded as follows:

Best exhibit: Class A, Bellevue H. S., first; Bryan Station H. S., and St. Catherine Academy, honorable mention. Class B, Kirksville H. S., first; White Hall H. S., honorable mention.

Best discussion: Class A, Roger McGurk, St. Catherine Academy, first; Eddie Robertson, Harrodsburg, honorable mention.

Largest percentage of pins owned: St. Catherine Academy.

Largest percentage of club members present: Class A, St. Catherine Academy; Class B., Newby H. S., Red House H. S., and White Hall H. S. 100 percent each.

Best contribution to Junior Science Bulletin: Class A, Margaret Van Arsdall, Harrodsburg; Bernard Foley, St. Catherine Academy, honorable mention. Class B, Clifford Stout, Fern Creek, and Zelda Childers, Waco.

PAPERS PRESENTED AT THE GENERAL SESSIONS

Theories Of Mind. Gordon Ross, Berea College.

Measuring The Fourth Dimension. Walter H. Bucher, Univ. of Cincinnati.

The Necessity Of Some Minor Elements In The Economy Of Plants And Animals. (President's Address) J. S. McHargue, Kentucky Agricultural Experiment Station. The subject I have chosen to discuss this afternoon is one in which I have been interested for a good many years. During my senior year in college I was required to write a thesis for my Bachelor's degree in chemistry. The title was "The Occurrence of Titanium in Kentucky." With the acceptance of the thesis by the Department of Chemistry of the State College, now the University of Kentucky, and the granting of my Bachelor's degree, there was a lull in my interest in the occurrence and distribution of the less common elements in nature until the latter half of 1912, when I began the duties of Assistant Chemist in the Department of Chemistry of the Kentucky Agricultural Experiment Station. I then began an examination of plant and animal tissues for the presence of minor elements. My first contribution pertaining to the subject was entitled "The Occurrence of Barium in Tobacco and other Plants" published in the Journal of the American Chemical Society in June, 1913.

At that time it was taught and accepted by botanists, plant physiologists and agricultural chemists that only ten of the total number of chemical elements then known were essential for the normal growth and maturation of plants. A reason for limiting the number of elements necessary for the growth of plants to 10, by the early investigators, was undoubtedly that they were first in this field of study and their methods of attack were crude at the best. Accordingly, only the more obvious problems in plant nutrition received attention in their researches. In later years further researches in analytical and biochemistry have developed new and more delicate tests and methods of analysis, which have made possible further advances in our knowldge of the number of chemical elements necessary in the economy of both plants and animals. Thus far chemists and physicists have discovered 92 different kinds of matter which are called chemical elements. There are several ways in which the chemical elements may be classified into groups, depending upon their abundance in nature, their physical and chemical properties and the use to which the elements or their compounds may be put in industry, medicine and art. As a matter of convenience in this discussion, I have divided the 92 chemical elements into three roughly quantitative groups.

Group 1. The major elements and their estimated proportions in the crust of the earth, arranged in the order of abundance.

Name	Percent
1. Oxygen	49.20
2. Silicon	25.67
3. Aluminum	7.50
4. Iron	4.71
5. Calcium	3.39
6. Sodium	2.63
7. Potassium	2.40
8. Magnesium	1.93
9. Hydrogen	.87
10. Titanium	.58
11. Chlorine	.19
12. Phosphorus	.11
13. Carbon	.08
14. Sulfur	.06
15. Nitrogen	.03
	99.35

The percentages were estimated by F. W. Clarke and published in Bulletin 770 of the U. S. Geological Survey, in 1924. They probably are the most authoritative data available on this subject. This group includes the elements which occur in the greatest abundance in the crust of the earth.

The remaining 77 elements which constitute a little more than one-half of one percent of the earth's crust, according to our best information on the subject, I have divided into two groups. It is the elements in Group 2, the importance of which, in the economy of plants and animals, we are seeking to ascertain.

Group 2. The Minor Elements, arranged in probable order of abundance in the earth's crust.

Name	Percent	Name	Percent
1. Manganese	0.0 x	16. Arsenic	0.000 x
2. Barium	0.0 x	17. Cadmium	0.0000 x
3. Fluorine	0.0 x	18. Tin	0.0000 x
4. Zirconium	0.0 x	19. Mercury	0.0000 x
5. Vanadium	0.0 x	20. Antimony	0.0000 x
6. Nickel	0.0 x	21. Molybdenum	0.00000 x
7. Strontium	0.0 x	22. Silver	0.00000 x
8. Lithium	0.00 x	23. Tungsten	0.00000 x
9. Copper	0.00 x	24. Bismuth	0.00000 x
10. Cerium	0.00 x	25. Selenium	0.000000 x
11. Beryllium	0.00 x	26. Bromine	0.000000 x
12. Cobalt	0.00 x	27. Tellurium	0.0000000 x
13. Boron	0.000 x	28. Iodine	0.0000000 x
14. Zinc	0.000 x	29. Rubidium	0.00000000 x
15. Lead	0.000 x	30. Cesium	0.00000000 x

Small quantities of most of these elements have been found in plants. The x represents the unknown digit which may have values ranging from 1 to 9. Assuming the value of x to be 9, then the minor elements constitute only 0.60 percent of the earth's crust. This figure is a mere approximation, because not enough analyses have been made of the minor elements to afford a very reliable average for the earth's crust as a whole. For example, Clarke states that bromine is a more abundant element in the earth's crust than iodine. Assuming that the value for bromine given by Clarke is 0.0000009, the maximum value for x, and that this element is 10 times more abundant in the earth's crust than iodine, we would have 900 and 90 parts per billion, respectively, for the average for bromine and iodine in the earth's crust. We have found limestone rocks in Kentucky which contain nearly 10 times more iodine than this. It appears that both bromine and iodine are much more abundant in the rocks and soils in Kentucky than the average figures for these two elements given by Clarke for the earth's crust as a whole.

Group 3. The Rare Elements, arranged alphabetically.

Alabamine	Helium	Osmium	Scandium
Argon	Holmium	Palladium	Terbium
Columbium	Illinium	Platinum	Thallium
Dysprosium	Indium	Praseodymium	Thorium
Erbium	Iridium	Protactinium	Thulium
Europium	Krypton	Radium	Uranium
Gadolinium	Lanthanum	Radon	Virginium
Gallium	Lutecium	Rhenium	Xenon
Germanium	Masurium	Rhodium	Ytterbium
Gold	Neodymium	Ruthenium	Yttrium
Hafnium	Neon	Samarium	

The difference between the sum of the percentages of the elements in groups 1 and 2, and 100, is approximately .05 percent for the amount of the rare elements contained in the earth's crust. Thus far we have very few reliable methods for estimating the amount of the rare elements contained in rocks, soils, plants or animals; therefore we know very little of the effect they may have on the life processes of either plants or animals.

The ten elements which were formerly considered as the only ones necessary for the growth of plants are: Carbon, Oxygen, Hydrogen, Nitrogen, Calcium, Magnesium, Phosphorus, Potassium, Sulfur, and Iron. Until very recent years text books on botany, agricultural chemistry, and plant physiology named these as the only elements essential for the growth of plants.

Dr. Cyril G. Hopkins was, for a considerable number of years, one of the most outstanding agricultural chemists in this country. He was head of the Department of Agronomy at the University of Illinois for many years and published textbooks, bulletins and journal articles on subjects pertaining to the chemistry of soils and plants. He died in 1918. In one of his textbooks pertaining to the chemistry of soils and plants we find this very interesting memory aid for the 10 chemical elements which he apparently assumed were the only ones necessary for the growth of plants. His students composed this so-called memory aid which was used and published with his permission.

Cyril G. Hopkins was the customary way he spelled and signed his name. His students altered the customary spelling of his name thus: C. Hopk ns Ca Fe Mg. With the omissions and additions of the letters thus shown and also with a little stretch of the imagination the "memory aid" was translated to mean that C stands for carbon, H, hydrogen, O, oxygen, etc. The Mg was translated to say that "C. Hopk ns cafe" was mighty good.

This incident is mentioned to show the teachings of an eminent authority in the science of agriculture concerning the number of chemical elements necessary for the growth of plants a little more than a decade ago .

It is not to be inferred from these remarks that there is any doubt about the essential nature of any one of the foregoing list of 10 elements, for the growth of plants, but I do wish to emphasize the information recently attained that they are not the only elements essential in the economy of both plants and animals.

It has long been a well-known fact among agricultural chemists that, when plants are grown to maturity under natural conditions in a fertile soil, harvested, brought into a chemical laboratory and subjected to careful, painstaking qualitative tests, as many as 30 elements in addition to the so-called 10 essential ones, can be found in small quantities.

For many years there was much speculation and controversy among investigators to explain the presence of the minor elements in plants. The soil is a heterogeneous mixture of the oxides, silicates, aluminates, carbonates, phosphates, sulfates, chlorides, nitrates, nitrites, and fluorides of the 92 elements contained in the crust of the earth. Consequently, when plants are grown in the soil, their roots are in contact with compounds of both the essential and the so-called non-essential elements. In absorbing the essential elements, they cannot exclude altogether an element that is not essential. If this theory is correct then we would expect to find that plants absorb elements from the soil somewhat in proportion to their abundance in the soil. For example, silicon and aluminum are the second and third most abundant elements in the earth's crust; therefore, we should expect to find these elements in relatively large quantities in plants. It is true that some species of plants do take up considerable silica, such as the straw flowers and many grasses. However, the majority of the most useful plants absorb relatively small quantities of silicon, and all species absorb considerably less aluminum than silicon. Furthermore, most of the more useful plants can be grown in cultures comparatively free from silicon and aluminum. It has been generally assumed to the present time that these two elements do not have any important functions in the economy of plants or animals. The same argument applies to titanium, an element less abundant in the soil than either silicon or aluminum, but several times more abundant in the earth's crust than the essential element, phosphorus. Therefore, the mere fact that plants absorb more of the elements that occur in small quantities in the soil than they do of those that are more abundant, affords considerable evidence, that they have selective properties in absorbing nutrients from the soil. This is in accordance with the hypothesis proposed by Liebig, a pioneer in agricultural chemistry and plant physiology, who taught that plants may absorb most any element occurring in the soil solution but that which is not essential in the plant's economy is excreted thru the roots. Consequently, that any element is a constant constituent in plants produced under natural conditions in the soil, was sufficient evidence for him of its necessity. While Liebig's theory was sound in principle it lacked the necessary experimental evidence to confirm it.

Methods for Ascertaining Which Elements Are Essential in the Economy of Plants. Since the soil is a heterogeneous mass of the compounds of a considerable number of chemical elements, it is not a suitable medium in which to grow plants for the purpose of ascertaining which elements are necessary for their growth. However, in recent years a number of soil areas which respond to treatment with the compounds of the minor elements have been reported in the literature.

Previous to the time this investigation was undertaken, very little attention had been given to the elimination of the various possible sources of contamination in water and sand culture experiments with plants. As the work progressed it soon became evident that contamination was undoubtedly the principal source of many erroneous conclusions in regard to the essential nature of a number of minor elements in the growth of both plants and animals.

The complete elimination of any one of the minor elements from the plants during the time of their growth is a task requiring special study, much effort and careful technique. The best that can be hoped for is to so control the experiment from further contamination with the element under consideration and to grow the plants for a sufficient number of cycles until the element to be excluded becomes a limiting factor for normal growth of the experimental plant. To completely eliminate all traces of the element under experimentation is an impossibility at the beginning because the seed from which the plant is propagated will at least contain traces of the element, if it is a necessary factor in the plant's growth.

Two different methods have been commonly used to ascertain which mineral nutrients are required for the growth of plants; namely water cultures and sand cultures. Water cultures were tried and found unsatisfactory because of the frequent changes of the nutrient solution when it was necessary to grow the plants thru a complete cycle. Accordingly, purified sand cultures were chosen for experiments planned to demonstrate the necessity of the minor elements for the growth of plants, for the very obvious reason that they are less tedious to conduct and furthermore the plants are grown under conditions more comparable to those of a soil than is the case in water cultures.

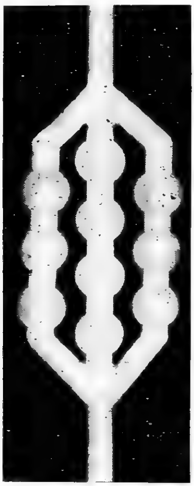


FIGURE 1. A quartz condenser tube for preparing metal-free distilled water.

Since the minor elements are widely distributed in such minute quantities in nature, as is shown in Table 2, it is not an easy task to prepare a solid medium in which to grow plants free from these elements. Pure quartz sand of medium size grain (40 mesh) from which all the adhering mineral matter with which the grains are coated in the natural condition, has been removed, offers the best possibilities for compounding purified cultures of a known composition. After considerable prospecting and examination of a good many samples of sand from different sources, a deposit was located at Erin, Tenn., which was better adapted for purification than other samples previously examined. This deposit was remarkably free from colored grains and pebbles which most ordinary deposits of sand contain. A supply of the natural deposit was obtained, dried, and run thru a 20-mesh sieve to remove fragments of undecomposed sandstone, pebbles and such other extraneous matter as could be separated in this way. The clay and fine silt was removed by washing the sand in running water and a uniform grade of yellow grains of quartz sand was thus obtained. To remove the yellow and brown coating of iron oxide which also carried traces of the minor elements, the washed sand was digested in large porcelain dishes over boiling water with a mixture of hydrochloric and nitric acids, washed, rinsed with distilled water until free from chlorides, and dried. Snow white quartz sand which contained 99.95 percent of silicon dioxide was thus obtained. The sand purified in this way formed the basal material for the sand cultures.

The next important factor in the preparation of purified sand cultures is pure chemical compounds of the 10 essential plant nutrients and also pure compounds of the minor elements to be subjected to experimentation.

Undoubtedly the use of chemical compounds containing small amounts of the minor elements has been one of the most common sources of error in ascertaining the necessity of the minor elements in the economy of plants and animals. The old abbreviation C. P. which was supposed to mean "Chemically

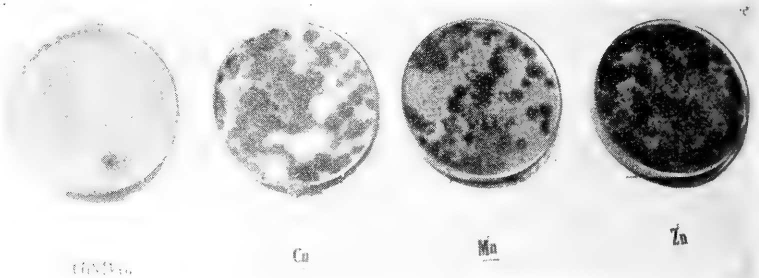


FIGURE 2. Sand cultures of *Aspergillus* 10 days old, showing stimulation of growth by copper (5ppm), manganese (2.5 ppm), and zinc (1ppm), in optimum concentrations.

pure" has lost its significance in recent years and the term "analyzed chemicals" on the label together with the analysis showing the limits of impurities are in more common use today. However, the new analyzed chemicals, tho perhaps of better grade than the old C. P. reagents which more often could have been translated "chemically poor" rather than "chemically pure," are not yet sufficiently pure to be accepted according to the analysis on the label without checking their purity in the laboratory before their use as plant nutrients. Compounds of iron, phosphorus, calcium and magnesium are rarely free from traces of the minor elements, manganese, copper, zinc, boron, barium, strontium, arsenic, bromine, chlorine, fluorine and iodine.

Another important factor to be kept in mind in ascertaining the necessity of the minor elements in the economy of plants is the kind of pots in which the plants are to be grown. The commonly used red flower pot and the straight earthenware jars which are usually carried in stock by grocery stores are in general use for growing plants. Langenbeck, in his book entitled "The Chemistry of Pottery," published in 1895, states that all earthenware pots have a varying degree of porosity and that even when the walls of an earthenware pot are so hard as not to be scratched with a hard steel point, they will absorb with avidity as much as 15 to 20 percent of their volume of water, and that even vitreous bodies that were brittle and had a conchoidal, glassy fracture, were found to absorb 1.8 percent of their weight, or nearly 4 percent of their volume of distilled water. It is therefore apparent that the walls of common earthenware jars which are in general use for pot experiments may be sufficiently porous to absorb mineral nutrients from soil or sand cultures, which may become available and affect the growth of plants in subsequent experiments.

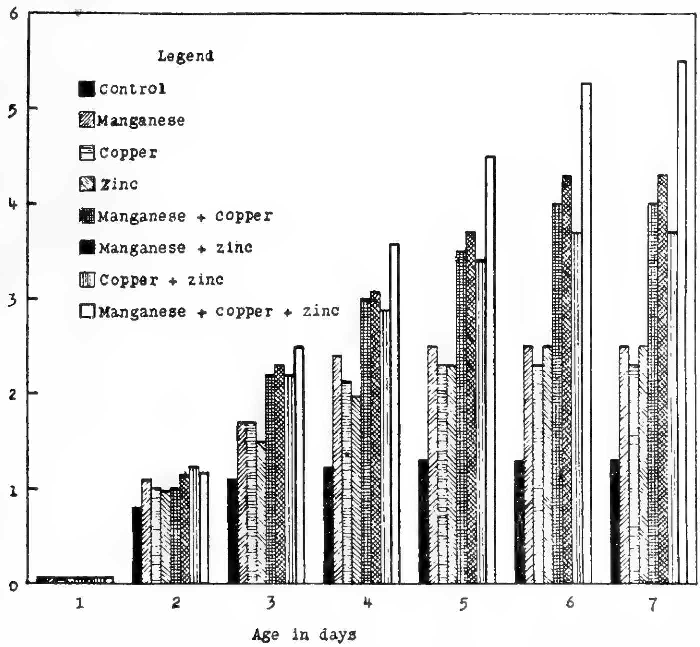


FIGURE 3. Effect of manganese, copper, and zinc on growth of aspergillus on silica gel.

Undoubtedly, many complexities and erroneous conclusions have resulted from the continuous use of the ordinary earthenware jars in pot culture experiments.

A further factor to be taken into consideration in experiments to prove the essential nature of some of the minor elements for the growth of plants is the purity of the distilled water which is to be used for watering the plants during the time they are making their growth. Many of the ordinary types of water stills are equipped with a brass tube condenser which has been coated with tin on the inside. The tin soon wears thru and the water becomes contaminated with tin, copper, zinc, manganese and iron. Under the best conditions, where a block tin tube is used, the distilled water will contain traces of tin. Platinum would be the most desirable metal to use in making a condenser but the expense is usually prohibitive.

To prepare distilled water free of metals a condenser tube made of pure quartz was designed and constructed according to our specifications as shown in figure 1. When this tube is properly housed and installed it has a capacity of about 1.5 gallons of metal-free distilled water per hour.

Heretofore very few investigators have so arranged conditions that the plants have made a complete cycle of growth, which is an important criterion for judging the necessity of any element for the growth of plants. Maintaining the cultures near a definite hydrogen ion concentration is important, as is also exclusion of dust and insects from the experiments.

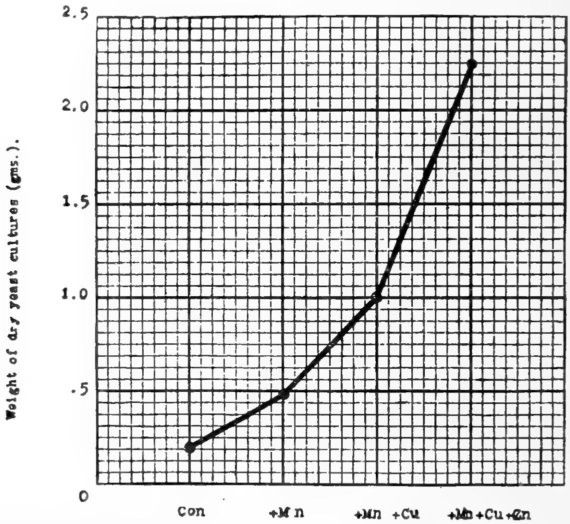


FIGURE 4. Addition of Mn, Cu, and Zn to the control medium—effect on weight of yeast cells.

For our experiments, we obtained acid-resistant stoneware jars made by the Maurice A. Knight Company, at Akron, Ohio, for the larger cultures and for the smaller ones we purchased porcelain pots. A definite amount of the purified sand was weighed, and adequate amounts of pure available compounds of the ten essential elements, which were tested and proved to be free from any of the minor elements were added and thoroly mixed with the sand in large porcelain dishes and the cultures transferred to the pots. These cultures served as the controls. To other similar cultures were added adequate amounts of pure compounds of the minor elements, singly and in combination. Plants were then grown in each culture under greenhouse conditions, attention being given during the time the plants were making their growth to the purity of the distilled water, hydrogen ion concentration, dust and insect control to such a degree as was possible under our conditions of experimentation.

