PROCEEDINGS

OF THE

PENNSYLVANIA ACADEMY OF SCIENCE

VOLUME XIV

1940

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F. D. Kern
1928-29

R. T. Hance
1929-30

D. S. Hartline
1930-31

E. M. Gress
1931-32

H. W. Thurston, Jr., *President*
1940-41

OFFICERS
1940-41

President . . . . H. W. THURSTON, JR., State College

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East . . . . WALTER S. LAPP, Northeast High School, Philadelphia

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Press-Secretary . . . . BRADFORD WILLARD, Bethlehem

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CHURCH CENTER PRESS
MYERSTOWN, PA.

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PENNSYLVANIA ACADEMY OF SCIENCE

MINUTES OF THE 1939 SUMMER MEETING

August 11-13, 1939.

Laporte, Sullivan County

The Mokoma Inn at Laporte, Sullivan County, elevation 1965 feet, was the headquarters for the summer meeting of the Pennsylvania Academy of Science August 11 to 13, 1939.

Members of the Academy and friends assembled at the Inn at 3 P. M., Friday, August 11, and journeyed to Haystock rocks where the peculiar geological formations that resemble haystacks were observed in the Loyalsock Creek. On the way to the rocks the botanists observed a large variety of plants, many of which were fairly rare and peculiar to mountainous regions.

Ninety-eight persons assembled on the lawn at the Mokoma Inn at 7 P. M., Friday. Philip Lewis, Burgess of Laporte, welcomed the group to Sullivan County. Joseph Ingram, Attorney-at-law, in a short address stated that God's country actually was in Sullivan County since a former resident of the county had deeded a tract of land situated in the county to God. The deed was properly executed and registered, but since God had never paid any taxes on his property the land was taken over by the county for unpaid taxes.

District Forester, M. H. Hench, of Bloomsburg, gave a history of Sullivan County in which he stated that in the past the chief occupation was lumbering, but that wasteful methods made lumbering at the present time unprofitable.

Dr. E. M. Gress, State Botanist, enumerated some of the plants that would probably be found during the field trips.

Dr. R. W. Stone, of the Geological Survey, President of the Academy, used a series of lantern slides to show some of the geological features that will be observed in Sullivan County.

The following six persons were elected to membership in the Academy:

Harry J. Schaeffer, 7047 Lincoln Drive, Philadelphia.
Jacob R. Schramm, Dept. of Botany, Univ. of Penn., Philadelphia.
David Martin Seaman, 6321 Howe Street, Pittsburgh.
William F. Etchberger, 925 Church Street, Lebanon.
Maurice L. Moore, 305 Cheswold Road, Drexel Hill.
William Albert Earl Wright, State Teachers College, Shippensburg.

The Research Committee of the Academy recommended that the $100.00 grant for research from the A. A. A. S. be allotted as follows:

Robert T. Hance, 1 Broadmoor Ave., Pittsburgh, to receive

$50.00 for a "Continuation of his study in new methods of histological technique."

Charles B. Wurtz, 55 Overbrook Road, Pittsburgh, to receive $25.00 for "A study of the presence and function of possible specific glands responsible for calcified structures commonly called teeth around the apertures of certain snails."

Wilbur C. Anderson, 221 Emerson Ave., Aspinwall, to receive $25.00 for "Investigations to find the optimum alkaloid and the percentage strength solution in which this alkaloid will produce inhibition on individual bacteria—particularly Staphylococcus aureus and Bacillus coli." This $25.00 grant was later returned and allotted to C. T. Van Meter, 1431 Boulevard of the Allies, Pittsburgh, "To prepare a series of compounds related to sulfanilimide but belonging to the biphenyl series instead of to the benzene series."

During the course of the evening talks, as well as after the session, meteor showers were observed in the sky. The aurora borealis also was exceptionally fine, long streaks of light illuminated the sky to the zenith.

The members of the executive committee in attendance held a short session after the evening meeting, when the secretary of the Academy was directed to write to Ralph E. Himstead, Secretary of the American Association of University Professors, Jackson Place, Washington, D. C., inquiring whether the hearing granted John C. Johnson, of West Chester, was a fair hearing according to the standards of their organization, or whether it was considered unsatisfactory. The secretary was also instructed to communicate to The Honorable Arthur H. James, Governor of Pennsylvania, the information that the Academy was anxious that John C. Johnson be given a fair hearing and that a letter was sent to the Secretary of the American Association of University Professors requesting information.

Saturday morning, August 12, the group took a trip along the gorge of the Loyalsock Creek to Whirl's (World's) End, and to Lincoln Falls. The cool, dense woods in this region make a splendid habitat for ferns and lycopods. Some of these plants not found commonly in Pennsylvania grow abundantly here. Along the Loyalsock, between Laporte and Whirl's End the ostrich fern and narrow-leaved spleenwort were found in abundance. In the rocky glen at Lincoln Falls, Cryptogramma stelleri, one of the very rarest ferns in the State was observed.

About a mile and a half north of Laporte the group examined a bog called Lost Lake, in which were found leatherleaf, bog rosemary, sheep laurel, and many other bog plants.

At Bernice is a splendid northern bog in which cranberry, pitcher plant, cotton grass, creeping snowberry, black spruce, and Labrador tea were found.

Sunday morning the group traveled through Eagles Mere to High Knob, and from there to the Keystone State Observatory. The view from both of these places is magnificent. The party disbanded at noon at the Keystone State Observatory.

MINUTES OF THE SIXTEENTH ANNUAL MEETING

WASHINGTON AND JEFFERSON COLLEGE,

Washington, Pa., March 22-23, 1940

The executive committee of the Pennsylvania Academy of Science met in the George Washington Hotel at 8 P. M., March 21. Present were past presidents E. M. Gress, Robert T. Hance, and Edgar T. Wherry; officers of the Academy, R. W. Stone, president; C. A. Horn, vice-president; V. Earl Light, Sec.-Treas.; and Karl F. Oerlein, Junior Academy adviser; also members of the local committee, C. D. Dieter and C. J. Pietenpol. The minutes of the summer meeting were read and approved.

The last three past presidents being absent, upon motion, the three past presidents present at the meeting were authorized to constitute a committe on grants to award the American Association for the Advancement of Science grant of $100.00 for 1940. The grant was awarded to E. R. Eller, of the Carnegie Museum, Pittsburgh, to carry on field work in his search for Scolecodonts, fossil polychaete, annelid jaws.

The Treasurer read his report for the year ending March 20.

The executive committee appoved of a change being made in the constitution so as to have a definite number of past presidents considered members of the committee.

On motion, the President was authorized to appoint a committee to communicate to the Superintendent of Public Instruction and the Governor of Pennsylvania the desire of the Pennsylvania Academy of Science to have the situation between the West Chester State Teachers College and John C. Johnson, of West Chester, cleared up so that the College may be removed from the black-list of the American Association of University Professors.

The suggestion was made that at times it might be found