Evidence that Manganese, Copper and Zinc are Necessary for the Growth of Fungi. To ascertain the necessity of manganese, copper and zinc for the growth and metabolism of fungi, it was necessary to prepare a medium favorable for their development but free from these elements. A solution containing 1 percent ammonium sulfate, 0.5 percent monopotassium phosphate, 0.4 percent potassium sulfate, 0.25 percent magnesium sulfate, 0.25 percent

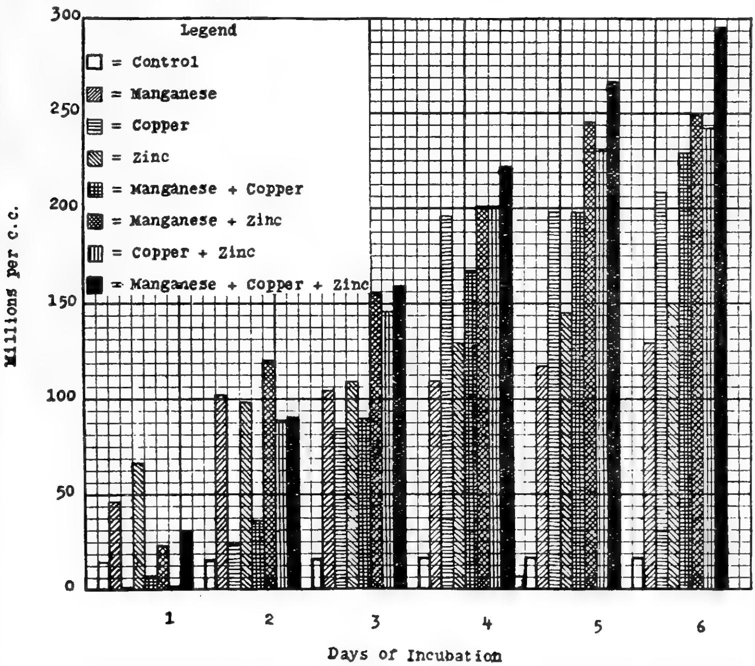
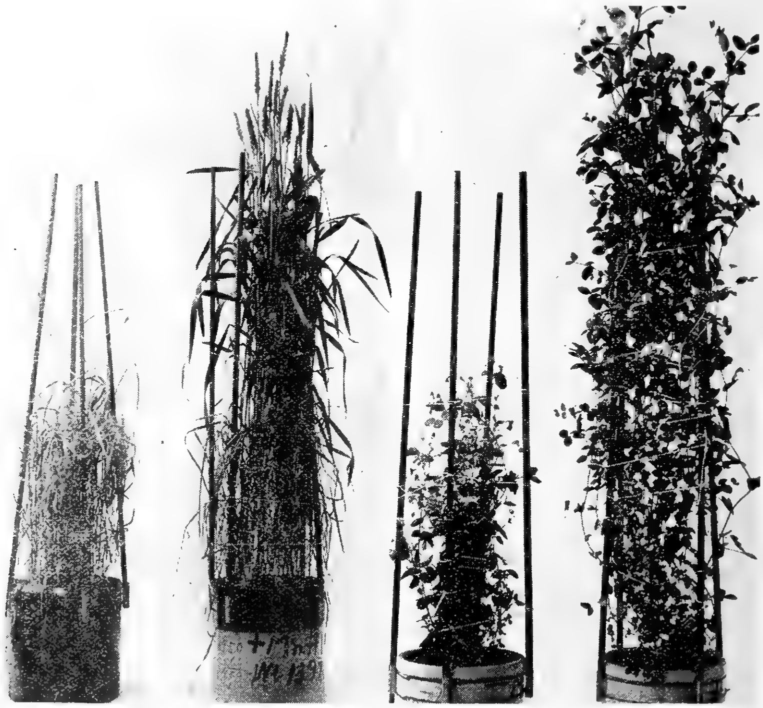


FIGURE 5. Addition of Mn, Cu, and Zn to control medium—effect on number of yeast cells.

calcium sulfate, and 5 percent glucose, in distilled water, produced a heavy, rapid growth of several fungi. A standard medium having this composition, using sucrose instead of glucose (because the latter contained impurities) was then prepared, employing only salts that had been shown to be free of manganese, copper, and zinc by chemical tests. The distilled water used in all the cultures was prepared by means of a quartz-tube condenser. In purifying these salts from manganese, copper, and zinc, other elements usually present as impurities were also removed. To avoid any effect due to the absence of these elements, 0.001 percent ferric citrate, 0.0001 percent potassium iodide, and 0.01 percent potassium chloride were included in the medium. Agar could not be obtained free from manganese, copper and zinc, so silica gel was added to the liquid medium for solid cultures. The growth of fungi on this medium was rather slow and weak. A green aspergillus of the flavus group made the most vigorous growth and was isolated in pure culture. Cultures were incu-



Wheat. Left, minor elements excluded. Right, minor elements added.

Field peas. Left, minor elements excluded. Right, minor elements added.

bated at different temperatures, and optimum growth was obtained at 28°C. Figures 2 and 3 show the effects of manganese, copper and zinc on the growth of aspergillus, when added singly and in combinations.

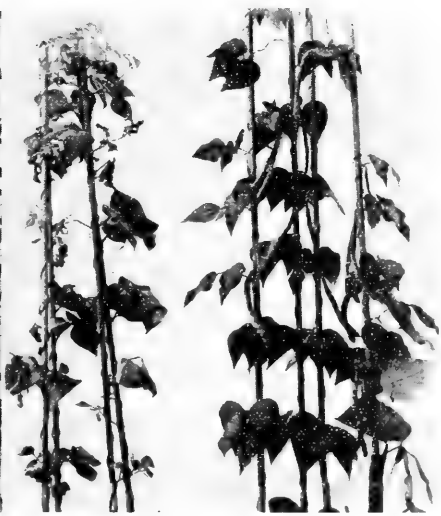
The relation between the cultures, in terms of the control as 100 percent was:

Control	100.0
Copper	234.5
Zinc	241.0
Manganese	247.5
Copper+manganese	399.7
Copper+zinc	510.8
Manganese+zinc	857.9
Copper+manganese+zinc	900.6

Mineral, nitrogen, and fat content of Aspergillus, in percentage of moisture-free material.

Culture	Con-trol	Cu 5 ppm	Mn 2.5 ppm	Zn 1 ppm	Cu 5, Mn 2.5 ppm	Cu 5, Zn 1 ppm	Mn 2.5, Zn 1 ppm	Cu 5, Mn 2.5, Zn 1 ppm
Weight as percentage of control	100	234.5	247.5	241.0	399.7	510.8	857.9	900.6
Ash	5.0	5.29	4.75	6.03	3.98	7.67	6.046	5.5
Copper	None	0.017	None	None	0.013	0.022	None	0.02
Manganese	None	None	0.0025	None	0.0025	None	0.0023	0.003
Zinc	None	None	None	0.009	None	0.0076	0.0097	0.0075
Phosphorus	0.9	0.977	0.157	1.26	0.95	1.14	1.415	0.957
Calcium	0.21	0.233	0.12	0.484	0.252	0.667	0.583	0.415
Magnesium	0.255	0.197	0.13	0.335	0.282	0.275	0.203	0.467
Iron	0.002	0.009	0.005	0.007	0.014	0.02	0.0076	0.008
Nitrogen	4.82	4.75	4.65	4.5	4.09	4.25	4.4	4.48
Protein (Nx 6.25)	30.1	29.75	29.00	28.1	25.6	26.6	27.48	28.00
Ether extract	1.64	2.03	2.55	2.25	2.51	2.57	3.355	3.5

Corn. 1. 10 elements. 2. 10 elements plus Mn. 3. 10 elements plus Mn and Cu.



Pole beans. Left, minor elements excluded. Right, minor elements added.

The Effect of Manganese, Copper and Zinc on the Growth of Yeast. The chief difficulty in investigating the effect of manganese, copper and zinc on the growth of yeast was in obtaining a medium suited to its growth that was free from traces of these metals. The medium used was an aqueous solution containing ammonium sulfate 0.5 percent, potassium dihydrogen phosphate 0.2 percent, potassium sulfate 0.05 percent., ferrous chloride 0.001 percent, and sucrose 5.0 percent. The inorganic salts used were tested and found to be free from manganese, copper and zinc. Sucrose could not be obtained entirely free from zinc, but less than 0.2 part per billion was contained in the medium, from this source. The water used was distilled in a quartz tube condenser. This medium was used as the control.

Pure cultures of *Saccharomyces cerevisiae* were prepared and transferred on the control medium six times to remove manganese, copper and zinc from the cells before a stock culture was accepted for inoculation of the experimental cultures. Counts were then made microscopically and a suspension in control medium was standardized so that one cubic centimeter contained one thousand cells. One hundred cells (0.1cc) were used for each inoculation. The results of the experiment are shown in figure 4.

Production of Yeast Cells (Average of 3 Cultures)

Culture	Total Weight	Percent of control
	gm.	*percent*
Control	0.2064	100
+Mn	0.4934	239
+Cu	0.5915	286
+Zn	0.5364	260
+Mn + Cu	1.0138	491
+Mn + Zn	1.9711	950
+Cu + Zn	1.1461	555
+Mn + Cu + Zn	2.2506	1090

Production of Carbon Dioxide, Aerobic Fermentation by Yeasts
Average of 3 Series

Culture	Weight CO_2	Percent of control
	gm.	*percent*
Control	0.2770	100
+Mn	0.6191	224
+Cu	0.8474	306
+Zn	0.8102	293
+Mn + Cu	1.0154	367
+Mn + Zn	1.1384	410
+Cu + Zn	1.1230	405
+Mn + Cu + Zn	1.1657	421

The results of the foregoing experiments with aspergillus and yeast show that proper amounts of manganese, copper and zinc are necessaray factors in their metabolism.

Necessity of the Minor Elements for the Growth and Metabolism of Forage Crops and Vegetables. In the early stages of this investigation it was observed that when dilute hydrochloric acid was added to the ash resulting from the incineration of brown hazelnut shells, a faint but unmistakable odor of chlorine was detected. This observation suggested that the ash contained an oxide of manganese which decomposed the hydrochloric acid and liberated chlorine. A test for manganese in the solution from the ash confirmed the presence of this element in moderate amount. This observation suggested further experiments in regard to the amount of manganese contained in the different parts of the hazelnut. Accordingly, a quantity of the nuts was obtained and separated into three parts, shells, seed coats and cotyledons. A definite weight of each of the parts was ashed and manganese determined in each. The results showed that the seed coats contained the largest amount of manganese when equal weights were taken. This fact was of sufficient interest to warrant similar determinations on like parts of other species of seeds. The results of this investigation showed that this relation obtained in all the seeds that were

Tomato plants grown in soil deficient in the major and minor elements. Left, major and minor elements added. Center, major elements added, only. Right, no treatment.

examined; namely, that the seed coat contained a greater concentration of manganese than any other part of the seed.

Of the different seeds examined, wheat afforded more interest than any other. It was found that the chaff which surrounds the berry contained a very minute amount of manganese and that the flour within the berry contained less than the chaff, but the bran or seed coat contained approximately 0.02 percent of its dry weight of manganese. This fact was of sufficient interest to cause some wonder as to whether or not manganese has a useful role in the economy of this and other plants. This question suggested itself: What would be the ultimate effect on the growth of the plant if seeds were germinated and the resulting plants grown to maturity in a medium which contained all the known plant nutrient compounds but no compound of manganese? This suggestion was of sufficient interest to warrant the undertaking of some experiments with this end in view. The results of some of the experiments are shown in the photographs.

Spinach. Left, minor elements excluded. Right, minor elements added.

Lettuce. Left, minor elements excluded. Right, minor elements added.

Summary and Conclusions

The author maintains that the detail and careful precision required in the procedures described in this paper possess some novel ideas, which are of fundamental importance in ascertaining the essential nature of the minor elements in the economy of both plants and animals. Furthermore, that the very striking results which have been obtained on the growth of fungi, yeast, forage crops and vegetables, by a close observance of the procedures described, contribute to a better understanding of the function of a number of the minor elements in the art and science of agriculture.

The writer wishes to express his grateful appreciation to various members of the staff of the Department of Chemistry of the Kentucky Agricultural Experiment Station who have rendered valuable and faithful assistance in connection with the experimental work reported in this paper.

DIVISION OF BIOLOGICAL SCIENCES

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Factors Involved In The Development Of Anthocyan In The Stem Of Phlox drummondii. J. S. Bangson, Berea College. Experiments with red-stemmed *Phlox drummondii* showed that the red color did not develop in parts of the stems protected from sunlight or in seedlings grown in diffused light. Others have reported similar observations with several other species of plants. Green-stemmed strains do not develop red in direct sunlight. It appears that direct sunlight is necessary for the production of red, even when the gene for red is present.

Pigment Migration In The Eye Of Forbesichthys Papilliferus. Harold E. Welborn, Western State Teachers College. The fish were exposed to sunlight, in running water of a spring. After 2 days, some pigment had migrated from the *stratum pigmenti* into the rods and cones, forming a slightly concentrated layer near their tips. After 4 days the pigment had migrated still further into the layer of rods and cones, and was more dense thruout the entire area. After 6 days the pigment had become concentrated into a heavy layer near the tips of the rods and cones, leaving a small portion of the tips exposed. After 8 days the layer of pigment was still more concentrated and very near the tips of the rods and cones, and was less concentrated in the *stratum pigmenti*. The process seemed to be completed in about 8 days. Migration was slower in artificial light.

The Inheritance Of Ectopia Lentis. A. R. Middleton, Univ. of Louisville. Dr. B. N. Pittinger of Paris, Kentucky, recently sent the writer a reprint of a recent paper by him in which he reports the hereditary occurrence of *Ectopia lentis* in five successive generations of a white family. At the suggestion of Dr. Pittinger I have attempted an analysis of the type of heredity shown in this pedigree.

Ectopia lentis is a congenital and, ordinarily, symmetrical displacement of the crystalline lens. Judging from the reports in the literature it is of comparatively rare occurrence. Dr. Pittinger cites eleven such records, and points out that Knapp has estimated that its incidence is approximately once in 5,000 cases, while the first official record is the case reported by von Graefe, in 1854. The cases from the literature cited by Dr. Pittinger all show an hereditary tendency but there is lack of agreement as to the type of heredity manifested. The case reported by Gunn shows its occurrence "in 17 members of five families with a total of 22 children, in which the hereditary tendency acted as a pure mendelian dominant characteristic. Francheshetti's case was one of recessive hereditary condition, while Kotlarveskaid's thirteen cases were considered by him as of the dominant hereditary type."

The present pedigree comprises five successive generations of one white family, totaling 63 in the herditary lines, and an additional fifteen non-related consorts. Of these 63 persons twenty-two were affected. The youngest affected individual is five years old and the oldest is 69. The sixth generation is represented by a pair of biovular twin boys four years of age and a boy aged one month, sibs, and also by two sisters in another family. Chart 1 is the pedigree in question. It shows the percentage of affected individuals in each generation.

This may be interpreted as a case of inheritance in terms of multiple factors. If we assume that three cumulative factors are operative and that any two, when present, will bring the condition to expression, the various percentages of affected individuals in the successive generations may be explained. Chart 2 accounts for the 50 percent of affected individuals in the F_1 generation. It is true that the expectation would be 50 percent of affected individuals if this were a case of a single dominant mendelian determiner, one parent being hybrid and the other recessive. But on that assumption the members of families in each successive generation should show no affected individuals or 50 percent of the individuals affected. If we assume that the original progenitor was a homozygous dominant then all of his children should have been affected, and heterozygous, and the families of the succeeding generations should show either no affected individuals or 50 percent affected.

If the normal parent of the F_2 generation carried one of these multiple

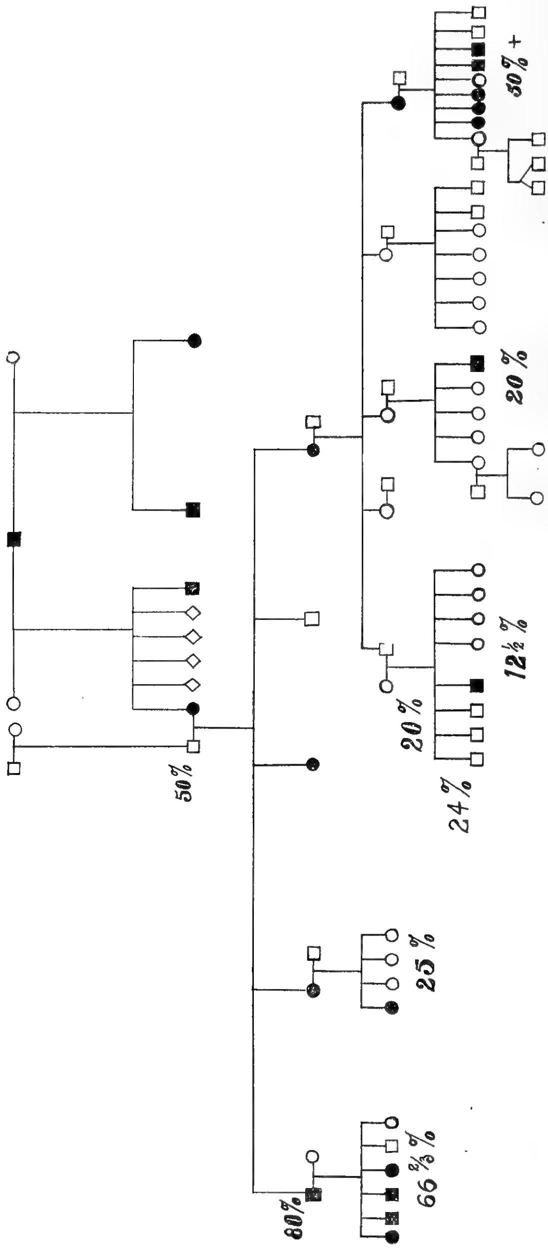

Chart 1. Lineage of family in question. Affected individuals indicated by black figures.

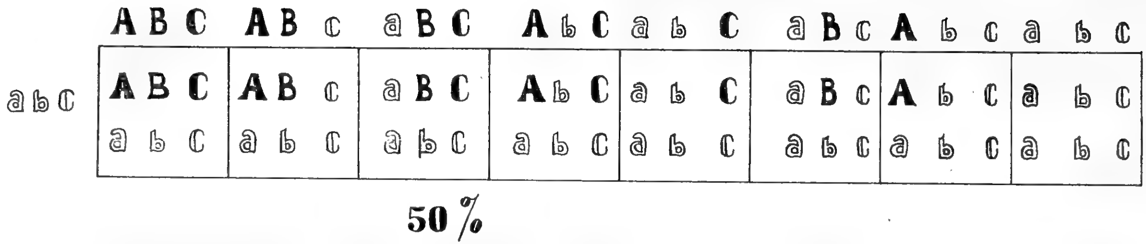

CHART 2. Expectation on basis of 3 cumulative multiple factors where a combination of at least 2 is necessary for the expression of the character. Solid letters mark factors producing the condition.

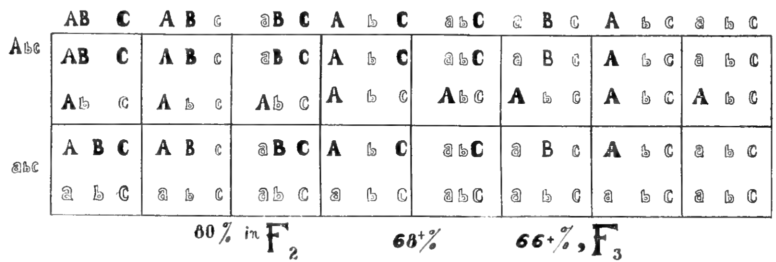

CHART 3. Expectation if the normal parent is the carrier of one multiple factor and the affected parent is the carrier of two.

factors and the affected parent two of them then the expectation would be for eleven out of sixteen children to be affected. This is approximately 69 percent. Since there are only five children in this family the fact that 80 percent of them were affected may be explained on this assumption. The same explanation would hold for the four affected children out of six in the F_3 generation. Chart 3 shows the expectation in this connection.

In the F_3 generation there are two families, one showing 20 percent affected individuals and one 25 percent. Chart 4 shows that on the assumption that the affected parent carries two of the determiners and the other parent no determiner for the defect the expectation is 25 percent affected individuals.

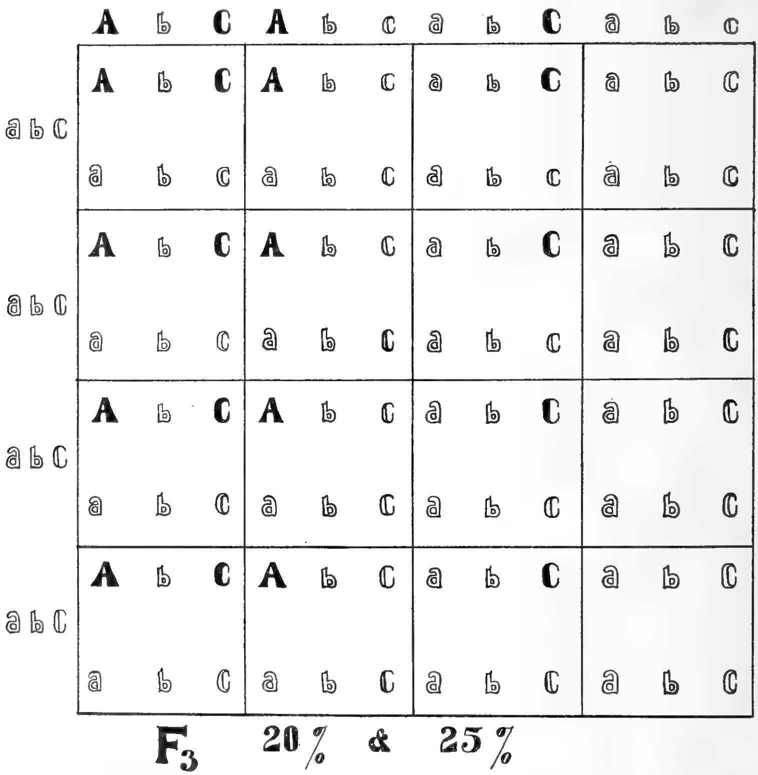

CHART 4. Expectation when one parent carries two determiners and the other parent none (25 percent of progeny affected.

In the F_4 generation there is a family of eight sibs only one of whom is affected. And also a family of five sibs only one of whom is affected. *Neither parent in either of these families is affected.* This condition cannot be explained either on the assumption of a single mendelian dominant or a single mendelian recessive. If the determiner were a dominant then the parent from the affected pedigree should show it. If it is recessive and the other parent homozygous normal, then none of the children could be affected. If it is recessive and both parents are hybrid then 25 percent of the progeny should be affected. If we assume that each of the parents carries one of our hypothetical multiple factors Chart 5 shows that the expected proportion of affected individuals is 25 percent, which agrees closely enough with the actual results.

On the contrary it may be that Prof. Bywaters is correct in his contention that "the one-factor dominant offers the simplest and most satisfactory explanation of the inheritance of the defect." He acknowledges, however, "Among the matings of the third generation, two were apparently normal men and women, but each produced one defective child and several normal ones. On the basis of the data, this is in opposition to the hypothesis of a single dominant gene causing the effect." He then quotes May (1917) as follows: "The congenital form (of ectopia lentis) is partial, usually upward, often becomes complete in after years, is generally bilateral and symmetrical, and somtimes hereditary." He follows this quotation with one from Berry (1893) as follows: "The partially dislocated lens often remains clear, and the diagnosis may consequently be difficult if the degree of displacement is slight."

	A b c	a b c
a B c	A b c a B c	a b c a B c
a b c	A b c a b c	a b c a b c

CHART 5. Expctation when each parent carries one determiner (25 percent of progeny affected).

Dr. Bywaters points out that sometimes diagnosis may be in error and also that "a partial displacement, if slight, does not seem to destroy the vision and persons so affected may not visit a physician or oculist but either suffer poor sight or visit an optician or optometrist, in either case, the patient being unaware of his or her real difficulty." On the basis of these points, Dr. Bywaters suggests that the cases in the third generation to which he has referred are reported as normal "because of lack of information," and that if this is the case this contradictory evidence to his single dominant gene suggestion is removed.

In this connection it is pertinent to point out that Dr. Pittinger who collected the pedigree in question is not only a qualified physician but a qualified oculist as well, and to quote Dr. Pittinger's paper which was published in the Archives of Ophthalmology (1935), "Of the twenty-two patients, I saw thirteen personally. The cases of the remaining nine were vouched for by members of the family who had previously given correctly the the histories of the thirteen members. On a statement of one member of the family that another had "bad eyes," investigation would reveal the condition of ectopia lentis. On the strength of these statements, the data on the first and second generations given in the accompanying chart were supplied . . . . The members of the families are of good general mentality."

From this it is evident that Dr. Pittinger personally examined the two cases to which Dr. Bywaters draws attention and this removes the objection he has raised. Those cases are in the third generation.

Obviously, in the present state of our knowledge, the suggestion of Dr. Bywaters that environmental conditions may also be operative in cases of the inheritance of ectopia lentis cannot be answered. He, himself, states "just what environmental condition would have an effect in this case, I hesitate to suggest" but claims that "it is not at all unreasonable to believe that the environment might prevent the defect from showing up in a person having the genetical makeup for it or it might delay its appearance, thus allowing death to prevent the expression of the genotype."

The Effect Of Extract Of Liver On The Fission Rate Of Paramecium Caudatum. A. R. Middlton, Univ. of Louisville. *The Problem.* In January 1936, the writer was discussing certain genetic studies in the fission rate of the Protozoa, in which he has been engaged for a number of years, with Dr. Wakerlin of the Medical School of the University of Louisville. Dr. Wakerlin suggested that I use liver extract as an experimenal agent in the medium, since the results would have some bearing on the use of that preparation in the treatment of anemia. The present paper is a report on the preliminary phase of that work.

Materials and Methods. On March 25, 1936, forty individuals all of the same generation of the descendants of a single "wild" *Paramecium caudatum,*

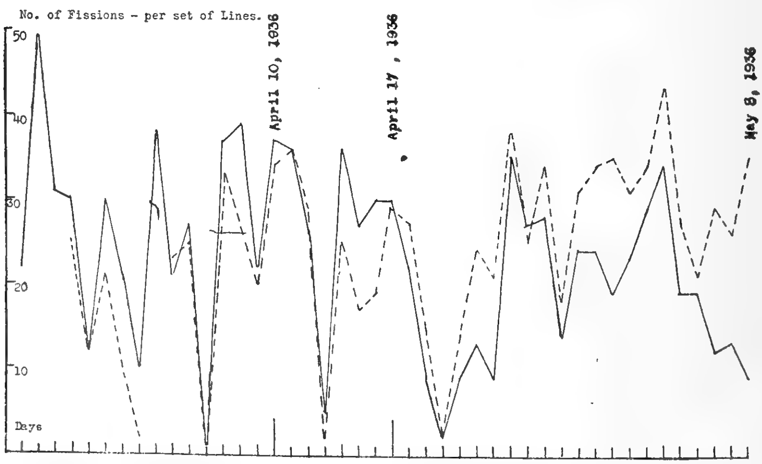

Figure 18. The continuous line shows the daily total number of fissions of the twenty control lines. The broken line shows the daily number of fissions of the twenty experimental lines.

were isolated. Twenty of these were placed in a 1/20 percent solution of Horlick's malted milk, prepared with distilled water, and another twenty, in a medium prepared by adding 1/10 gram of Lilly's liver extract powder to 100 cc of the control medium. Each of the forty animals was isolated in a concavity of a hollow-ground slide. By March 27 the animals of this experimental group were so deteriorated that an experimental medium prepared by adding 1/10 gram of liver extract powder to 150 cc of the control medium was substituted, but the last of the experimental animals died by March 28th.

On March 28th the control lines were duplicated to form a new experimental set which was placed in a medium prepared by adding 1/20 gram of liver extract powder to 200 cc of the control medium. All of this experimental set were dead by April 3rd. On that day a new experimental set was isolated from the control set and placed in a medium containing 1/20 gram of liver extract powder to 400 cc of the control medium. In this medium the experimental animals survived and reproduced. During all of this time, i. e., up to

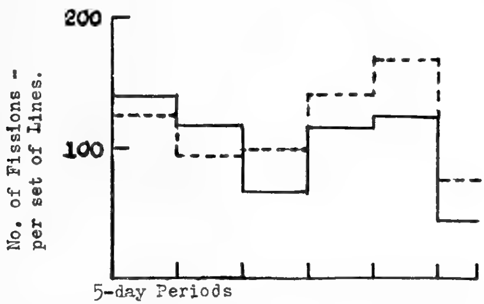

FIGURE 19. Total number of fissions during the successive five-day periods. The continuous line is the graph of the control set of twenty lines; the broken line is the graph of the experimental set of twenty lines.

April 10th, the fission rate of the experimental lines was slower than that of the controls, as is shown by Figure 1. On April 10th the experimental medium was still further reduced in concentration of liver extract by mixing equal quantities of the experimenal medium last used and the control medium to set a new experimental medium. In this medium the rate of fission of the experimental set of lines exceeded that of the control set and continued to do so until the end of the experiment, except April 25th when the controls had one single fission more than the experimntal set. From this date on to the end of the experiment there was a continuous increase in the excess of the fission rate of the experimntal lines and this excess was decidedly the greatest on the last day of the experiment. This is shown in figures 1, 2 and 3. Figure 2 shows the total number of fissions for each set for successive five-day periods, beginning April 10, and the average number of fissions per line per set for the twenty-eight days. Figure 3 is the curve of distribution of the two sets of lines.

Conclusion. In this paricular clone of *Paramecium caudatum* the effect of Lilly's liver extract powder on the fission rate is determined by the concen-centration of that extract in the medium. Whether the rapid increase in the fission rate of the experimenal set after introduction into the weakest medium used is due to that particular concentration or to the progressive reduction in the concentration of the experimental agent employed is now under investigation. This result may indicate that in anemia the liver extract used directly stimulates the rate of mitosis in the erythrocyte-forming tissue of the body.

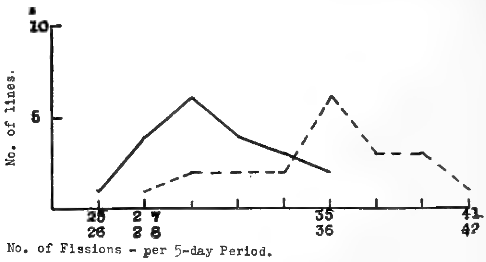

FIGURE 20. Distribution of the total number of fissions of the individual lines of the control set and the experimental set for the whole period of the experiment. The continuous line is the graph of the control set; the broken line is that of the experimental set.

VARIATION IN THE LACTOSE-FERMENTING ABILITY OF COLON BACILLI. J. L. Stokes, R. H. Weaver and M. Scherago, Univ. of Kentucky. *Paracoli,* found in water, in feces of man and other animals, resemble coli in every respect except that they do not ferment lactose within 48 hours. This investigation was made to determine whether paracoli are variants of coli organisms or a distinct organism. Thirty-two strains of paracoli, from human feces, fermented lactose, the fermentation being delayed 3 to 25 days. Endo plates streaked from the lactose broth cultures usually yielded both red and white colonies. Inoculations from the red colonies, into 1 percent lactose broth produced gas and acid within 48 hours. These variants were therefore indistinguishable from organisms of the coli group. That a process of variation was involved, rather than an adaptation, was shown by the sudden appearance of the variants also some colonies showed sector variation. When Endo plates of the 32 strains were incubated at 37° C. for 48 hours and then left at room temperature for a week, quick-fermenting variants were produced from 22 of the strains, which appeared as papillae, or red, pimple-like eruptions scattered over the colonies. Five variant strains were subcultured daily in safranine broth. The 21st subculture showed that two variants had given rise to non lactose-fermenting strains identical with the parent paracoli. Therefore, for these two strains, the cycle, paracoli to coli and back to paracoli, was complete. Evidently the variation is reversible. Therefore it appears that paracoli are variants of coli and should be given the same significance as coli in judging the potability of water.

An Adaptation Of The Winogradsky Technic To The Study Of The Microflora Of A Trickling Filter. R. H. Weaver, H. A. Raidt and R. P. Kerr, Univ. of Kentucky. A 9° Baume solution of sodium silicate was poured into a 13° Baume solution of hydrochloric acid and about 30 cc of the mixture was put into each Petri dish and allowed to set for about 24 hours. The plates were then washed for 2 or 3 days in running tap water, after which they were washed in several changes of boiling distilled water until the wash-water was free from chloride by the silver nitrate test. A definite quantity of a solution containing the substance to be tested and the mineral elements necessary for bacterial growth was then poured on and the plates were dried in a partial vacuum, in the presence of drierite. One cc or less of liquid from the trickling filter was spread on each plate, they were dried, as before, and incubated at 28° C. When simple organic substances were used as the only source of energy in the medium, only one or two types of organisms developed on the plates. Only rarely did the same organism appear on two plates containing different organic substances. Of the many species present in a tricking filter, only one or two appear to utilize a given simple organic substance. The organisms which decompose phenol, resorcinol, ortho-, meta-, and paracresols, and the sodium salts of formic, acetic, butyric, lactic and citric aids are being studied. (See Journal of Bateriology, January, 1936).

A New Disease Of Young Guinea Pigs. M. Scherago, Univ. of Kentucky. A fatal epizootic septicemia appeared suddenly in the stock of young guinea pigs. The older animals in the same house were not affected. The symptoms were sudden onset, ruffled fur, sluggishness, weakness, eyelids closed and stuck together, prostration and death in 5 to 6 hours. Autopsy showed the axillary and inguinal lymph glands enlarged and congested, and congestion of the liver, kidneys, adrenals, lungs, uterus, cecum and colon, the latter filled with gas. Smears from the peritoneum showed a gram-negative, encapsulated rod with rounded ends and straight sides, occasionally in pairs end to end, ranging from 0.6 to 1.0 micron in diameter and 1 to 4 microns long. An organism of similar morphology was isolated on agar slants, from all the internal organs. Four strains having identical characteristics were isolated from four animals. Saline suspensions of the organism, injected into young guinea pigs reproduced he disease with typical symptoms and pathology. The organism was isolated from the internal organs of these experimental animals and reproduced the disease with typical symptoms, when injected into young guinea pigs. Attempts to infect adult guinea pigs and one adult rabbit failed, but the organism was fatal to mice when injected intraperitoneally. The natural mode of infection was not ascertained. Guinea pigs fed saline suspensions of the organism or organs of animals that had died of the disease, were not affected. Inasmuch as a search of the literature disclosed no organism having the same characteristics, it was reported as a new species named *Pseudomonas caviae*.* That *P. caviae* was the cause of the disease reported was proved by the fulfillment of all of Koch's postulates.

* Jour. Bact. 31 : 83. 1936.

The Effect Of Alcohol On The Growth Of Protozoa, And The Growth-promoting Ability Of Some Commercial Peptones. John B. Loefer, Berea College. The effect of ethyl alcohol (0.025-5.0%) upon growth of *Chilomonas paramecium, Chlorogonium elongatum, Euglena gracilis, E. deses, Astasia* sp., *Colpidium campylum, Glaucoma piriformis* and *Paramecium bursaria,* was determined. Cultures were incubated at room temperature in moderate light for green forms and *P. bursaria,* and in darkness at 28° C. for colorless forms, for varying lengths of time, depending on the growth rate. Ratio of final to initial concentration of organisms per cc (x/x_0) was determined by the Sedgwick-Rafter counting-cell method. All experiments were carried out with bacteria-free cultures. Growth of *Euglena gracilis* was accelerated by concentrations of alcohol ranging from 0.025 to 1.0 percent, and that of *E. deses* by 0.05 and 0.1 percent alcohol. Among the remaining species, there was no evidence for acceleration of growth by alcohol. Complete inhibition of of growth of *Chilomonas* and *Paramecium bursaria* was observed in 2 percent alcohol, while *Chlorogonium* and *Glaucoma* grew slowly in concentrations as high as 4 percent. Growth of all the species tested was inhibited by 5 percent alcohol. Growth of *Paramecium bursaria* was tested in a variety of media made with commercial "peptones." Difco Proteose-peptone and Bacto-tryptone were best.

Fossombronia: A Liverwort New To Kentucky. H. Bishop and G. E. Quinby, Univ. of Louisville. On October 27, 1935, the writers noted a moss-like plant on the north side of a sandy bank of Cane Run, a creek in Jefferson county about 6 miles south of Louisville. The light green thalli, 3 cm. in diameter, were scattered among the darker ones of *Anthoceros laevis* L. and *Notothylas orbicularis* (Schwein) Sulliv. Its moss-like appearance was belied by spherical capsules. Closer examination in the laboratory indicated that the plant belonged to the rare genus, *Fossombronia.* Altho it is a member of the Marchantiales, its thallus is so like a leafy liverwort that one would at fiirst place it in the Jungermanniales. Specimens sent to Mr. Aaron J. Sharp of the University of Tennessee, were identified as *Fossombronia foveolata* Lindb. According to Mr. Sharp and a fairly thoro search of the liverwort records of Kentucky, this is the first occurrence of this genus and species in Kentucky. A recent letter from the Farlow Herbarium at Harvard University reords the species from Ontario, Maine, New Hampshire, Vermont, Massachusetts, New York, New Jersey, and South Carolina, and states that the species is also known from northern Europe.

The Mosquitoes Of Louisville, Ky. Griffith E. Quinby, Univ. of Louisville. Fourteen species are represented, in both tribes of the true mosquitoes. To ensure accurate identification specimens were checked by Dr. Matheson, at Cornell University. Most records were based on both male and female adults. *Anopheles quadrimaculatus* is relatively abundant and is important in malaria control. *Culex pipiens, Aedes aegypti, A. vexans, Psorophora cyanescens,* and *Anopheles punctipennis* are the principal pests. The remaining species are of little but scientific importance.

Anopheles quadrimaculatus bred chiefly in Paddy Run, Beargrass Creek and the ponds in nearly all the gardens, parks and cemetaries. *A. punctipennis* and *Culex pipiens* were found chiefly in Beargrass Creek, city dump ponds, Millcreek, and surface sewerage ditches thruout the city. *Aedes vexans* bred in nearly every fresh-water pool of any permanance. *Psorophoro cyanes cens* occurred most frequently near woods where temporary woodland pools abounded. Identified species stood at twenty-two when this paper was completed. An extended list of species is given in a later paper; see page .... of this volume.

A New Record For The Rare Ascomycetous Genus Melastiza. Harlow Bishop, Univ. of Louisville. On November 8, 1933, in Iroquois Park, Louisville, we found several bright-colored fruiting bodies of a cup fungus, on some charred logs. The cups were sessile, fringed with long, colored hairs. The spores were ellipsoidal, hyaline and elaborately reticulate. The description of Melastiza pennsylvanica Seaver in Dr. Fred Seaver's recent monograph (1928) of the operculate cup fungi of North America, appeared to fit very well. but to be certain of the identification, a specimen was sent to Dr. Seaver who stated that the identification was correct. This collection seems, therefore, to establish the first record of the species outside of Pennsylvania and constitutes an interesting and colorful addition to our flora. The organism seems to have been found only once, in Pennsylvania, by W. A. Murrill.

Tooth Attachment And Tooth Succession In Sphyrena Barracuda. Theo. B. Beust, Univ. of Louisville. The observations were made on two barracuda minnows about 40 mm long and three adult fish of 12 to 20 pounds weight. The largest and smallest mature specimens possessed 182 and 151 laterally compressed, enamel-covered teeth, respectively, and many thousands of cilliaform teeth situated on gill bars, pharyngeals and tongue. All teeth were composed of vasco-dentine covered with enamel. Altho differing in size, all were uniform in shape, structure and, apparently, mode of replacement. Dissections of the specimens guided by x-rays, admit of the following interpretations:

a. The dentogenetic zone is at the end of an epithelial cord, lamina or gubernaculum which passes from the oral epithelium thru a canal entering the bone immediately to the lingual of each tooth, sometimes in such proximity that its buccal wall is formed by it, or the tooth may be grooved for its reception.

b. About half way between the alveola crest and the base of the tooth, the latter is entered by the lamina. The depth and extent of the cavity absorbed into the tooth vary from a slight depression in the early stages of germ growth to a cavern containing a young tooth, occupying most of the embedded portion of the member. Curiously, the germ resorbs its way into the calcified body of each tooth, to be replaced from above. not, as might be inferred, from a permanent dento-genetic zone lying in the depths.

c. Teeth containing large germs usually have their bases absorbed; i. e., in a pulpy condition. Teeth entirely lacking germs or containing only small ones, have closed root ends, perforated only by the vertical nutrient vessels.

TISSUES AT THE STEM TIP IN AILANTHUS ALTISSIMA. P. A. Davies, Univ. of Louisville. The role the stem tip plays in histogenesis is well known. Hanstein (Die Scheitelzellgruppe in Vegetationspunkt der Phanerogamen. Bonn. 1868) classified the histogens (promeristematic tissue) at the stem tip in angiosperms into *dermatogen, periblem*, and *plerome*. More recently, Schmidt (Bot. Archiv. 8:345. 1924) classified them as *tunica* and *corpus*. The histogens at the stem tip in *Ailanthus altissima* may be classified either by Hanstein's or Schmidt's method. The tunica is divided into two layers; an outer layer of slightly flattened cells (the dermatogen of Hanstein) which produces the epidermis of the stem and foliar organs, and an inner layer of palisade-like cells (the periblem of Hanstein) which produces the outer layer of the cortex. The corpus (plerome of Hanstein) is divided into two parts; an outer, thick layer of cells which give rise to the inner cortex and pro cambial tissues, and an inner layer of transversely flattened cells which produce the pith. The histogens at the stem tip in *Ailanthus altissima* appear early in the development of the stem apex, maintain their individuality thruout the life of the growing tip, and develop definite, permanent tissues.

THE EFFECT OF SIZE OF GRAFT UPON THE DETERMINATION OF THE DORSOVENTRAL AXIS IN AMBLYSTOMA MICROSTOMUM. Harvey B. Lovell, Univ. of Louisville. The present experiments were undertaken to study the effect of size upon the determination of the dorsoventral axis in the forelimb of *Amblystoma microstomum*. Previous experiments have shown that the dorsoventral axis of the fore-limb bud of this species is determined before stage 33, using grafts 3 to 3½ somites broad (Lovell and Batts '35, Lovell '37). Recent experiments by Hollinshead ('36) on *A. tigrinum* have shown that grafts 2 somites in diameter behave differently from grafts 3½ to 4 somites broad. His work clarifies the rather confusing results previously reported for this species by Ruud ('26, '31) who used the larger grafts.

Experiments. In the first series of experiments grafts only 2 somites in diameter were employed. Since a disk is nearly circular, the area of a 2-somite graft is less than half that of a 3-somite graft (ratio 1 to 2.25). Only the center of the limb-bud region was excised. The left limb bud was implanted on the right flank with the dorsoventral axis inverted (heteropleural, dorsoventral, anteroanterior orientation). The dorsoventral axis therefore was the only one out of harmony with its surroundings. All grafts were homoplastic.

As shown in Table 1, a relatively large number of imperfect limbs was obtained. This was perhaps due to the failure to include all the limb-forming tissue in such small grafts. The distal end of these grafts was incomplete, the hand being absent or having one or two thin digits. The symmetry in such cases could not be determined.

The imperfections and resorptions were more frequent at stages 36 and 37 (58 percent) than they were at stage 38 (27 percent). At the older stage the limb bud had thickened to such an extent that a large amount of limb-forming tissue was included even in a 2-somite graft.

Table 1 shows that at stage 36 the dorsoventral axis was not yet determined. In every case which could be interpreted (four) the dorsoventral axis of the graft had been reorganized under the influence of the host tissue and, as a result, a right limb with normal orientation had differentiated from an inverted left limb bud. In such cases digits three and four are formed on the dorsal border of the graft, indicating that this is the ulnar margin.

At stage 37, out of 14 grafts only six were sufficiently perfect to be interpreted. In three of these cases the dorsoventral axis was already determined whereas in the other three it was still labile. Half of the cases had retained their prospective asymmetry and had developed into inverted left limbs, but the other half had reoriented their dorsoventral axis and formed harmonic right limbs.

At stage 38 eight out of eleven grafts formed supernumerary limbs the primary member of which had a well-formed hand. Seven of these continued to develop according to their original prospective asymmetry; that is, their dorsoventral axis had been determined irreversibly before the operation. Only one case had developed into a right limb in response to its changed environment. The presence of this case with a reoriented dorsoventral axis raises the question as to whether the axis is actually determined before stage 38 or whether this too is a transitional stage. Further experiments are being undertaken to settle this point.

Table 1. Summary of 2-somite grafts of fore-limb bud in *Amblystoma microstomum*.

Series	Total	Resorbed	Imperfect limb	Axis not determined	Axis determined
2sHIL36	10	2	4	4	0
2sHIL37	14	0	8	3	3
2sHIL38	11	0	3	1	7
Totals	35	2	15	8	10

A second series of experiments were performed to study the effect of increased size of the grafted disk upon the determination of the dorsoventral axis. From embryos at tail-bud stage (stage 29) disks of tissue 5 to 5½ somites in diameter were excised. The ectoderm, mesoderm and, to some extent, the underlying endoderm were stripped off from segments 2 to 6, inclusive. The pronephric rudiment was also included. A large piece of ectoderm was removed from the right flank of the host embryo, posterior to somite 5. The excised left-limb rudiment was implanted to this location with the dorsoventral axis inverted (het. dv. aa.).

When these transplanted buds began their development, their tips pointed posteriorly in a manner resembling a normal right limb. Later, when the digits began to form, the 3rd and 4th digits developed on the ventral margin (the ulnar border). This indicated that the dorsoventral axis had retained its original asymmetry and that the graft was developing into an inverted left limb. The material immediately around the base of the limb bud appears able to control the polarization of the dorsoventral axis in *A. microstomum*. Similar results were obtained by Nicholas ('24) for *A. punctatum*.

Discussion. We have just shown that the time of the determination for the dorsoventral axis of the fore limb in *A. microstomum* is much later when 2-somite grafts are used than when the grafts are 3 to 3½ somites broad. In this characteristic *microstomum* agrees with *tigrinum* but not with *punctatum* (Swett '27). Does this indicate that the size of the embryonic area is smaller in the first two species than in the last? The large number of defective limbs obtained from 2-somite grafts leads us to believe that the rudiment is larger than 2 somites.

The fact that the fore limb of *tigrinum* does not develop until much later than that of *punctatum* would seem to explain the later determination of its dorsoventral axis. This can not be the explanation in the case of *microstomum,* however, since its fore limb appears at about the same time as that of *punctatum.*

The present experiments seem to indicate that the determination of the dorsoventral axis is a gradual rather than a sudden process. The time of determination depends upon the size of the graft, the reorientation of the axis occurring more readily in small grafts than in large ones. Smaller grafts are more labile, more easily influenced by surrounding conditions. When the graft is of normal size in *microstomum* (3-3½ somites), the dorsoventral axis is determined by stage 33, but when the graft is very small (2 somites or less), the axis is not determined until stage 38 or perhaps not until one stage later, stage 39.

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THE ORIGIN OF BEHAVIOR IN EMBRYOS OF BRUCHUS QUADRIMACULATUS. (Coleoptera) by Wm. Lowenthal, Univ. of Ky. First movements were noted after 72 hours incubation at 30° C, as a faint lateral bending of the thoracic region. These increase in amplitude and are followed by an undulating or wave-like movement anterior-posteriorly. Stimuli do not elicit response till the ninety-eighth hour. The general progression of movement is in an antero-posterior gradient centered in the anterior thoracic region.

A PRACTICAL SMALL AQUARIUM UNIT. J. W. Lancaster, Univ. of Ky. This unit, recently constructed at the University of Kentucky, is so designed that a variety of equatic life can be exhibited at one time. It has eleven tanks for tropical fishes, a 90-gallon tank for native fishes, and a trough for aquatic reptiles and amphibians The tanks are arranged so as to be viewed from the front whereas work in them is done from the rear. Each is lighted by a light-bulb above it. Water is supplied by an overhead line and aeration by an electrically-driven air pump. Temperature is regulated by electric heaters controlled by thermostats. The tanks for tropical fishes are at the highest level and the trough for reptiles, lowest. Temperature in the former is 75-80° F.; in the tank for native fishes, 65-70°, and in the trough, about 65°.

The Relation Of Season, Sex And Weight To The Basal Metabolism Of The Albino Rat. T. C. Sherwood, Univ. of Ky. Observations of more than 6,000 tests during 6 years show a seasonal, sex and weight relationship to the basal metabolism of the albino rat. Surface area as well as weight technique show a decrease in heat production of 45 per cent in rats weighing from 100 to 400 grams. The seasonal effect is not seen in the younger growing rats but is well-defined in the older groups. Young males and females have the same basal metabolism. However, the matured males show a higher rate than do the females. The older rats again become more nearly the same in heat production.

The Relation Of Excessive Vitamin A To The Vaginal Epithelium. T. C. Sherwood, M. A. Brend and E. A. Roper, Univ. of Ky. A study was made to show the effect of excessive vitamin A on the epithelial tissues. Following the observation of at least 5 normal oestrus cycles by the vaginal smear wethod, large amounts of carotene were given the animals for a period of 15 days. In every case, the rats showed a continuous young nucleated cell picture for approximately 30 days. In no case was the normal cycle observed in the experimental rats. The animals were allowed to return to normal and the vaginal smears continued for a time.

The Relation Of Ovarian Hormone To The Thyroid Gland In The Control Of Basal Metabolism. T. C. Sherwood and L. M. Bowers, Univ. of Ky. An extensive study of the relation of ovarian to thyroid function, by Sherwood, Savage and Hall (1923), Sherwood and Bowers (1936) showed that theelin and amniotin bring about a decrease in basal heat production when injected into normal adult albino rats, overiectomized rats and experimental hyperthroid rats. Metabolism is decreased as much as fifty-four percent in overiectomized rats. The experimental hyperthyroid curve indicated that amniotin therapy immediatly following the thyroid feeding caused a return to the normal heat level in one-half the time necessary for a return to normal in animals fed desiccated thyroid only.

The Relation Of Experimental Hyperthyroidism To The Blood Picture Of The Albino Rat. T. C. Sherwood and Grace P. Birge, Univ. of Ky. After studying the blood picture of approximately 100 male and female rats, thyroid therapy was given for a number of days and the blood counts made at various intervals. There was apparently no change in the red-cell count in the hyperthyroid animals but a decided increase of the white-cell count on the 5th day following therapy. The white-cell number had nearly returned to normal on the 8th day following therapy.

DIVISION OF CHEMISTRY

Malcolmn Lyons, Acting Chmn. W. F. Forsee, Acting Secy.

Some Effects Of Deuterium Oxide On Staphylococcus aureus. E. W. Cook, Centre College. Several strains of *Staphylococcus aureus* and *Staphylococcus albus* were grown in nutrient broth. After 24 hours several large, white Staph. aureus colonies were noted. This variant was white, rough and large, while the control grown in broth made with distilled water was yellow, smooth and small. The colonies were 1 cm. to 4 cm. in diameter, flat, and the edges were sharply serrated, characteristics quite the opposite of the normal colony which is 0.25 cm. to 0.5 cm. in diameter, the surface smooth and glistening and the edges quite even. This rough variant retained its characteristics after serial transfers in broth made with distilled water. Physically, then, this strain had been definitely changed. Physiologically it had lost its pigment-producing power.

Fermentation reaction of the variant was tested on 24 carbohydrates including monosaccharides (pentoses and hexoses), disaccharides, glucosides and trihydric, pentahydric and hexahydric alcohols. In 13 of the 24 strains there were differences in the production of acid. In some, fermentation resulted in the variant but not in the control; in others the reverse was noted. Morphologically the variant and the original strain were the same. Both stained well and the appearance of individual cocci and the characteristic arrangement of groups of cocci were the same in both.

Chemical Analysis And Probable Cause Of Urinary Calculi Formed In A Yearling Bull. G. Davis Buckner and E. S. Good, Ky. Agricultural Experiment Station. Autopsy upon a yearling Hereford bull showed that the kidneys contained 157 grams of stones ranging in size from shot to more than an inch in diameter. The bladder contained 61 grams of smaller, smooth stones, and the urethra contained one, nearly ⅜ inch in diameter. Chemical tests showed that all the calculi were composed mainly of ammonium magnesium phosphate with a little calcium phosphate; that is they were "triple phosphate." The probable cause was surmised to be faulty metabolism.

Solubility And Compounds Of The Halides Of Cadmium, Zinc, Cobalt, and Nickel With 1-4 Dioxane.* Sister Roderick Juhasz, S. C. N. and L. F. Yntema, St. Louis University. Herz and Lorentz[1] showed that the salts of some of the lighter metals are only slightly soluble in anhydrous dioxane. Other investigators[2] prepared a number of molecular addition compounds of inorganic salts and dioxane. In the present work anhydrous dioxane was saturated with anhydrous cadmium and zinc halides at 26.5° C. The amount of solute

* From the thesis presented to the graduate faculty of St. Louis University by Sister Roderick in partial fulfillment of the requirements for the degree of Master of Science, June, 1934.

was determined after evaporating the solvent by titration with silver nitrate, using potassium chromate as indicator.

Solubility in 100cc. of solution at 26.5° C.

	Grams	Milligram Molecules
Cadmium bromide	0.0115	0.04
Cadmium iodide	0.0407	0.11
Zinc chloride	2.2606	16.61
Zinc bromide	7.5764	33.60
Zinc iodide	36.1400	113.17

These results indicate that the solubility of inorganic salts in anhydrous dioxane increases with increase in molecular weight.

The following molecular addition compounds were prepared.

$CdCl_2 \cdot (C_4H_8O_2)$	$CdBr_2 \cdot (C_4H_8O_2)$	$CdI_2 \cdot (C_4H_8O_2)$
$ZnCl_2 \cdot (C_4H_8O_2)$	$ZnBr_2 \cdot 2\,(C_4H_8O_2)$	$ZnI_2 \cdot 2\,(C_4H_8O_2)$
$ZnCl_2 \cdot 2\,(C_4H_8O_2)$	$CoBr_2 \cdot 2\,(C_4H_8O_2)$	$CoI_2 \cdot 2\,(C_4H_8O_2)$
$CoCl_2 \cdot (C_4H_8O_2)$	$NiBr_2 \cdot 2\,(C_4H_8O_2)$	$CoI_2 \cdot (C_4H_8O_2)2H_2O$
$NiCl_2 \cdot (C_4H_8O_2)$		$CoI_2 \cdot (C_4H_8O_2)4H_2O$
$2\ CdCl_2 \cdot (C_4H_8O_2)$		$NiI_2 \cdot 2\,(C_4H_8O_2)$

A PRELIMINARY REPORT ON VAPOR PHASE ADSORPTION BY "FILTROL" AND ACID-TREATED BENTONITE. R. N. Maxson, Univ. of Ky. and R. I. Rush, Centre College. This paper discusses an experimental study of the vapor phase adsorption of an acid-treated clay called "Filtrol." Bentonite from various sources was also examined. The dynamic method was used and certain improvements were made in the apparatus employed by previous workers. "Filtrol" gave a maximum adsorption of 30.1 percent of thiophene-free benzol. The data showed that the acid-treated clay approached the efficiency of a commercial silica gel.

Untreated Medicine Bow bentonite gave very low adsorption values. A comprehensive series of experiments indicated that suitable treatment with 6 N sulfuric acid gave the most efficient capillary structure. The maximum amount adsorbed at equilibrium was 39.7 percent. This result shows that the treated bentonite used is as efficient as Patrick's silica gel for adsorption of benzol but is much below the efficiency of the Holmes-Sullivan type of gel.

Further investigation is planned along the following lines: 1. Continued study of various acid treatments. 2. Extension of the study of adsorbates. 3. The effect of lower partial pressures. 4. Efficiency curves and the rate of adsorption as affected by the pH of the clay. Complete details of this preliminary work can be obtained from the authors.

DISTILLERS' DRIED GRAINS AND DISTILLERY SLOP IN CHICKEN RATIONS. G.

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1 Herz and Lorentz, Z. physikal. Chem. 140: 419-421. 1929.

2 Reinboldt and Boy, J. prakt. Chem., 2, 1929: 268. 1931. Paterno and Spallino, Atti. Acad. dei Lincei, 16: 87. 1907. Faworsky, Chem. Centr., 1: 15. 1907.

Davis Buckner, W. M. Insko, Jr., J. Holmes Martin and Amanda Harms. Ky. Agricultural Experiment Station. Experiments in feeding chicks in battery brooders indicated that thick distillery slop and distillers' dried grains can be used advantageously in place of a large part of the corn and all the wheat middlings of the usual mash.

The Tolerance Of Certain Species Of Fishes For Low Dissolved Oxygen And Increased Carbon Dioxide Concentrations. Charles R. Allen, Western Ky. State Teachers College. The experiments were made with fishes 5 to 9 inches long, in slowly renewed water of determined dissolved-oxygen content, at 26 to 29° C. Lethal concentration was that which failed to sustain life for 3½ hours. Such concentrations were: for *Ameiurus natalis, Carassius auratus, Cottus bairdii, Forbesichthys papillifera,* and *Claricola* sp., 0.6 to 1.3 ppm; for *Helioperca incisor, Shaenobryttus gulosus,* and *Notropis ardens lythrurus,* 2 to 2.3 ppm, and *Pomoxis annularis,* 2.8 to 3.5 ppm. An excessive concentration of carbon dioxide was injurious, but the number of experiments was too small to render the results conclusive.

A Student Looks At The New Analytical Standard, Ceric Sulfate. Louis Gordon, Univ. of Ky.

The Effect Of Hydrogen Ion Concentration On The Coloring Of Whisky. Frank M. Shipman and C. R. DeSpain, Brown Foreman Distillery Co., Louisville. The author concludes from the experiments described: 1, the pH value of whiskey decreases during ageing; 2, the stable range of pH value is below 5, with 4.2 to 4.3 preferred for younger whiskys; 3, color increases with increase in pH.

Test Tube versus Taster. William J. Lenz, Louisville, Ky. (By title.) The paper points out that chemical control in the manufacture and ageing of whisky is important and is being used more and more by distillers.

Particle Size Distribution In Hydraulic Cements. Eugene J. Vechter, Louisville Cement Company. Cement particles above 60 microns in diameter have little cementing power because the reaction with water takes place slowly. The turbidimeter affords a reliable means of measuring the size of particles smaller than 60 microns and these measurements are an index of the behavior of a given cement.

The Distribution Of Orally Administered Arsenic In The Tissues Of Animals, With Special Reference To Its Partition In Rat Blood. J. S. McHargue and Malcolm Lyons, Ky. Agricultural Experiment Station. Albino rats, guinea pigs, rabbits and chickens were given a diet containing 250 ppm of As, as As_2O_3. Analyses of their blood gave 1300, 7.0, 5.2 and 4.0 parts of As per million, respectively. Repeated analyses showed that the blood of albino rats fed As_2O_3 contained a higher concentration of As than any other tissue, and 99 percent of the As was found in the clot, when the blood coagulated. When cells, serum, and fibrin were separated, practically all the As was found in the cells. Crystalline hemoglobin prepared from the blood of rats that were fed As_2O_3 contained 1620 to 2125 ppm, and the As content was not appreciably diminished by five recrystallizations from relatively large volumes of solution, nor was it removed from solutions of this hemoglobin by dialysis These facts suggest that the arsenic is in some way chemically combined with the hemoglobin molecule.

A Polarizing Attachment For The Spectroscopic Determination Of Boron. J. S. McHargue and R. K. Calfee, Ky. Agricultural Experiment Station.

GEOLOGY AND GEOGRAPHY

D. M. Young, Acting Chmn. Paul Averitt, Secy.

The Problem Of Coal Correlation In Eastern Kentucky. Paul Averitt, Univ. of Ky. Experience seems to indicate that the interval between coal beds is the most trustworthy guide in correlation. It is thought that, over limited areas at least, the interval varies between small limits which represent the maximum relief possible under swamp conditions, and that over wide areas variation of somewhat greater magnitude is possible in one direction. Furthermore, neglecting diastrophism, two successive coal beds should be essentially parallel. When these principles are applied to coal correlations, it seems likely that noticeable changes in intervals between coal beds and apparent convergence and divergence are due to mistakes in correlation rather than to actual conditions.

A Sandstone Dike In The Kentucky River Fault Zone Of Central Kentucky. Arthur C. McFarlan, Univ. of Ky. The Kentucky River Fault zone is commonly regarded as late Paleozoic. Large blocks, weathered from a sandstone dike which follows one of these faults closely, were found, in 1928, near Valley View. In 1934, such a dike was found at Clay's Ferry occupying a fissure in the Jessamine limestone within a few hundred feet of the Kentucky River fault. The dike is only three to four inches thick and consists of poorly sorted, often angular, sand grains, with a calcareous cement. These dikes are interpreted as sand of Irvine age, washed into earthquake fissures resulting from renewed slipping along the old break. There were two periods of notable uplift and westward tilt in the post-Paleozoic, one of which occurred after the deposition of the Irvine sand. It is believed that the old break constituted a line of weakness and was ruptured in this movement. The possibility that this sand was Pennsylvanian, washed into these fissures at the time of original faulting, is recognized but regarded as less likely. Such an interpretation would be significant as additional evidence of the former extent of the Pennsylvanian in central Kentucky.

Summary Of Kentucky Meteorites With A Description Of The Camprellsville Siderite. D. M. Young, Univ. of Ky.

Precipitation And Tree Growth In The Berea Region. W. Lyle Dockery, Berea College. The width of growth rings, in groups of 10, was measured, in oak stumps in the Berea Region. Correlation between growth and rainfall, during 34 years, was 83 percent. The growth rings measured extended back to 1760.

Soil Erosion And Its Prevention In The Berea Region. Warren R. Wagner, Berea College. The seriousness of erosion is little realized by farmers in this country, and only in the last few years has much attention been paid to the problem. Erosion in the Berea region was discussed in relation to physiography, climate, types of soil, location, causes, geology, and geographic factors. Methods of preventing and controlling erosion were decsribed and examples cited. The paper was illustrated by lantern slides to show conditions in the region.

The Chester Rocks Of Meade, Hardin And Breckenridge Counties Kentucky. R. E. Stouder, Louisville Gas and Electric Company. The following table gives the relative age and thickness of the Chester formations as found in the region, using the Indiana and Illinois names.

Formations			Thickness feet
Upper Chester	Buffalo Wallow	Kinkaid ls.	15-30
		Degonia ss-sh.	50-60
		Clore fm.	20-45
		Palestine ss.	2-6
		Menard ls.	15-20
		Waltersburg fm.	80-100
		Vienna ls.	4-8
		Tar Springs ss.	50-60
Middle Chester		Glen Dean ls.	55-100
		Hardinsburg ss.	35-40
		Golconda ls.	40-70
		Cypress ss.	40-65
Lower Chester	Paint Creek	Productus inflatus zone	6-12
		Elwren ss. - sh.	8-30
		Reelsville ls.	25-35
		Sample ss.	12-35
	Renault	Beaver Bend ls.	14-30
		Mooretown ss, shale and coal	0-75
		Unnamed ls.	0-20

Some Phases Of Repressuring In Kentucky. D. J. Jones, State Geologist, Univ. of Ky.

A Mineral Collection For High Schools. D. J. Jones, Univ. of Ky.

Statistical Measurement Of Agricultural Contrasts. A. Bruce Poundstone, Ky. Agricultural Experiment Station. Striking differences in the types of farming, agricultural income, density of rural population, population adjustment, levels of living, land-use problems and kindred topics are so closely integrated with geologic and other contrasts that a thorò delineation of these natural differences is an important need in the interpretation of agricultural conditions. Knowledge of the finer details of geology will be of most value to the agriculturist when they are carefully mapped, for it is knowledge of the location and extent of such differences that is of practical value. A growing interest in plans for conservational uses of land and better utilization of other agricultural resources means greater dependence upon the combined fields of geology and land utilization. The geologist and agriculturist are becoming more closely associated. A clear conception of geologic facts is perhaps the most important prerequisite to careful land-use planning. Statistical measurement of agricultural differences shows the striking need for a more thoro analysis of basic factors.

A STUDY OF BIRD LIFE ON A TEMPORARY LAKE.* Gordon Wilson, Western State Teachers College. Ten miles south of Bowling Green is a depression that is normally cultivated in corn. After very wet winters and springs some 300 acres of this area become covered with water. This wet-weather lake attracts large numbers of wading and water birds. I have found 56 species on or near the lake, many of which remained to nest, in 1927 and 1935. In March and early April ducks are the most numerous of the birds found, as many as 5,000 having been recorded in a single day. Eighteen species of ducks and two species of geese have been recorded, the most rare being the Blue Goose, five of which stayed at the lake for a month, in 1933. The second period of great interest commonly occurs when the water is receding, in late April and early May. Then come the shore birds, 20 species of which have been recorded including the very rare Golden Plover. The most numerous species thruout the late spring is the Coot, many of which nested in the area in the years when the water lasted longest. The various Herons, including the beautiful white American Egret, are most numreous in late summer. On one day in August, 1935, sixty of this species were counted and the similar but smaller Little Blue Heron in immature plumage.

SOME FUNCTIONS OF THE STATE DEPARTMENT OF MINES AND MINERALS. Geo. R. Wesley, State Department of Mines and Minerals, Owensboro. The functions are twofold: the Coal Mining Division enforces State Mining Laws thru mine inspection and instruction of workers and operators; the Geological Division gives services to all mineral industries thru technical assistance in field studies and by laboratory studies in the repressuring laboratory at Lexington and in the sedimentary laboratory in Owensboro. At present cooperation beween the industries and the Department is better than heretofore. By such cooperation it is hoped that a fuller contribution to both Science and the Industries may be realized.

MATHEMATICAL ASSOCIATION OF AMERICA
KENTUCKY SECTION

Smith Park, Chm. A. R. Fehn, Sec.

Fundamental Mathematical Concepts for Mathematics Majors. Guy Stevenson, Univ. of Louisville.

The Defense of High-school Mathematics. Wallace Smith, New River State College, Montgomery, W. Va.

* See the "Wilson Bulletin" and "The Kentucky Warbler."

Teaching the Binomial Theorem. Tryphena Howard, Western State Teachers College.

A Device for Calculating Mechanically the Square Root Deviation from the Mean. J. G. Black, Morehead State Teachers College.

Curves and Surfaces of Floatation. Fritz John, Univ. of Ky.

On Linear Measure of Point Sets Composed of Any Number of Rectifiable Arcs. Susan J. Howard, Western State Teachers College.

The Fundamental Lemmas in the Calculus of Variations. F. W. Donaldson, Univ. of Ky.

Euclidian Algorithm in Algebraic Fields. E. D. Jenkins, Univ. of Ky.

Differentials. L. P. Hutchinson, Univ. of Ky.

DIVISION OF PSYCHOLOGY AND PHILOSOPHY

M. M. White, Chm. M. L. Billings, Sec.

Mental Adjustments Used in Promoting the War System. Clio Arnold, Sue Bennett College.

Comparison of Blood Pressure Changes Following Ideational and Sensory Stimuli. James E. Calvin, Univ. of Ky.

Relation of Material Learned to Rate of Pulse. Walter E. Watson, Western State Teachers College.

Bergson and the Symbolists. Joseph C. Burk, Univ. of Ky.

ASSOCIATION OF PHYSICS TEACHERS KENTUCKY CHAPTER

Charles Hire, Chmn. B. P. Ramsey, Secy.

Magnetic Rotation of Polarized Light for Thin Liquid Films Suspended in Air. Alvin Pershing, Western State Teachers College.

Research Work in Magneto-optics. Francis G. Slack, Vanderbilt Univ.

Comments on the Coefficient of Elasticity. Waldemar Noll, Berea College.

A Study of Insulating Properties of Asbestos Paper. Waldemar Noll and Walter Picklesimer, Berea College.

Properties of Interference Systems Formed by Parallel Plates. W. E. Anderson, Univ. of Ky.

Right-angled Lever Paradox. W. G. Wineland, Morehead State Teachers College.

A Comparison of Maxwell-Lorentz Magnetic Forces With Those of Weber. F. W. Warburton, Univ. of Ky.

Some Experiments in Photographic Testing. Ralph A. Loring, Univ. of Louisville.

An Improved Impendance Bridge. T. M. Hahn, Univ. of Ky.

MINUTES OF THE TWENTY-FOURTH ANNUAL MEETING, 1937

The 24th Annual Meeting of the Kentucky Academy of Science was called to order by President Hinton, at 2:00 p. m. April 30, 1937, in the Playhouse on Belknap Campus of the University of Louisville. Dr. Raymond A. Kent, President of the University, cordially welcomed the Academy to the University. The response was made by Dr. L. Y. Lancaster, Vice-President of the Academy. Dr. Hinton then reviewed the work of the Academy during the past year.

The proposed amendments to the constitution were read and discussed and the following were adopted unanimously:

ARTICLE XI, BOARD OF DIRECTORS. A Board of Directors consisting of eight (8) members shall be elected as follows: The first year two members shall be elected to four-year terms, two members to three-year terms, two members to two-year terms, and two members to one-year terms. Thereafter, two members shall be elected annually for the full term of four years. In said Board shall be vested and by said Board shall be exercised all the ordinary and appropriate corporate powers and functions of the Kentucky Academy of Science. Said Board shall annually choose from their number a Chairman and a Secretary to act as such, respectively, until their sucessors are elected, and a fair record shall be made and kept of its proceedings, the same to be submitted to the Kentucky Academy of Science at each Annual Meeting thereof or whenever called for by the President of the Kentucky Academy of Science.

Change the title of the present Article XI, AMENDMENTS, to Article XII, AMENDMENTS.

That the headquarters of the Kentucky Academy of Science, Incorporated, shall be at Lexington, Kentucky.

The meeting then adjourned till 8:45 a. m., May 1.

The second session of the 24th Annual Meeting opened in the Playhouse of the University of Louisville, at 8:45 a. m., May 1, 1937, President Hinton in the chair. Reading of the minutes of the first session was dispensed with. The following amendments to the consitution were discussed and unanimously adopted.

ARTICLE IX. MEETINGS. The Annual Meeting of the Academy shall be held at such time and place as the Executive Committee may select. The Executive Committee may call a Special Session, and a Special Session shall be called at the written request of twenty members. Any group of members of the Kentucky Academy of Science may hold meetings for the presentation of the results of research, or for any similar purpose, such as field excursions or demonstrations, at their pleasure but such group meetings shall not be held at such time or place as will conflict in any manner with the Annual Meeting of the Academy.

ARTICLE V. EXECUTIVE COMMITTEE. The Executive Committee shall consist of the President, Vice-Presidents, Secretary, Treasurer, Councilor of the American Association for the Advancement of Science, President of the preceding year and the Chairman of the Committee on Junior Academy. The Executive Committee shall direct the affairs of the Academy during intervals between Annual Meetings, except those duties assigned to the Council, and shall fill vacancies in its own membership occurring during such intervals. A majority of the members of of the Executive Committee shall constitute a quorum of that committee for the authoritative transaction of its functions and duties. The first meeing of the Executive Committee shall be held immediately after the adjournment of each annual meeting of the Kentucky Academy of Science. In case of a tie vote the vote of the President shall decide.

It was voted to place the awarding of grants in research in the hands of the Executive Committee.

On motion it was ordered that a Committee be set up on Conservation of Natural Resources, and hat Dr. Austin R. Middleton, Chairman for Kentucky of the Committee of the Ecological Society of America be its chairman. Dr. Middleton immediately named the following as the other members of this committee: Dr. L. Y. Lancaster, Dr. Alfred Brauer, and Dr. V. F. Payne.

On motion it was ordered that each member of the Kentucky Academy of Science be notified of available grants in aid of research, from the A.A.A.S., and that this notice shall be sent in time for members to make their recommendations to the Executive Committee within 30 days.

The Committee on Nominations reported the following nominations for officers: President, Dr. L. Y. Lancaster; Vice-president, Dr. Theodore Beust; Secretary, Dr. Alfred Brauer; Treasurer, Prof. Julian H. Capps; Councilor for A.A.A.S., Dr. Austin R. Middleton.

For Board of Directors: One-year term, Dr. Charles Hire and Dr. J. S. McHargue; two-year term, Mr. R. C. Ballard Thruston and Dr. E. S. Maxwell; three-year term, Dr. Irvin Abell and Mr. Jay B. Kenyon; four-year term, Mr. Lucien Beckner and Judge S. M. Wilson.

A ballot was cast and the nominees were unanimously elected.

The general session then adjourned to permit the meetings of the several divisions.

NEW MEMBERS ELECTED, 1937

Albright, John B. Science teacher, Eubank, Ky.
Belcher, Robert Orange, Student, 701 College P. O., Berea, Ky.
Birge, Grace Pitkin, Anat. & Physiol. U. of Ky. Lexington, Ky.
Bolton, Dr. Ernest, Dentistry, U. of Louisville, 129 E. Bdwy.
Bond, Miss Wilma, Student, 123 E. 3d St. Maysville, Ky.
Clay, Dr. Wm., Biology, U. of Louisville, Louisville, Ky.
Crider, Marvin, Student, U. of Ky. Zoology. 43 Main St. Paintsville.
Currie, John Will, Ky. Wesleyan, Winchester, Ky.
Dimmick, G. B. Prof. Psychology, U. of Ky. Lexington, Ky.
Ernst, Dr. R. C. Col. of Engineering, U. of Louisville.
Fonaroff, Miss Ruth N. Dept. of Chemistry, U. of Louisville.
Ford, M. C. Ogden Dept. Science. W. S. T. C. Bowling Green, Ky
Hardin, Dr. Rector, Dept. Economics, Berea College.
Hawkins, Dr. J. Gordon, 311 Republic Bldg. Louisville, Ky.
Hudson, Alfred A. E. 1103 Evergreen Ave., Goldsboro, N. C.
Kenyon, Jay B. Professor, Asbury College Wilmore, Ky.
Ketron, C. V. Teacher, Frankfort H. S. Frankfort, Ky.
Koppius, Dr. Otto, Dept. Physics, U. of Ky., Lexington.
Lenz, Dr. Wm. J. Lenz Research Laboratory, Starks, Bldg. Louisville.
LeStourgeon, Dr. Elizabeth, Mathematics, U. of Ky., Lexington.
Mann, Edma, Dept. of Science, U. of Louisville, 1305 Washington St., Louisville.
Marble, Miss Guita, Dept. Chemistry, U. of Louisville.

Marks, Miss Mary E. W. K. S. T. C., Bowling Green, Ky.
Mitchel, J. R. Chemistry, U. of Ky., Lexington.
Monroe, Mr. Burt L. 207 Birchwood Ave., Louisville, Ky.
Neel, J. K. Zoology, U. of Ky., Lexington.
Page, Mr. Geo. V. Dept. Physics, W. K. S. T. C. Bowling Green.
Pardue, Louis A. Dept. Physics, U. of Ky., Lexington.
Quinby, Griffith E. State Dept. of Health, Louisville, 1811 Algonquin Pkwy.
Scherago, Dr. M. Dept. Bacteriology, U. of Ky., Lexington.
Schneider, Evelyn J. Librarian, U. of Louisville. Ornithology.
Scutchfield, Bucher, Prestonsburg, Ky.
Shipman, Frank M. Brown Forman Distillery, Louisville.
Sikes, Prof. W. W., Berea College, Berea, Ky.
Todd, Jarvis, Dept. Physics, U. of Ky., Lexington.
Webb W. S. Professor Physics, U. of Ky., Lexington, Ky.
White, Dr. M. M. Psychology, U. of Ky., Lexington, Ky.
Wimmer, C. R. Chemistry, Union College, Barbourville, Ky.

REPORT OF THE SECRETARY

The Academy has 263 members distributed as follows: Local, 155; National, 79; Corresponding, 9; Honorary, 15; Honorary, National, 1; Life, National, 2; Corresponding, National, 2.

All members of the A. A. A. S. in Kentucky who were not members of the Academy, were invited, by letter, to join. Five responded by becoming members of the Academy.

Eight divisions took active part in the meeting, and 54 papers were read. The Division of High School Science Teachers, and the Louisville Astronomical Society met with the Academy for the first time.

REPORT OF THE EXECUTIVE COMMITTEE

The committee held two meetings; October 24, 1936, and January 30, 1937, at which the following actions were taken:

A committee was appointed to harmonize the constitution with the articles of incorporation. A fall meeting will not be held, but only the annual spring meeting, in 1937. The invitation of Dr. Middleton, to hold the annual meeting at the University of Louisville was accepted. Amendments to the constitution, to be proposed at the annual meeting, were prepared.

JUNIOR ACADEMY

The fourth annual meeting was held Saturday, May 1, at the gymnasium, University of Louisville. Mr. Morris Garret, President, presided at all sessions. Dr. Anna A. Schnieb gave the principal address on "Alaska, Our National Playground."

The awarding of prizes was as follows:

Best Exhibit: Class A. Bellevue H. S., first. Honorable mention, Bryan Station, Fort Thomas. Class B. Independence H. S., first. Honorable mention, Kirksville, Whitehall.

Best Discussion: Class A. First, Eddie Ribertson, Harrodsburg. Honorable mention, Alice Davis, Bellevue; Mildred Murry, Henry Clay. Class B. First, Mary Samuels, Red House. Honorable mention, Earl Rowlette, Kirksville; Warren Dorman, Independence.

Best Contribution: First, James Ison, Harrodsburg. Honorable mention, Nettie Payton, White Hall.

Largest Percentage of Members Present: Anchorage, Bryan Station, Independence, Newby, White Hall, each with 100 percent.

Largest Percentage of pins owned: Anchorage.

The following officers were elected: President, Dorothy Sheer, Anchorage; Vicepresident, James Coyle, Bellevue; Secretary, Earl Rowlette, Kirksville; Treasurer, James Ison, Harrodsburg.

The attendance was somewhat over five hundred.

PAPERS PRESENTED AT GENERAL SESSIONS

Address of Welcome. President R. A. Kent, University of Louisville. Response by Dr. Lancaster.

Application of Modern Techniques in the Recovery of the Prehistoric. W. S. Webb, Univ. of Ky.

The Responsibility Of Science To Youth. (President's Address.) Robert T. Hinton, Georgetown, College. Omitting the usual introductory remarks, let us proceed to a consideration for a few minutes of the responsibilities of organizations such as ours toward the world of today. Since there is little that can be done at the present moment of a corrective nature which would be effective at once it would be more profitable to turn our eyes to the future and plan accordingly.

I believe one of the best indications of a sense of responsibility on the part of scientists is that they be willing to criticise now and then conditions as they are and decide by the evidence whether things are better or worse and whether the state of mankind at present is a happier one because of the changes Science has effected. The situation as a whole excites us to wonder if the young people of today are being introduced into anything like that orderliness of social conditions they have a right to expect when they are told of the marvelous achievements of Science and of the Utopia they are soon to possess.

Let us think about this matter from the viewpoint of the effects of the findings, practices and teaching of Science upon the coming generation, or for convenience, let us use the term "Youth." What kind of a world is it to inherit? Does Science help or hinder? Can Science remedy the defects and improve that which is already good? Can it give to Youth something that will enable it to tackle the job of living, not merely to have a so-called easier life or to exist thru a span of years without any particular discomfort, but to be inspired to gladly assume responsibilities and duties as they arise, in the full and happy knowledge that it is playing a worthwhile role and that it has a worthwhile objective.

It is not a debatable question that thru scientific inventions and attainments there has been created a better world to live in when it is measured by the yardstick of improved physical conditions of every kind, and that man's control and command has been extended and deepened to make nature yield its wealth and power to lighten his work, to give more bountiful crops, and to serve his pleasure in many ways. Knowledge of the environment, the structure and functions of organisms has made it possible to understand more clearly the vital relationships existing in the living world, and to defend the human body from such as would destroy it, creating more healthful surroundings and finer care in the preservation of health. These things have set free for the individual more hours of leisure which may be used for the enjoyment of things outside the necessary daily routine.

But Youth is accustomed to these things from birth. They are the only things it knows in this connection, and it has no long view in retrospect to make comparisons and revel in the present as contrasted with the past. So let it not be expected that it will be lost in wonder and admiration over the usual. Youth would, I believe, be rather dazed and bewildered by the widely contradictory scenes to which it is introduced in this world so constructed and guided by the hand of Science and the Scientific method, where the findings of Science are so strongly misused and where the Scientist as a member of society seems to wield such slight authority over the adapting of the fruits of his labors to social uses.

Youth observes bread lines in the midst of an abundance; that crops are plowed under and food animals slaughtered; dust storms over great areas of once fertile fields in a country that boasts of its leadership in agricultural methods and the ultra in labor-saving agriculural machinery. It observes that Science seeks to save life and also that Science seeks to kill in the most wholesale and barbarous fashion; that Science gently soothes the expectant mother so that the newborn child may come into the world as gently as possible and often nurtures this helpless mite that it may be assured not merely of life, but of living in the full possession of its physical and mental strength; that Science hurls bombs from the air, tearing asunder mother and child, or spreads a cloud of deadly gas over the battle front and countryside choking the life out of young and old, rich and poor alike.

We of the older generation are used to such contradictions and think of them as "natural" and so explain the matter to the novitiates and, unfortunately, they too are convinced that it is a condition about which little or nothing can be done and so have the ardor and zeal for accomplishing "great things" completely dampened or totally extinguished. Should Science be expected to come to the rescue in such a situation and seek ways and means to correct these abuses and to straighten out the thoughts and actions of men? Can it at least be a helpful agency?

President Fosdick of the Rockefeller Foundation says, "Natural Science does not hold itself responsible for the intelligence or capacity of those who apply its findings. Its discoveries are left on the doorstep of Society with no directions as to how they are to be cared for." I think we will agree that this expresses the normal position taken by many scientists in these fields. President Fosdick's statement is corroborated by the answer of a scientist when questioned about the doubtful or even dangerous results that might be brought about by certain experiments he was making. "I am not interested in the implications of the facts I am seeking to discover." Shall we say then that those who find and furnish the facts are to show no interest in the implication of these facts; that they are unwilling to guide the incorporating of them into individual and social living Is it to be said of those persons who are devoted to the great branches of study which are prefaced upon the proposition of law and order in the universe and who are dedicated to the endless search for the Truth, that they are not particularly interested in arousing in the human mind a vast respect for law and order and a reverence for Truth? If pressed upon this point, I believe we would all admit such an interest.

In this matter of the "Obligation of Science to Youth" and treating it from the view point of the teaching and explaining of the Biological Sciences in their various phases to those who have had little or no experience, three points are to be stressed:

1. The obligation to get before the young people the facts, so far as known, concerning living organisms, the environment in which they live, the functions they perform, and all the various relationships between them * * * Poor facilities as to buildings and laboratory equipment may readily be advanced as a criticism of the present set-up, particularly in the preparatory schools. The chief weakness here is the lack of time devoted to these subjects, the ground being covered entirely too hastily in sketchy and bird's-eye-view courses so that the sudent is not impressed that anything very important is being attempted. The touching upon so many topics so hastily is poor procedure. Fundamentals are sadly neglected and, as statistics show, the great percentage of students quit even before graduating at high school and those who do enter college find themselves badly handicapped when they enter the advanced courses.

2. To instill into the student's mind an appreciation of clear, accurate, honest work and thinking, the development of ability as contrasted with cleverness. There is hardly any good substitute for a course that includes laboratory work. The history of the procedure necessary to establish a fact as a fact is very impressive. The weighing of evidence, the careful guarding against the possibility of error, the attack upon a problem from many angles and the readiness to admit a mistake if one is made. Truly this is an eloquent plea for soberness of thinking, patience, fairmindedness, the ability to take it on the chin in failure and a silent rebuke to gossip, cheating and lying. The romance of the capture of a fact can be recommended as a stimulating study and as excellent training.

3. The interpretation and explanation of Biological facts, laws and theories

in such a manner as to aid young people in adjusting themselves in the social order as workers and as citizens and also to aid them in formulating their philosophy of life. The conviction that this is one of the functions of Science has been expressed before this Academy in former addresses with this question usually asked. "Why should other persons be better qualified to render this service?" I merely wish to add emphasis to this point. If there is some other field of study which can train people better to handle all the implications of scientific facts, scientists should investigate that field and if possible take advantage of its resources for training.

Here may be the particular reason for the need to develop the social sciences along lines that will be of still greater aid in treatment of Biological questions that naturally arise in connection with social problems. Reluctant as we may be to admit it, it is very difficult to impose, even purely academically, strict limitations upon the biological fields. They include the study of every living organism from the beginning to the present in all of its phases. The physical sciences are incorporated in the study of structures of plants and of animals. When the study of man is reached, the biological flowing into the social is as definite as one stream of water merges with another. * * *

In the teaching of biological sciences, a greater emphasis should be placed upon the social and humanitarian implications of the facts and theories in these studies. All workers in the biologial field are teachers either by example or by precept, by publication of articles or textbooks, or in the classroom and laboratory. Facts and theories, laws and principles and the interpretations of them emanate from the original investigators, are handed on down thru the universities to the colleges, preparatory schools and grades, to the ends of the country. But by far the greatest number of persons are engaged primarily in instructional work only. To these I am restricting the term "teacher." They are the ones who come into personal touch with the greatest number of students, especially students of younger years. They are the ones who must present and interpret biology, using in the main the facts and interpretations as they have been received from their own teachers. They constitute the chief agency for the diffusion of the knowledge of biology and how young people will think about it. They are, on that account, a very important if not the most important factor for putting into effect any new methods or disseminating changes of any kind.

What kind of omnipotent genius shall the teacher of biology be to meet the needs of the future? It is said that the best teachers are those who, while actively teaching, find time to do some research work. Surely they must have at least the spirit of research and a good grasp of its intents and purposes to be effective in instructing others. Too often the teachers of biological subjects, especially in schools where the requirements for teachers are rather meagre, must gather information from day to day in order to keep about two jumps ahead of the class, or they are shanghaied into service by a desperate superintendent or principal who has to make some adjustment to fit the budget; so they carry a class in science as a side issue to the work they feel best fitted to do. No one regrets their insufficient training more than they do themselves, but what can be done about it? These conditions are regrettable, but all are victims of a system and general mass inertia.

Teachers of biology must help to bridge the gap between this field and the sociological, and should have a good knowledge of the fundamentals of the latter. Teaching the young demands simplicity of presentation, patience, and wisdom. Those who know their subject best are generally the most skillful in arranging their material in the simplest terms without losing the real essentials of its content. Many of the questions that arise in biology and its related fields are packed with dynamite and need a skill in handling such as only broad study and an understanding that has been obtained by living and meeting the deepest experiences can give. Only when we learn to place at the strategic places in our educational system wise and experienced guides will we take a decided step in advance. Such positions must be made attractive enough to draw to them those who are so badly needed..

This Academy might profitably use some of its time in considering ways and means to aid the teachers of Science in a definite and practical manner. Those of the colleges and universities have opportunity to contact only a very small proportion of the future citizens of our country,and their field of influence is restricted to the class room unless they are able to reach out by other means and assume their share of this obligation of science to Youth. All of us are teachers, so let us strive for a knowledge of the needs of the times and the wisdom to make our work more effective. Let us paraphrase a saying of Paul the Apostle and keep it in mind as a guiding principle in all instruction:

> "Yet in the class room I had rather speak five words
> with understanding, that by my voice I might teach others
> also, than ten thousand words in an unknown tongue."

PAPERS PRESENTED AT DIVISIONAL MEETINGS
DIVISION OF BIOLOGICAL SCIENCES

H. B. Lovell, Chm. R. H. Weaver, Secy.

PRELIMINARY REPORT ON THE MOSQUITOES OF KENTUCKY. Griffith E. Quinby, Entomologist, State Department of Health, Louisville. This is the first comprehensive report on the mosquitoes of this state. A list of species with notes on distribution, first records, economic importance as pests and disease vectors, and other interesting biological aspects is given, followed by a bibliography of referenes available in this state. The following is the list of mosquitoes recorded in the paper:

Anopheles barberi Coquillett. .*A. crucians* Wiedemann. *A. punctipennis* Say. *A. quadrimaculatus* Say. *Aedes aegypti* Linnaeus. *A. canadensis* Theobald. *A. hirsuteron* Theobald. *A. nigromaculis* Ludlow. *A. triseriatus* Say. *A. triciattatus* Say. *A. triviattus* Coquillett. *A. vexans* Meigen. *Culex apicalis* Adams. *C. erraticus* Dyar and Knab. *C. inhabitator* Dyar and Knab?* *C. peccator* Dyar and Knab?

*Question mark indicates doubt on author's part of certainty of determination.

C. pilosus Dyar and Knab? *C. pipiens* Linnaeus, *C. quinquefasciatus* Say. *C. salinarius* Coquillett. *C. tarsalis* Coquillett. *C. territans* Walker. *Psorophora ciliata* Fabricus. *P. columbiae* Dyar and Knab. *P. cyanescens* Coquillett. *P. discolor* Coquillett. *P. ferox* Humbolt. *P. horridus* Dyar and Knab. *P. howardii* Coquillett. *P. varipes* Coquillett. *Mansonia perturbans* Walker. *Orthopodomyia signifer* Coquillett. *Theobaldia inornata* Williston. *Uranotaenia sapphirina* Oesten-Sacken. *Megarhinus septentrionalis* Dyar and Knab.

A Discussion Of The Tooth Root Of The Teleost Fish, Sargus Ovis, Or Sheepshead. Theodore B. Beust, Univ. of Louisville. The incisors of the sheepshead, which have such close resemblances to the incisors of man, may be characterized in the following terms:

(1) offset, or jointed, at the neck; (2) crown of orthodentine; (3) vaso-dentine at the joint, or neck; (4) embedded portion of vaso-dentine; (5) osteodentine of the pulp zone in mature teeth; (6) an ankylosis with the jaw bone in mature teeth; (7) a submerged pedestal of bone, not previously interpreted as a root; (8) a tooth sac holding uncalcified young erupted tooth in the bony socket; (9) both with tooth germ.

These characters show close homology with the mammalian tooth, the two last-named having come into line with the discovery by Doctor Beust that the young toothsac serves to attach the crown to the pedestal and hold it in the socket until its ankylosis with the pedestal. This is strictly in harmony with the action of the periodontium of mammals. We may regard the pedestal as a true root. This study seems to extend the phylogenetic origins of the mammalian tooth farther back than the previously recognized reptilian type as exemplified by the alligator.

Phases Of Susceptibility Of The Bruchid (*Coleoptera*) Egg To KCN During Early Development. Alfred Brauer, Univ. of Ky. The eggs of *Bruchus quadrimaculatus* Fabricius when treated with a .01 molar solution of KCN during the first day of development exhibit four phases of susceptibility which do not correspond to visible developmental events. The first is one of high total susceptibility and has a duration of 6½ hours in the newly laid egg. This corresponds precisely to that period during which determination of prospective values is established in the egg. The second phase (7-12 hours) is one of high resistance in regard to entire development. Treatment during this period results in a very high percentage of elongate embryos. The third phase (14 to 18 hours) is one of higher susceptibility than the second. Treatment during this phase results in anomalies involving fission of the *embryonic plate*. The fourth phase, beginning at approximately 18 hours, is highly resistant to KCN. Developmental processes effected by treatment, as indicated by the type of anomalies produced, precede their visible manifestation by several hours in each instance.

Bacteria Using Indol In A Trickling Filter. H. E. Calkins, R. H. Weaver, and M. Scherago, Univ. of Ky. The modification of the Winogradsky tecnic described by Weaver, Raidt and Kerr before this Academy in 1936 was utilized in a study of the bacteria in a trickling filter, which decompose indol. Tho earlier workers reported that indol is not readily decomposed by microorganisms, we found 500 to 1000 bacteria per ml. of filter effluent that were capable of using indol as a sole source of carbon and energy. Of these approximately 80 percent were elongated diplococci. While they have not been found to be identical with any known species, they are apparently similar to the phenol-utilizing species, *Micrococcus sphaeroides* and *M. piltonensis,* described by Gray and Thornton. A species of rod shaped bacterium with single polar flagellum and one belonging to the Flavobaterium genus were found in much smaller numbers.

SEXUALITY OF SAPROMYCES REINSCHII. Harlow Bishop, Univ. of Louisville.

BACTERIA USING LOWER AMINES, IN A TRICKLING FILTER. T. C. Samuels, R. H. Weaver, and M. Scherago, Univ. of Ky. The modification of the Winogradsky technic described by Weaver, Raidt and Kerr before this Academy in 1936 was utilized in a study of the bacteria which decompose lower amines in a trickling filter. The following organisms were isolated: from methylamine hydrochloride, *Protaminobacter alboflavum d*; from ethylamine hydrochloride, *Proactinomyces salmonicolor, Protaminobacter alboflavum d,* and *Proactinomyces opacus;* from diethylamine, *Protaminobacter rubrum* and *Aerobacter aerogenes.* No organisms were found to use triethylamine. These results are in accord with the previous observations that only a few species of microorganisms utilize a specific organic compound and that closely related compounds are usually decomposed by different microorganisms. Studies of the life cycle of *Proactinomyces salmonicolor.* were made.

THE EFFECT OF HYDROGEN-ION CONCENTRATION ON THE GROWTH AND MORPHOLOGY OF PARAMECIUM BURSARIA. John B. Loefer, Berea, College. The organism was grown, under bacteria-free conditions, in a salt medium containing either 0.75 percent of proteosepeptone or 0.5 percent of bactotryptone. The pH was adjusted at 10 different points, from 4.6 to 8.6. In bactotryptone optimum growth was at pH 6.5 to 6.8 and the range, 5.1 to 8.2; in proteosepeptone the optimum was at pH 6.8 and the range, pH 4.9 to 7.8. The longest organisms, 129 microns, were grown at pH 6.0 and the shortest, 86 microns, at the extreme limits of growth. Induced morphological variation was discussed and the need for a standardized procedure for culturing protozoa was pointed out.

RELATION OF VITAMIN A TO THE ESTRUS CYCLE AS DETERMINED BY THE HOSTOLOGICAL PICTURE OF THE OVARY AND UTERUS. Grace Pitkin Birge, Univ. of Ky.

EFFECT OF AMNIOTIN ON THE BASAL METABOLISM OF EXPERIMENTAL HYPOTHYROID RATS. Theodore Martin Wilson, Univ. of Ky.

CAMBIAL STIMULATION. P. A. Davies, Univ. of Louisville. In *Ailanthus altissima* Swingle, two definite cases appear which indicate that a cambial stimulating influence is produced in the leaves and transported in a morphological downward direction within narrow limits in shoots and stems. The first case occurs in abnormal methods of branching, while the second occurs in shoot dominane.

THE BOMBIDAE OF JEFFERSON COUNTY, KENTUCKY. Harvey B. Lovell, Univ. of Louisville.

Key to the Females and Workers

—Females and workers with pollen-baskets on hind tibiae 1

—Females without such pollen-baskets, no worker caste: A large bee with occiput and anterior 2/3rds of thorax yellow, abdomen black .... *Psithyrus variabilis.*

1. Thorax with a broad, black band between the bases of wings 2

—Thorax yellow with a few black hairs at most in center of disk 5

2. First 4 dorsal abdominal segments yellow, the 5th and 6th black; sides of thorax mostly yellow; occiput black; ocelli small .... *Bombus fervidus*

—At least the 4th, 5th, and 6th abdominal segments black 3

3. First two abdominal segments yellow, the last 4 black; occiput black; ocelli large .... *B. fraternus*

—First abdominal segment wholly or partly black, segments 2 and 3 yellow, the others black 4

4. First abdominal segment with basal portion black and apical portion yellow; occiput black; ocelli small .... *B. americanorum*

—First abdominal segment black; occiput with yellow hairs; ocelli large, the lateral ones nearer the eyes than to each other .... *B. auricomus*

5. First abdominal segment yellow, the others black .... *B. impatiens*

—First abdominal segment yellow, the second with yellow or orange hairs on at least the basal portion 6

6. First and second abdominal segments entirely yellow .... *B. vagans*

—Second abdominal segment with some black hair apically 7

—A patch of orange hair on basal portion of second abdominal segment; ocelli small; malar space longer than wide at apex .... *B. bimaculatus*

—A patch of orange hair on basal portion of second abdominal segment; ocelli large; malar space shorter than its width at apex .... *B. separatus*

Occiput refers to top of head; malar space is region between ventral side of compound eye and base of mandible; color of abdominal segments refers to dorsal side only.

All these species have been taken several times in Jefferson County except *B. fervidus* which was included in the key because it is known to occur in other parts of Kentucky.

DIVISION OF CHEMISTRY

Malcolm Lyons, Sec.

THE EFFECT OF SOME NATURAL RESINS ON THE DRYING OF RAW LINSEED OIL. C. C. Vernon, and W. W. Renne, Univ. of Louisville.

REACTION OF ETHANOL AMINES ON SOME BETA-CHLORETHYL ESTERS. C. C. Vernon and W. P. Crouch, Univ. of Louisville.

SOLUBILITY AND COMPOUNDS OF COPPER, SILVER, CALCIUM, STRONTIUM, AND BARIUM HALIDES WITH 1,4 DIOXAN.* Sister Virginia Heines, S.C.N., and L. F.

* The work described in this paper is taken from the thesis presented to the graduate faculty of St. Louis University by Sister Virginia in partial fulfillment of the requirements for the degree of Master of Science, June, 1934.

Yntema, St. Louis University, St. Louis, Mo. The original purpose of this investigation was to show what effect 1,4 dioxan, $C_4H_8O_2$, as an organic solvent, has on certain inorganic halides of some of the Group I and II metals, both as to the extent of their solubility and the addition compounds formed.

Diethylene dioxide or 1,4 dioxan is an excellent solvent for cellulose esters, resins, oils, and waxes. (1) Recently it has been used as a dehydrating agent for tissues, because it removes water without hardening the materials that are to be mounted. (2) The molecular addition compounds as given by various investigators may be found in the literature as follows:

Dioxan dibromide	$C_4H_8O_2\ Br_2$	(3)
Dioxan diodide	$C_4H_8O_2\ I_2$	(4)
Dioxan chloroiodide	$C_4H_8O_2\ ICl$	(4)
Dioxan chlorostannate	$C_4H_8O_2\ SnCl_4$	(5)
Dioxan bromostannate	$C_4H_8O_2\ SnBr_4$	(5)
Dioxan iodostannate	$C_4H_8O_2\ SnI_4$	(5)
Dioxan chloromercurate	$C_4H_8O_2\ HgCI_2$	(6)
Dioxan sulfate	$C_4H_8O_2\ H_2SO_4$	(7)
Dioxan nitrate	$C_4H_8O_2\ 4/3HNO_3$	(8)

I. Solubility of the Copper Halides

Apparatus and Method. Compressed air, dried by means of a calcium chloride tube and a sulfuric acid tower, was used to force the liquid up into the glass filter from which the samples were taken. A constant temperature of 26.5° was maintained thruout the experiment.

Commercial dioxan is not entirely anhydrous. It was refluxed over metallic sodium for at least an hour, then filtered and let stand over anhydrous magnesium sulfate for twenty-four hours. After distillation, tests were made by taking the freezing point of the liquid or by placing a few cubic centimeters on some anhydrous copper sulfate.

About five grams of the anhydrous salt were placed in a large tube containing at least twenty-five cubic centimeters of anhydrous dioxan. The tube was sealed and let stand at room temperature for two weeks. At the end of this time, the tube was connected to the apparatus and samples of ten cubic centimeters of the liquid were taken. After the dioxan was evaporated off, the residue left in the flask was titrated against standardized silver nitrate according to the method of Mohr.

Results. The average solubility of the copper halides was obtained as follows:

Solubility in 100 cc. of solution at 26.5° C.

$CuCl_2$	0.311 grams
Cu_2Cl_2	0.031 grams
$CuBr_2$	0.075 grams
Cu_2I_2	insoluble.

Solubility determinations were made on the silver halides but they were found to be too insoluble to yield accurate data.

2. Compound Formation

A. Copper halides.

a. *Cupric chloride and dioxan.* A saturated solution of cupric chloride and dioxan required at least two weeks to become sufficiently clear for sample taking. During this time the brown cupric salt had changed to a bright orange powder, and large emerald-green crystals had separated from solution. Using Mohr's method for the determination of halogens, the green crystals analyzed as $CuCl_2.2(C_4H_8O_2)$, and the orange residue gave the formula, $2(CuCl_2).(C_4H_8O_2)$. The crystals were very unstable as they gradually changed to the orange powder, even in the desiccator.

b. *Cuprous chloride and dioxan.* This salt dissolves slightly in dioxan imparting to the solution a light amber color. Determination of copper in the undissolved cuprous chloride showed that the compound had added no dioxan.

c. *Cupric bromide and dioxan.* By evaporating a solution of dioxan containing an excess of undissolved anhydrous cupric bromide, a crust of dark green crystals formed. These were quickly dried in the air between filter paper and immediately placed in a weighing bottle. Analysis showed the formula to be $CuBr_2\,2(C_4H_8O_2)$.

Calcium chloride seemed to be the most suitable desiccant for drying the salt residues, altho great care had to be taken that the compounds were not left too long in the desiccator. Sulfuric acid and phosphorus pentoxide took dioxan from the samples very quickly. Soda lime, anhydrous calcium sulfate and anhydrous dioxan would not dry the residue but could be used to excellent advantage for keeping the samples after equilibrium had been reached.

B. Calcium halides.

a. *Calcium chloride and dioxan.* Analysis of this halide showed that it took six months to reach equilibrium with dioxan. The formula proved to be $CaCl_2\ (C_4H_8O_2)$.

b. *Calcium bromide and dioxan.* The bromide was very soluble in the liquid and gave off a great deal of heat when dissolving. No crystals could be obtained by evaporating the solution, but the residue analyzed as $CaBr_2.2(C_4H_8O_2)$.

c. *Calcium iodide and dioxan.* The iodide was more soluble than the other halides of calcium. The undissolved portion became a light yellow, pasty substance that gradually assumed a crystalline structure. After several days of careful drying the ratio was found to be one molecule of the iodide to two of dioxan.

C. Strontium halides.

Strontium chloride is the least soluble of these halides. The solubility as well as the heat of solution seem to increase with the increase of the molecular weight of the salt. No crystals of the dioxanated compounds could be obtained, but the residues showed the following results:

Strontium chloride added no dioxan.
Strontium bromide gave the formula, $SrBr_2.(C_4H_8O_2)$.
Strontium iodide gave the formula, $SrI_2.2(C_4H_8O_2)$.

D Barium halides.

The barium halides seem the least soluble of the calcium, strontium, barium group. The chloride was the least soluble. Volhard's method was used in the determination of these compounds.

The chloride added no dioxan. The bromide, altho slightly soluble, gave the formula of the anhydrous salt. The iodide was very soluble and formed a definite crystaline compound. Analysis showed that these crystals were $BaI_2.3(C_4H_8O_2)$. After drying several days longer over calcium chloride the most stable form seemed to be $BaI_2.2(C_4H_8O_2)$.

Table 1. Halides of Copper, Calcium, Strontium, Barium, With 1,4 Dioxan.

Compound	% Halogen In Sample	% Halogen Calculated	Formula
$CuCl_2$	22.1	22.8	$CuCl_2.2C_4H_8O_2$
$CuCl_2$	22.8	22.8	$CuCl_2.2C_4H_8O_2$
$CuCl_2$	22.8	22.8	$CuCl_2.2C_4H_8O_2$
$CuBr_2$	40.4	40.0	$CuBr_2.2C_4H_8O_2$
$CuBr_2$	40.9	40.0	$CuBr_2.2C_4H_8O_2$
$CuBr_2$	40.9	40.0	$CuBr_2.2C_4H_8O_2$
$CaCl_2$	34.9	35.6	$CaCl_2.C_4H_8O_2$
$CaCl_2$	34.8	35.6	$CaCl_2.C_4H_8O_2$
$CaCl_2$	35.9	35.6	$CaCl_2.C_4H_8O_2$
$CaBr_2$	43.5	43.3	$CaBr_2.2C_4H_8O_2$
$CaBr_2$	43.5	43.5	$CaBr_2.2C_4H_8O_2$
CaI_2	54.2	54.0	$CaI_2.2C_4H_8O_2$
CaI_2	53.7	54.0	$CaI_2.2C_4H_8O_2$
CaI_2	53.8	54.0	$CaI_2.2C_4H_8O_2$
CaI_2	54.3	54.0	$CaI_2.2C_4H_8O_2$
$SrCl_2$	44.9	44.7	$SrCl_2$ No dioxan added
$SrBr_2$	47.9	47.6	$SrBr_2.C_4H_8O_2$
$SrBr_2$	48.2	47.6	$SrBr_2.C_4H_8O_2$
$SrBr_2$	48.3	47.6	$SrBr_2.C_4H_8O_2$
SrI_2	48.4	49.0	$SrI_2.2C_4H_8O_2$
SrI_2	48.6	49.0	$SrI_2.2C_4H_8O_2$
SrI_2	48.3	49.0	$SrI_2.2C_4H_8O_2$
$BaCl_2$	34.5	34.0	$BaCl_2$ No dioxan added
$BaBr_2$	53.5	53.7	$BaBr_2$ No dioxan added
BaI_2	44.7	44.7	$BaI_2.2C_4H_8O_2$

Summary

Anhydrous cupric chloride and cupric bromide add two molecules of dioxan. Addition compounds of the halides of calcium, strontium, and barium with dioxan are in the ratio of two molecules of dioxan to one of the salt. Various desiccants, such as calcium chloride, sulfuric acid, anhydrous calcium sulfate and phosphorus pentoxide were used. Determination of the halogens was made according to the methods of Mohr and Volhard.

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THE VALUE OF KENTUCKY BLUEGRASS IN POULTRY RATIONS. J. Holmes Martin and Amanda Harms, Ky. Agricultural Experiment Station.

A NEW METHOD FOR THE MICRO-DETERMINATION OF IODINE IN PLANT MATERIAL. J. S. McHargue and W. T. Forsee, Jr., Ky. Agricultural Experiment Station.

THE PHYSIOLOGICAL SIGNIFICANCE OF SMALL AMOUNTS OF ARSENIC. EFFECT ON ERYTHROGENESIS. (A Preliminary Report.) J. S. McHargue and W, K. Hall, Ky. Agricultural Experiment Station. Fourteen albino rats in two equal groups with respect to sex, were fed a stock ration to which was added nine parts per million of sodium arsenate. Reticulocyte counts made at weekly intervals showed an increase during the first and second weeks, after which there was a gradual return to normal by the end of the seventh week. The hemoglobin showed a transitory stimulation extending from the second to the sixth week. The red-blood count was increased in two male rats for about two weeks, after which it returned to normal. The red-blood count in two female rats declined sharply, altho the hemoglobin values remained at a normal level. After seven weeks the counts were again normal. Apparently, arsenic stimulates erythrogenesis in rats, altho the mechanism by which stimulation occurs is not apparent from this experiment.

SOLUTION OF SOME OF THE DIFFICULTIES IN BALANCING ELECTRONIC TRANSFER EQUATIONS. V. F. Payne, Transylvania College.

A REVIVAL OF SULFUR THERAPY. A. W. Homburger, Univ. of Louisville.

GEOLOGY AND GEOGRAPHY

D. M. Young, Chm. Paul Averitt, Sec.

FLOOD FACTS. Lucien Beckner, Louisville.

THE ROCK ASPHALT INDUSTRY OF WESTERN KENTUCKY. Mary E. Marks, Western Ky. State Teachers College. This industry, the only one of commercial proportions in the isolated area to which it is confined, grew from a production of nearly 4000 tons in 1901 to approximately 400,000 tons in 1928. Three districts capable of commercial production are: the Grayson-Hardin county, the Edmonson county and the Logan county districts. They lie to the southwest of the Bluegrass on the western flank of the Cincinnati Arch. The Edmonson county district, the most important in amount of output, is composed of alternating high, rather narrow, flat-topped ridges and deep, steep, sometimes precipitously-sided, V-shaped valleys.

The major portion of the rock asphalt is quarried, tho mining is done at Indian Creek. It is conveyed from the quarry by trains of side-dump cars drawn by small steam locomotives to the mill where it is crushed and rolled until reduced to the original sand grain. The quarries are on the same level as the railroad and the first crusher about 600 feet. The hill extends down the side of a steep bluff permitting a down-hill haul of the heavy material. It is loaded on barges and shipped down Nolin and Green Rivers and up Barren to Bowling Green, and thence by rail to any desired point.

Kyrock, in the right angle formed by Nolin River and the south fork of Pigeon Creek, has an irregular pattern conforming to the topography. The retail and service enterprises within the corporation are a part of the company's operations. Local agriculture has been affected in many ways by the demands of the quarry community. Much of the sparse population is either engaged in the work of quarries or in providing food for such workers.

The rock asphalt industry of western Kentucky definitely depends on the road-building industry. There is, therefore, a very definite seasonal variation in the movement of the rock asphalt. Its future depends largely on the solution of problems of competition within the industry and with the manufactured product.

Agricultural Contrasts In The Eden Shale Area Of Kentucky. **Bruce Poundstone, Univ. of Ky.**

Some Aspects Of Petroleum Geology In Western Kentucky. George R. Wesley, Geologist, Owensboro. A definite relationship exists between the amount of oil discovered and the quantity and quality of exploratory effort. Commercially important deposits of petroleum in Western Kentucky are largely stratigraphically controlled, modified in some instances by structural deformation. These stratigraphic traps consist largely of shoreline deposits, buried channels of ancient streams, porous horizons below unconformities, or other forms of variable pore space and permeability available in the strata for petroleum concentration. The application of pure geology to petroleum exploration is the only apparent means by which the necessary reserves may be maintained.

Notes On Kentucky Physiography. A. C. McFarlan, Univ. of Ky. A map was prepared in which the uplands represented by accordant hill-top levels were reconstructed and contoured for those parts of Kentucky which have been topographically mapped. The relationship between regional structure and these upland levels is strikingly shown. Particularly true is this of the Pottsville cuesta and parts of the Pennyroyal. The study was prepared because of the overuse of the "peneplain." Except the Lexington plain and the Scottsburg lowland, these various levels are more or less dissected strip plains developed on some of the more resistant formations.

THE EASTERN KENTUCKY GEOSYNCLINE. A. C. McFarlan, Univ. of Ky. Structure, as portrayed by contours drawn on the Fire Clay Coal, is the southern tip of the structure preserving the Permian in Ohio, West Virginia, and Pennsylvania, cut off from that structure by the Paint Creek Uplift. This same structure is not shown by the contoured top of the Chattanooga shale. This horizon dips eastward at a fairly uniform rate. This relationship is interpreted as due to continued downwarp of this flank of the Cincinnati Arch developing the rapidly thickening pre-Fire Clay Pottsville to the southeast. The convexity of this eastward-dipping structure at the top of the Chattanooga shale was flattened to a more or less uniform eastward dip by the deformation that produced the synclinal structure in the younger Fire Clay and associated beds.

REPRESSURING THE CHESTER SANDS OF WESTERN KENTUCKY. Phil Aswerus, Owensboro. Repressuring is the partial restoration of reservoir gaseous energy to an oil sand by injection of air or natural gas into it, by means of mechanically operated compressors with pressure lines leading to imput wells. Chester sandstones in Western Kentucky are lenticular, and cores from them reveal variable permeability, porosity and saturation. Control of the amount of gas injected into variable zones of permeability in the same well is accomplished by setting packers and running multiple strings of pipe. Pressure on wells near the thinner edges of a sand lens tends to affect producing wells near the central and thicker part of the lens; pressure on wells near the center tends to affect those along the long axis of the lens. Control of the volume and pressure of injected gas and control of the back pressures on individual producing wells is of great importance. Results in Western Kentucky have been most gratifying, with gains in production ranging from fifty to six hundred percent.

THE ECONOMIC IMPORTANCE OF PRE-DEVONIAN DEFORMATION IN EASTERN KENTUCKY. D. J. Jones, State Geologist. A detailed study of the conditions determining the accumulation of oil in Lee, Powell, and Estill counties,* indicates a definite arrangement of these pools around a buried pre-Devonian structural high with local detail determined by topographic relief. It it clearly demonstrated that the so-called Corniferous horizon may be entirely absent in certain areas with production occurring on all sides of the locality where this formation would be expected. Studies in other areas of Eastern Kentucky indicate productive areas around probable pre-Devonian structural highs. Thus it is of utmost economic importance to not only determine certain areas where this formation is absent, but to determine the axial alignment of these buried structures. The indications are that some of these older structures parallel the Appalachian folds to the southeast. Studies along this line will undoubtedly develop other pools in the Corniferous, as well as add to our knowledge of the distribution of that formation.

* Geology of the Big Sinking Pool, Lee county, Kentucky, by D. J. Jones and Arthur C. McFarlan, Bureau of Mineral and Topographic Survey, Series VII, Bulletin I.

A New Occurrence Of Gypsum In Kentucky. A. C. Munyan, Dept, of Mines and Minerals. In an air entry of the White City Mine of the Hart Coal Co., near Morton's Gap, in Hopkins county, well-developed selenite crystals occur in profusion, in two leached limestone zones between coals Nos. 11 and 12. The limestone is the Providence formation of the Allegheny group in the Pennsylvanian. It is thought that sulfuric acid formed in Coal No. 12 has seeped downward to the limestone by means of open joints, there reacting with the calcium carbonate to form gypsum. Crystals are large, well-developed and contain fan-shaped inclusions of clay from the limestone residue. These crystals are thought to be the largest ever found in the state.

AMERICAN ASSOCIATION OF PHYSICS TEACHERS
KENTUCKY CHAPTER

D. M. Bennett, Chm. B. P. Ramsey, Sec.

Field Of A Magnet. F. W. Warburton, Univ. of Ky.

Double Refraction Of Muscle During Twitch. C. L. Cottrall, Centre College.

Ultra-high Frequency Measurements. J. H. Daniel, Univ. of Ky.

Some Research Experiences At Michigan In The Summer Of 1936. J. G. Black, Morehead State Teachers College. Duffendack and his students found that when a rare gas ion collides with a normal metallic atom, ionization results and the excess energy is used to excite the first spark spectrum of the metal. Recent experiments by Gran and Duffendack show that this excess energy excites the first spark levels selectively in a manner strangely dependent on the "L" quantum number of the level excited. The paper describes an attempt to extend the work to other elements and learn more of the process. A mixture of helium and thallium vapor was used in a small furnace in a vacuum. The experimental and photographic work was completed and, altho the analysis was unfinished, the more interesting features of the problem are described and mention is made of a more rapid process for analyzing spectra data which was incidentally developed.

Comment On The Theory Of Viscosity Experiments. Jarvis Todd, Univ. of Ky.

The Structure Of Matter And Energy. Olus J. Stewart, Univ. of Ky.

Introduction. Investigation shows that matter and energy are closely related but the current "wave particle" concept and statistical interpretation provide a picture admittedly hazy. In seeking a more lucid description of matter and energy this paper resorts to assumptions and to a model which, tho departing somewhat from modern theory, enables one to describe physical phenomena in the terms of the three fundamental concepts, space, time and primordial force.

An assumption of prime importance concerns the concept, time. It is assumed that time, which the doctrine of relativity defines as a dimension reaching from the future to the past in the four dimensional space-time continuum, is more accurately described when, in addition to the foregoing, it is assigned the properties of a perfectly elastic and well-nigh irresistible stream flowing thru all space from the future to the past with a velocity which is constant and slightly greater than that of light. The quality of elasticity suggests that the act of altering the direction or the velocity of the stream at any point sets up strains locally which in turn call into play opposing forces tending to restore the system to normalcy. If, then, a suitable force were momentarily applied and properly directed so as to accelerate laterally a portion of the time stream, forces arising from the resulting distortion would oppose this acceleration. At the moment when the acceleration reached a minimum, the distortion would be maximum and the direction of the motion would reverse only to suffer a like fate at the opposite terminal of its vibratory path, whether rectilinear, circular or elliptical. Such is taken to be a description of energy the whole of which was created at the beginning.

An energy disturbance of the type outlined is assumed to possess mass (m) by virtue of the frequency (ν) of its generating force-impulse in accordance with the equation, $m = nh\nu/c^2$, where (n) is an integer to be defined later, (h) is Planck's constant and (c), the velocity of light thru space, is a factor concerned with the velocity of the force-impulse in the orbit. The particles or orbits may be either at rest in the time-stream and therefore move, with respect to space, with the velocity of light or they may be at rest in space, in which event it is assumed that circular or elliptical orbits may be gyroscopically oriented with respect to the time-stream in such a manner that the latter flows thru the former maintaining an electric charge the magnitude of which is proportional to the area of the orbit's projection on a plane set normal to the direction of time-flow, the square of the frequency of the generating force-impulse and the velocity of the time-stream thru the orbit. The character of the charge, positive or negative, depends on the direction, clockwise or counter clock-wise, taken by the generating impulse.

It is necessary to postulate further that a magnetic field exists when the time-stream flows by an orbit which is so oriented that its plane is parallel to the direction of time-flow. The time-stream therefore does not flow thru such an orbit when the latter is at rest in space. The polarity of the orbit is determined by the direction of rotation of the force-impulse which generates the orbit and the strength of the magnetic field depends upon the rate at which the stream flows past the orbit and on the frequency of the force-impulse. Electric and magnetic fields consequently are perpendicular to each other. The foregoing description is designed to correspond with the fact that light in free space exhibits no electric or magnetic effects but when retarded by matter it apparently undergoes orientation and produces magnetic effects.

This arrangement suggests several distinct types of particles. 1. Relatively large orbits of low frequencies and correspondingly insignificant masses. These particles are carried along by the time-stream whose velocity they share and they exhibit no electric or magnetic effects irrespective of their orientation because the velocity of the time-stream thru or past the orbits is almost nil. When sufficiently retarded or momentarily stopped, however, and suitably oriented they may temporarily develop electric or magnetic fields. Since the rotating main impulses defining the orbits in flight always trace thru space wave-like paths not unlike that traced thru space by a mark on the tire of a motor vehicle for example, it is convenient to recognize in this sense the "inseparable duality of particles and accompanying waves and to identify the fusion with radiation." A later development will show however that the inseparability of particle and wave is not uniquely a property of light. 2. Small orbits which, because of their relatively high frequency and mass, lag behind in the time stream. Whether at rest in space or moving with velocities less than that of light they are so oriented in the stream that they possess an electric charge. We elect to specify that the direction of the accelerated motion which defines the orbits is counter clock-wise and the charge is negative. The particles are called electrons. 3. Orbits characterized by high frequency and great mass. They are relatively slow or at rest in space and are oriented to develop electric charges. The direction of the accelerated time in the orbits is opposite to that of the particles described in (2) and consequently their charges are of an opposite character. The simplest of these positively charged particles is the proton but conceivably there are many other positively charged particles in the nuclei of atoms whose masses exceed those of ordinary hydrogen atoms. These will be considered later. 4. Particles which are similar to those described in (3) but are so oriented in the time-stream that the latter does not penetrate them. Their masses equal that of the proton but they bear no charges. This theory however, assigns them magnetic properties at low velocities. They are to be identified with neutrons. The neutron is the only non-composite heavy neutral particle yet conceived aside from photons of high frequencies but the system developed in this paper provides for a host of this type and even leaves room for positively charged electrons and negatively charged protons.*

The Stream-like Nature of Time. Fundamental concepts are characterized by unique properties. If time is a fundamental concept it will possess unusual characteristics. The non-simultaneity of certain events lends meaning to the antonyms, sooner-later, before-after, and the clock-like regularity with which the future becomes an event of the present and then fades into the past strongly suggests that time moves with a definite velocity and possesses properties not unlike those of a stream, albeit a unique stream whose direction of flow is unrelated to directions in space. Recalling the stand taken in this paper that radiation is carried from one place to another by the time-stream whose velocity it shares and remembering that the transit of light is not instantaneous but requires in its description the before-after concept, it is evident that both beams of light in Michelson-Morley's interferometer traveled simultaneously in the same direction with respect to time, i. e., from future to past, even tho

* Since writing the foregoing I note that Hoffman, Livingston and Bethe, Psy. Rev., 51, 214-15 (1937), following the suggestion of F. Bloch, Psy. Rev., 259 (1936), have found experimental evidence of the magnetic moment of relatively slow neutrons. This evidence has a bearing on the description of the neutron given above. O. J. S. March 5, 1937.

the two arms of the instrument were at right angle to each other in space. Thus the model accounts for the failure to detect an ether drift and removes the necessity for the Lorentz-Fitsgerald correction for contraction.

The question naturally arises: Is time a physical stream? If one may class as physical those phenomena which are detected and measured by physical means, the time-stream is physical. The very omnipresence of time may be the chief obstacle impeding the recognition of the stream as in the early days was true in a lesser degree of air. The maintainance and form of the time-stream also require consideration. As to the first point attention is called to the vastness of the momentum of the radiation and other forms of energy which pervades the stream. Time probably has the same shape as space which Einstein describes as cylindrical. It therefore is conceivable that time returns and the future and the past at some point unite.

The Radii of Photons and the Amplitude of Light Waves. The assumption is made in this paper that radiation consists of energy orbits of relatively low frequencies carried along with the time-stream. If ν is the frequency of the force-impulse generating the orbit, the distance along the circumference of the circular orbit traveled by the impulse per second is $2\pi r\nu$. For reasons to be discussed later the average velocity of the impulse is designated 137.3 nc, where (n) is a small whole number and (c) is equal to the velocity of light thru space. Then $2\pi r\nu = 137.3nc.$ and $r = 137.3nc/2\pi\nu$. Assigning n the value unity, the radii of photons and the amplitude of the accompanying waves may be calculated. In Table 1 the representative values of ν are those easily found in the literature.

Table 1. Radii and Amplitudes.

Type of radiation.	Frequency. Sec.$^{-1}$	Radius or amplitude of wave. cm.	Mass. g.
Herzian ray	1.5×10^{4}	4.37×10^{7}	$1.09. \times 10^{-43}$
Infra red	3.75×10^{14}	1.75×10^{-3}	2.73×10^{-33}
Visible spectrum	5.77×10^{14}	1.14×10^{-3}	4.20×10^{-33}
Ultra violet	2.20×10^{16}	2.98×10^{-5}	1.60×10^{-31}
X-ray	3.00×10^{19}	2.18×10^{-8}	2.18×10^{-28}
Gamma ray	3.00×10^{20}	2.18×10^{-9}	0.22×10^{-26}
Cosmic ray	6.00×10^{21}	1.09×10^{-10}	4.37×10^{-26}

Planck Constant. One may write, $E = nh\nu =$ force $\times$ distance. The circular orbits under consideration exist because a force (f) acts each second thru a distance $2\pi r\nu$. Therefore $nh\nu = f \times 2\pi r\nu$ and $f = nh/2\pi r$. This force, acting each second thru the distance $2\pi r\nu$, accounts for the energy $E = nh \times 2\pi r\nu/2\pi r = nh\nu$. Employing c. g. s. units and assigning n and ν the value unity, $E = h$ erg sec. Planck's constant therefore represents the quantity of rotational energy involved each second in an energy orbit of unit frequency and unit quantum number. Since this constant has the same dimensions as angular momentum, the model and dimensional analysis are in agreement. It is true that the model does not picture a rotating mass but the force which is predicated has the dimensions of mass and acceleration. The radius of this energy orbit if circular is, $r = 137.3\ nc/2\pi\nu = 6.553 \times 10^{11}$ cm; its mass is, $m = h/c^2 = 0.7282 \times 10^{-47}$g.

The Velocity and Radii of Heavy Particles. The concept, energy orbit, is not confined to particles classed as radiation but may be extended to include massive orbits which move more slowly thru space. Orbits designated radiation are nearly at rest in the time-stream but in one second their force-impulses trace thru space wave-like paths 3×10^{10} cm. in length. On the other hand, high-frequency orbits, that is to say massive orbits such as electrons and protons, appear to lag behind in the time-stream and may even be at rest in space. Consider such a particle at rest relative to space. The time-stream moves past with a velocity approximately that of light, but a Maxwell demon riding on a photon in the time-stream insists that the particle at rest in space moves with the velocity of light. The force impulse which generates the massive orbit excutes high frequency vibration and traces in the moving time-stream a wave-like path similar to that traced thru space by the force-impulse of the radiation orbit, but of higher frequency. If the time-stream were a river and the energy orbit a fixed tuning fork whose vibrations could be recorded on the surface of the water, one could measure the distance along the surface of the water traced in one second by the wave-like path of the tuning fork. It would be in this case 3×10^{10} cm., a magnitude identical with the length of the photon's path in space for the same duration of time.

A third condition suggests itself. A massive orbit moves with reference to space with the velocity c/2. The case may be restated by saying that every second the particle traces a wave-like path in space $3/2 \times 10^{10}$ cm. in length and in the time stream another path also $3/2 \times 10^{10}$ cm. in length, the total length of the particle's path for the second being 3×10^{10} cm. If the total length of a particle's path per second in both space and time may be regarded as the velocity of the particle, the velocity of each of the three particles cited and therefore of all particles is that of light. The de Broglie equation, $\lambda = h/mv$, is concerned with low velocities in space-time, in which case time is a dimension only, but if time may be assigned the dual role of a dimension and a stream, and if the foregoing is valid, the de Broglie (v) becomes (c) and his relation reverts to that due to Einstein, $mc^2 = nh\nu$.

If then radiation and matter may be regarded as special cases of energy orbits and if the same laws apply thruout, the radii of the more massive orbits may also be calculated from the same formula that was used earlier for radiation, $r = 137.3nc/2\pi\nu$. Since $\nu = mc^2/nh$, the expression then becomes, $r = 137.3n^2h/2\pi mc$. If n is unity, the radii of the electron and proton are 0.5304×10^{-8} cm. and 2.874×10^{-12} cm. respectively. This discussion discloses the necessity for the constant 137.3, for when employed, the calculated radii of atomic nuclei agree reasonably well with those experimentally determined and the electronic radius is nearly identical with that of the Bohr electronic orbit in the normal hydrogen atom tho the description commonly given of the electron differs widely from that offered in this paper. The constant also possesses an additional significance which might be classed as numerological,* for it is the reciprocal of the fine structure constant. It will be noticed that 137.3c is the minimum velocity of the force-impulse in all orbits.

The Magnitude Of The Charges Developed by Energy Orbits. It is assumed that the number of unit charges which an orbit at rest in space develops is proportional to the area (a) of the orbit's projection on a plane normal to the direction of time-flow and to the square of the frequency of the force-impulse which generates the orbit. Consequently one may write, $s = Ka\nu^2 \sin\Theta \cos\phi$, where s is the number of unit charges, K is a constant and Θ and ϕ are respectively the angles which the plane of the orbit makes with the x-z and the x-y planes of an xyz reference system along the x-axis of which the time-stream flows. Since the radius, $r = 137.3\ n^2h/2\pi mc$ and $\nu = mc^2/nh$, $s = K\ (137.3nc)^2 \sin\Theta \cos\phi/4\pi = KK'n^2 \sin\Theta \cos\phi$, which becomes, $s = KK'n^2$, when the plane of the orbit is normal to the direction of time-flow, the condition under which the orbit at rest in space develops its maximum charge. The maximum number of unit charges (See section on atoms) developed by the K, L, M, and N electronic orbits of modern atomic theory are respectively 2, 8, 18, and 32. Employing one of these figures say that of the L-orbit where n is 2, and substituting in the foregoing equation, we have, $8 = 4KK'$ and $K = 8/4K'$. Then $s = 2n^2$, and it follows that the maximum number either of nuclear or electronic unit charges developable by the K, L, M, N, O, P, and Q orbits, where the quantum numbers are respectively 1, 2, 3, 4, 5, 6 and 7 are respectively 2, 8, 18, 32, 50, 72 and 98.

When an orbit, at rest in space, does not develop its maximum charge, it is tilted in the time-stream. Thus the L-electronic orbit of lithium atoms may be taken as an example. (See section on atoms.) Substituting in the formula, $s = 2n^2 \sin\Theta$, the plane of the orbit being assumed normal to the x-y reference plane for simplicity sake, there results, $1 = 2 \times 4\sin\Theta$ and $\sin\Theta = 1/8$, where Θ equals 7 degrees and 11 minutes.

The Variability of Electric Charges and the e/m Ratio. The diminution of the e/m ratio which accompanies an increasing electronic velocity is generally interpreted to be the consequence of a constancy of charge and a variability of mass, and the results of experimental work are in excellent agreement with the Lorentz-Fitzgerald-Einstein equation, $m_v = m_0/(1\text{-}v^2/c^2)^{1/2}$. On the contrary, this paper takes the stand that the magnitude of a mass is proportional to the frequency of the orbital force-impulse and not to the velocity of the particle thru space. It is also consistent with this new picture and contrary to modern theory that the charge of an electron or of any charged orbit should decrease as the velocity of the particle thru space increases, for, as the oriented particle overtakes the time-stream, the latter flows less and less rapidly thru the orbit. It is conceivable that a charged orbit, traveling at high velocity thru space, could alter its orientation with respect to the time-stream and thereby maintain the constancy of its charge. When however the plane of the orbit becomes normal to the time-stream, the possibilities are

* Bell, E. T. Numerology. The Williams and Wilkins Co., Baltimore.

exhausted for an increase of charge unless the frequency of the force-impulse also increases, and it is doubtful if the energy of translation can be equal to this contingency because of the high energy requirements in the orbits. If such a transformation may take place at high velocities, the increased frequency would be recognized thru the increase of mass as well as charge. It has been mentioned elsewhere that the e/m ratio of a moving electron has never been measured under circumstances which insured the constancy of the charge.

On the assumption that, for free eletrons at rest in space, $n = 1$, the equation, $s = 2n^2$ would give s the value 2. But since free electrons carry unit charge, the simplified equation, $s = 2n^2 \sin\Theta$, states that Θ equals 30 degrees. Now let the electron increase its velocity to $c/2$. The velocity of the time stream thru the orbit would then be reduced to $c/2$ and the charge would become 0.5 unit because the magnitude of the charge is dependent on the velocity of the time-stream thru the orbit. Since the e/m ratio for electrons is practically constant thruout the velocity range, c to $c/2$,* this paper is forced to conlude that by the time the velocity of the electron has reached the value $c/2$, the orbit has straightened up and its plane has become normal to the time-stream, under which conditions it is possible for it to develop unit charge. Any further increase in velocity however must result in decreased charge.

It is now necessary to consider the diminution of the charge, the mass of the electron remaining constant, as the velocity of the electron changes from $c/2$ to c, or reciprocally, as the velocity of the time-stream thru the orbit changes from $c/2$ to zero. Since the charge developed by the electronic orbit, when its velocity thru space is greater than $c/2$, is directly proportional to the velocity (V) of the time-stream thru the orbit, and since the rate of change of charge is greatest when the charge is least, one may write, $-\,ds/dV = K/s$. On integrating between the limits, $s = 1$ to 0 and $V = c/2$ to 0, and solving, K becomes $-\,1/c$ and the equation is $s^2 = 2V/c$. If one substitute into this equation the velocities of the time-stream thru the orbit, (1.5, 0.6, 0.5, 0.4, 0.3, 0.2) $\times\ 10^{10}$ cm. sec.$^{-1}$ which correspond respectively to the electron's velocities thru space, (1.5, 2.4, 2.5, 2.6, 2.7, 2.8) $\times\ 10^{10}$ cm. sec.$^{-1}$, there results the following respective numbers of unit electronic charges, (1.00, 0.63, 0.58, 0.52, 0.45, 0.37), which correspond with the e/m values, (1.77, 1.12, 1.02, 0.91, 0.79, 0.65) $\times\ 10^8$ coulomb/g. These values compare quite favorably with the experimental results of Bucherer* and others and with those calculated on the assumption that the charge of the electron remains constant but the mass varies according to the relationship, $m_v = m_0/(1-V^2/c^2)^{1/2}$.

The Properties Of Light. The Photo-electric Effect. Whenever a moving photon of mass, $nh\nu/c^2$, collides with a massive object, the particle will come to rest momentarily. The time-stream will then flow thru the orbit, if suitably oriented, and develop a positive or negative charge which, if $n = 1$, will have a magnitude of either one or two units according to the equation, $s = 2n^2\sin\Theta$.

* Bucherer, A. H. Ann. Physik, 28:513 (1909).

If the charge is positive the photon may unite with an electron at the surface of the massive body. The compressed photonic orbit then rebounds carrying with it the electron and the velocity attainable by the photon-electron couple will depend on the magnitude of the photon's energy. Thus a photon from the red portion of the spectrum, $\lambda = 0.65$ microns, possesses while in flight a momentum of 1×10^{-22} g. cm. sec.$^{-1}$ which is 10^5 times as great as that of an electron moving one centimeter per second. Consequently the rebounding electron-photon group may acquire a velocity of approximately 10^5 cm. per second. This velocity will be augmented somewhat by the accelerating effect of the time stream.

Another circumstance contributes speed to the rebounding couple. If the photon develops two unit positive charges and unites with a single electron the net charge will be one which the massive positively charged body will repel. Other factors also, such as the difficulty of extricating the electron, collisions with other rebounding photons, etc., must be taken into account in any precise prediction of the maximum velocity which the couple may attain.

As the velocity of the photon-electron molecule or ion increases the velocity of the time-stream thru the orbit decreases because both the orbits and the stream are moving toward the past. The net result of this reciprocal action is a reduction in the magnitude of the charges, and when the latter becomes too small the molecular or ionic union dissolves, the photon accelerating to the velocity of the time-stream and losing its charge altogether, the electron lagging behind and increasing its charge. The model furthermore implies that the rate at which electrons will be ejected, sufficient energy for ejection being assumed, depends upon the intensity of the light, i. e. the number of photons striking the massive body in unit time.

The foregoing exposition suggests that, whereas the extent to which radiation, especially X-ray, penetrates matter is in general inversely proportional to the density of the material, a behavior consistent with a corpuscular structure of light, opacity appears to be related to the abundance of free electrons available at the surface of the irradiated body. Thus lithium and sodium, metals low in density, are quite opaque but they are excellent sources of photo-electrons.

The Compton Effect. If, as has been assumed earlier,energy exists fundamentally only as orbital motion, it is necessary to describe the Compton Effect as a transference of orbital frequency or mass. In other words the electron's increased momentum is referred to a changed and quantized mass rather than to an altered and non-quantized velocity because energy is transferred in the process and energy-change is a quantized phenomenon. If, in accordance with an earlier section, it is agreed that the total velocity of all particles is always c, and if m_1 and m_2 represent respectively the electron's masses before and after the collision, the change in the electron's momentum is $(m_2 - m_1)c$, a value equal to the photon's loss of momentum, $(nh\nu_1/c^2 - nh\nu_2/c^2)c = (\nu_1 - \nu_2)nh/c$, where ν_1 and ν_2 are respectively the observed frequencies of the incident and reflected photons.

The disposition of the electron's acquired mass, whether it appears as an increased frequency of the electronic orbit's force impulse or as a radiation orbit united in some manner with the electronic orbit, is not clear. Neverthless the force of impact with the photon and the momentum of the mass derived from the photon cause the electron to deviate from its original course and change the ratio of its velocity with respect to space on the one hand and with respect to the time stream on the other, but its total velocity remains constant and equal to that of light. The electron later emits its acquired energy as a photon or transfers the same to other bodies with which it collides.

Diffraction. The failure of the emission theory to explain the phenomenon of diffraction has been so complete and the success of the wave theory so signal that the terms, diffraction and interference, have become almost synonymous. Nevertheless the experimental work of Davisson and Germer and of others has shown that corpuscles are capable of producing so-called interference patterns. In the discussion of the photo-electric effect the assumption was made that charged photons and electrons unite. On the other hand certain phenomena taking place in the mass-spectrograph can best be interpreted by assuming that electrons may also unite with neutral particles. With this in mind it is easy to imagine that a neutral photon, grazing the jaw of a narrow slit, may unite momentarily with an electron. The interaction of the positively charged jaw and the rapidly moving negatively charged photon-electron ion would cause a deviation of the photon from its straight path, the more massive particles from the violet region of the spectrum being less deviated than the lighter particles from the red. On the other hand, if the ion should be composed of a photon and two, three, etc. electrons, greater deviations would result and when monochromatic light was used, light and dark bands would alternate at the screen.

Refraction and Dispersion. Altho the diffraction of light as it passes thru a small orifice appears not to be due to gravitational force because the required lateral displacement (s) in the direction of the jaw of the slit would have to be a function of the time required by the particle to pass the jaws, $s = Kt^2/2$, and all photons move at practically the same velocity in space, the phenomena, refraction and dispersion, seem to be capable of being described as gravitational effects because the velocity of light in dense media depends on the frequency of the photons, those of higher frequencies being the slower. The progress of a photon of high frequency therefore, as it enters a prism, is more retarded than is that of a photon of low frequency and consequently violet light suffers greater refraction than does red. It is also required by the model proposed in this paper that light, retarded during its passage thru a dense medium, accelerate immediately on emerging into free space and assume the constant velocity of the time-stream irrespective of the velocity of the dense medium from which it escaped.

The reflection of light can be described satisfactorily in the terms of any emission theory and the phenomenon requires no further discussion here. Polarization is generally regarded as being the result of an orientation process and the model proposed in this paper refers the magnetic effect to the reduced velocity and the orientation which is supposed to obtain while the photons are passing thru regions congested with atoms, no magnetic effects being possible while light is in flight thru space because the photons nearly keep pace with the time-stream. Finally the model leaves room for a Lebedew pressure and detracts no energy from a photon while in flight thru light years of free space.

The description of light given in this paper avoids the zero rest-mass and the infinite flight-mass dilemma because mass is conceived to be invariable. Even tho this position should be found untenable the retention of the time-stream concept would make it possible to avoid the aforementioned dilemma if the Lorentz factor, $(1 - V^2/c^2)^{1/2}$, were changed to, $(1 - V^2/t^2)^{1/2}$, where t is the velocity of time, for then the quantity, V^2/t^2, could not become unity. The new picture also divorces the electro-magnetic concept from mass by stating that mass is not an electro- magnetic phenomenon but rather one depending on frequency.

Atoms. The problem of atomic structure is confronted not only with the anomaly of the non-radiating electron but also with the absurdity of the stable grouping of similarly charged particles closely packed within the nuclear space. In that which follows it will be seen that the concept of energy avoids the first of these difficulties by denying the existence of a rotating charge within the atom. The concept also offers some relief from the second difficulty.

The electron and proton have already been described and it is obvious that the light hydrogen atom consists of these two concentric but not necessarily co-planer orbits each characterized by mass, frequency and charge as outlined. Similarly the deuterium and tritium atoms are built of two concentric orbits, and tho the outer one in both cases is identical with the electronic orbit of proteum, the nuclear orbits are respectively twice and thrice as massive as the proton and consequently require proportionately greater frequencies and smaller radii. All of the orbits of hydrogen are oriented to develop unit charge. The helium nucleus possesses a charge of two units and a mass of four units. It consists of a single energy orbit whose frequency is adequate to account for the required mass and is oriented in the time-stream to develop two units of charge. It should be noted that according to this theory there are no negative electrons within the nucleus of any atom. Concentric with the nucleus is the single electronic orbit oriented to develop two units of charge. In calculating the nuclear and electronic frequencies and radii of the preceding elements from the equations, $\nu = mc^2/nh$ and $r = 137.3\ n^2h/2\pi mc$, the nuclear masses are derived by dividing the mass numbers, divested of extranuclear electronic mass, by the Avogadro number, and n is unity.

The description of the atoms of the next elements in the series introduces a feature not encountered in the preceding discussion. The lighter variety of lithium atoms is assumed to include the entire helium atom unchanged but the nucleus contains, in addition to the helium nucleus, a second energy orbit whose mass is derived by deducting the helium nuclear mass from the total lithium nuclear mass. This added nuclear orbit is oriented to develop a positive charge of unity and its presence necessitates the addition also of a second electronic orbit of unit charge. The description need not be repeated for the atoms of the heavier lithium isotope. A beryllium atom differs from a lithium atom only in that the nuclear orbit which replaces the added lithium nuclear orbit is heavier and is oriented to develop two unit charges, and the identical added electronic orbit of the lithium atom is tilted further in the time-stream so as to develop the required charge of two units. By continuing this process from element to element the second inert-gas element is eventually reached. The atoms of this element therefore contain a nucleus made up of two orbits, one identical with the helium nucleus and the other of appropriate mass oriented to develop eight positive charges. The outer atom consists of two electronic orbits one of which is identical with the doubly charged helium electronic orbit while the second is oriented to develop eight units of negative charge. In calculating the frequencies and radii of all added nuclear and electronic orbits from lithium to neon the value of n is 2.

The next group of atoms, sodium to argon, the n-value of whose added orbits is 3, introduces a new feature into the process of atom building. The argon atom consists of a composit nucleus built from a helium nucleus, an added neon nuclear orbit and a third added orbit which, like the second develops a charge of eight units. The electronic system also contains three orbits whose total charge is 18 units, each electronic orbit having the mass, 8.994×10^{-28}g. The new problem introduced by this group, and it is one common to all succeeding groups, is that of selecting an isotope of neon as the foundation on which to build the group. Evidently a new type of isotopism is here encountered. The n-values of the added orbits of potassium, rubidium, cesium and element 87 are respectively 4, 5, 6, and 7.

Spectroscopic evidence, as it is applied in the Bohr atom, demands that the electrons added in the development of the electronic systems of the atoms of the transition groups of elements, specifically certain groups of elements beginning respectively with scandium, yttrium, lanthanum and actinium, enter inner orbits. This requirement is capable of being fully met in the scheme of atomic structure proposed in this paper, not by the addition of electrons to inner electronic orbits but by conferring upon the appropriate electronic energy orbits already present increased inclination to the time-stream in order that they may develop the necessary charges. If this procedure is also followed in the nucleus, the question of the allotment of mass as well as charge requires attention. Since this system of atomic structure employs fewer electrons than does Bohr's, considerably more of the mass of heavy atoms is confined to the nucleus. Thus it is seen that in the description of the electronic structure of the atoms of all elements, the new system follows closely that of Bohr, and it deviates from that classical work only as the peculiar characteristics of the proposed new building blocks lead to a simpler picture without yielding to inaccuracy. It is also seen that the new proposal aims to construct nuclear systems which are quite faithful diminutive mirror images of their associated electronic systems.

Line Spectra. It has been shown that for electronic orbits, $\nu = 137.3$ nc$/2\pi$r

Dividing by c we have, $\nu/c = 137.3\ n/2\pi r = w$, wave number of the electronic orbit. The relationship, $r = 137.3\ nc/2\pi\nu = 137.3n^2h/2\pi mc$, shows that since all electrons have identical mass, $r \propto 2n^2$. Consequently the foregoing equation may be written, $w = 137.3\ K/4\pi n = 10.925\ K/n$, where K is a constant. Dividing this equation by n there results, $w/n = 10.925\ K/n^2 = w'$. Now n is a multiplier defining the velocity of the orbital force-impulse. Consequently w' is to be regarded as the orbital wave number per unit increment in the velocity of the orbital force-impulse

If the quantum number of the hydrogen electron may have any of the values, n = 1, 2, 3, 4, etc., one may consider the effect produced when an orbit, say the M-orbit, is transformed into an L-orbit. The difference between the two values of w', $w'_2 - w'_3 = 10.925\ K\ (1/n_2{}^2 - 1/n_3{}^2)$ is taken to represent the wave number per unit quantum number (in this instance the wave number, for the change in the quantum number is unity) of the radiation orbit emitted when the transformation occurs.

If the figure, 10.925, were 10.9677, the substitution of Balmer data would give K the value 1×10^4 in order to yield the Rydberg constant. In the calculation of the value of the reciprocal of the fine structure constant, $1/\alpha = hc/2\pi e^2 = 137.29$, if one take for h and e the values 6.55×10^{-27} and 4.765×10^{-10} respectively, which are within the limits of error of the commonly accepted values, $(6.547 \pm 0.008) \times 10^{-27}$ and $(4.770 \pm 0.005) \times 10^{-10}$, then $1/\alpha = 137.8$, and $137.8/4\pi = 10.9658$. This latter figure, when multiplied by $K = 1 \times 10^4$, yields a figure differing but little from the Rydberg constant.

The stable K-orbit of the hydrogen atom develops a charge of one unit due to its slope of 30 degrees. If this orbit should expand to the dimensions of an L-orbit without changing its inclination to the time-stream, it would develop four units of charge. It seems probable that some necessity forces the orbit to tilt back to the unit charge. Conversely if a uni-charged L-orbit should contract to the dimensions of a K-orbit, an increased slope would be required. It is evident however that precession would accomplish the same result. Phenomena of this nature are are believed to be involved in the meaning of $(w'_2 - w'_3)$ and the constant K of the foregoing equation.

The process whereby the quantum number of an electron changes is not evident. However it seems to be unnecessary to assume that mechanical collisions occur; the field of a charged orbit, such as that of an electron or a retarded photon, passing thru an atom would cause an electronic orbit to alter its slope, the larger orbits being the more easily affected. According to the theory developed in this paper, the charge of the electron will become zero when its slope, with respect to the direction of time-flow, is zero. The electron will then be magnetic. The interaction of the magnetic field of the disturbed electron and that of the passing charged orbit would be expected to effect electronic ejection.

Radioactivity. The system of atomic structure described in this paper places no electrons and only one helium nucleus in the nuclei of atoms heavier than helium. Consequently beta rays cannot originate in the nucleus and once the inner orbit has been emitted as an alpha particle; another nuclear K-orbit must be provided because most radioactive atoms emit alpha particles repeatedly. It is therefore assumed that when the nuclear K-orbit is emitted some unknown necessity forces the last added nuclear orbit to part with sufficient energy for the construction of a new K-orbit. The remainder of the disrupted orbit, whose mass has been diminished 4 units, then orients itself to develop two charges less than it originally possesed. This action leaves the atom negatively charged and makes it necessary for the last added electronic orbit to tilt back and develop two units less charge, yielding a neutral atom. It appears necessary to account for beta ray emission by assuming that the emitted electrons, altho not originally present as electrons in the nucleus, are formed at the time of emission from available nuclear energy.

Gravitation. This paper interprets the universal tendency of bodies to approach one another to be the result of pressures developed in accordance with the Bernouilli principle. Just as two ships, anchored abeam in a stream, are drawn together, so the theory predicts that the distance between two masses will tend to become less as the time-stream flows by them. Consider the condition in which but one body exists. The pressure of the current on the upstream side of the body would confer upon the latter a down-stream drift toward the past but there would be no tendency for a non-spinning body to move laterally because the velocities of the time-stream along the two opposite sides of the body are equal. If now a second body were brought into existence the velocity of the time-stream flowing between the bodies would be greater than that of the stream flowing along the far sides. Consequently pressures on the far sides would be greater than those on the near sides and convergence would tend to be the result.

In order to investigate this question, air pressures were measured at the near and far sides of pairs of bodies suspended in a wind tunnel and the information thus acquired, when transferred from air-stream to time-stream, appeared to carry meaning notwithstanding the extensive extrapolation required. The apparatus consisted of a wind tunnel near the middle of which were suspended in streamline fashion two nearly spherical glass bulbs. One bulb was fixed in position and provided internally with two small glass tubes which, lying in a horizontal plane and terminating flush with the outer surface of opposite sides of the bulb, led inward to the center, thence thru the downstream side of the bulb and the wall of the wind tunnel to a sensitive Toepler pressure-level. The other bulb, which was not provided with a device for making pressure measurments, was so suspended that its lateral distance from the first bulb could be regulated. This arrangment made it possible to compare with one another the pressures at the near and far sides of the first bulb as the distance of the second bulb from the first was altered. Unfortunately various factors such as eddies, changing air density and varying motor speeds caused considerable fluctuations in pressure and permitted the establishment of trends only.

When average data were substituted into the expression, $P_1 : P_2 ::$

$1/r_1^2 : 1/r_2^2$, where P_1 and P_2 are pressures on the far side in excess of that on the near side in two experiments in which the distances apart of the centers of the bulbs were r_1 and r_2 respectively, the result was 13:1 : : 1.2 : 1. Since matter is extremely porous and the time-stream is assumed to penetrate it quite freely, it seemed desirable to replace the bulbs of the foregoing experiment with bodies composed of small glass beads held together by a coating of thin shellac in order that the air current might pass thru the bodies more freely. When this was done the relationship became, 4 : 1 : : 1.5 : 1.

The results of the foregoing experiments support the assumption tacitly made that all bodies of equal mass possess, independently of their several densities, equal ability to exclude the time stream from the spaces actually occupied by their orbits and to effect correspondingly equal acceleration in the time stream in the manner described, for, when the bulbs were made penetrable to the air stream, the ratio approached more nearly that required by the law of gravitation. Finally the bulbs were stripped until there remained only the two pressure tubes and a ring of fine copper wire which, as a great circle, defined the boundaries of an imaginary sphere. The ratio then was, 2.4 : 1 : : 1.25 : 1. Here the approach to the inverse square law is still closer.

This description of gravitation contains several implications. It implies that bodies traveling toward the past with the velocity of the time-stream cannot be subject to gravitation. At first thought this appears to contradict Einstein's prediction that the path of light grazing the sun would be found bent. The case assumes less serious proportions however when one recognizes that one of the bodies concerned, the sun, is not moving with the velocity of light, and it is the contention of this paper that light under no circumstances keeps pace with the time-stream. In addition to this, light probably moves through the sun's atmosphere more slowly than in free space. Consequently in this instance one would expect to find the path of light bent. In fact light, the swiftest of particles, is always slightly subject to gravitation, for its velocity never reaches that of the time-stream.

Another implication of the theory is that the aforementioned difference in the velocity of the time-stream along opposite sides of bodies, will with sufficient lapse of time, confer upon the masses, even tho they be heavenly bodies, a spin. This problem also was studied in the wind tunnel where a "ping pong" ball, provided with a doubly pointed steel needle shaft, was carefully mounted on glass bearings. This ball would spin when a similar ball approached its side, the adjacent side moving in the down stream direction. It will be recalled that the earth and the moon spin in the same direction. The inference is that the flow of the time stream between these two bodies and the sun accounts for the spins. It is necessary in considering these relationships to keep in mind that the future and the past are on opposite sides of the line joining the two bodies. On this basis it seems possible that the slow rate of the moon's rotation may be due to the tendency for a counter spin because of the proximity of the earth. Finally it should be stated that the aforementioned spin may react with the time-stream thru the Magnus effect and play a part in the orbital motion of the earth and moon.

Summary. This paper takes as its thesis the proposition that time is a unidirectional stream flowing from future to past while matter and energy are energy orbits created in the time stream by the action of a primal force. Time flowing thru the orbits produces an effect called electric but when time flows past orbits oriented so their planes are parallel to the direction of time-flow the effect of the force-impulse is called magnetic. On this basis it is possible to build a system of atomic structure and account for a variety of natural phenomena including gravitation.

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THE SYSTEMATIC CLASSIFICATION OF THE "CONSCIOUS," "SUBCONSCIOUS" AND "UNCONSCIOUS." J. B. Miner, Univ. of Ky. The author suggests that the term "subconscious" might be used in conformity with good usage as being synonymous with "disorganization." If the term is to be used at all, its meaning can be classified thus in relation to both conscious and unconscious activities. It is necessary, however, to recognize that a psychological activity may always be regarded from either the subjective or objective point of view.

SOME PHYSIOLOGICAL ASPECTS OF PSYCHOPATHOLOGY. Milton B. Jensen. In terms of modern scientific findings it may be said that (1) what an individual thinks or believes has relatively little to do with physiological balance; (2) how an individual thinks (his emotional tone) has a great deal to do with bodily functions; (3) normal bodily functioning facilitates thought processes and normal effective tone while imbalance of bodily functioning impedes thought processes and results in emotional imbalance. An understanding of this interplay between emotional tone and bodily change is essential to proper differentiation between the demented, the deluded and those who are neither demented nor deluded but whose behavior is socially undesirable. This understanding is the basis of a sound system of mental hygiene.

THE EMERGENCY VALUE OF ADRENALIN. Judith Key, Univ. of Ky. Eight white rats were given three series of swimming trials. The first series was for training or practice and to provide an opportunity for the attainment of a relatively constant swimming rate. Another was given in which after an adaptation period the rat was subcutaneously injected with adrenalin. A third series in which the animal was injected with physiological salt solution followed the same procedure and served as the control. A finding of some significance was the difference in response among the individuals, indicating the tendency of a stable organism to remain comparatively stable and a variable one to become even more variable when subjected to the influence of adrenalin. A retarding effect, varying in degree for the individuals of the group, was found in a majority of the subjects.

An Evaluation Of Play Of The Pre-school Child, Based On Potential Postural Improvement. Mary Mumford, Univ. of Ky. Thirty-eight children, ranging in age from two to five years, at the Iowa State College Nursery School, served as subjects. Within the limits of the data, the following conclusions were drawn: (1) the more active child was extroverted; (2) there was a signifiant positive correlation between extraversion and flat feet or pronated ankles; (3) chronological age and good longitudinal arch development showed a signifiant positive correlation; (4) there was no relationship between (a) total amount of activity and posture, (b) amount of energy expended and posture, (c) amount of activity of theoretial postural value and posture, (d) pronated ankles and posture in general, (e) chronologial age and posture, (f) introversion-extroversion rating and posture; (5) the average posture of the thirty-eight children was poor; (6) an accurate method of grading posture of the pre-school child is still to be devised.

Social Maturity On The Vineland Scale As Related To Other Traits In Nursery-school Children. Ruth Melcher, Univ. of Ky. The Vineland Social Maturity Scale and other tests were applied to 21 nursery school children from superior homes. Data obtained appear to indicate that: (1) the Social Maturity Scale is as differentiating as the Minnesota Preschcool Scale and the Binet Scale; (2) group averages are about the same on the Binet and the Social Maturity scales, and both are higher than the group average obtained upon the Minnesota; (3) scores on the social scale show very little relationship to the child's achievement upon the intelligence tests; (4) tests most frequently failed on the Social Maturity Scale are those dealing with routine dressing and toilet activities; (5) there appears to be a much higher sex difference in favor of girls on the social scale than on the intelligence scales; (6) the half of the group showing a higher percentage of weight for height had a higher average social maturity quotient than the half showing the lower percentages; (7) no relationship was found between the social maturity scores and the relative verbal or non-verbal ability of the child, the sociality as evinced by amount of interest in other people, or the personality traits of the children as estimated by the teachers.

The Evaluation Of Curriculum Reorganization In The College Thru The Use Of Objective Tests. J. J. Oppenheimer. Univ. of Louisville. The use of standardized tests combined with research in the internal educational problems of the college was the determining factor in the continuation of the Louisville program of reorganization now in its sixth year. At the outset a bureau of educational research attached to the Office of the Dean was established, thru which regular, periodic evaluations were made and circularized to the faculty. The organization of the college and its subsequent measurement involve: (1) changes in functions of the upper and lower levels, junior and senior; (2) the establishment of survey sources in the junior and senior colleges; (3) wider use of the achievement tests; (4) use of varied techniques of teaching; (5) varied methods of evaluating the changes. The changes which were measured thru tests were admission to the senior college, based upon standing the National Sophomore Tests and local tests, the establishment of a divisional requirement strengthening the major, and the construction of objective and essay-type comprehensive examinations.

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DIVISION ON THE PROBLEMS OF THE TEACHING OF SCIENCE

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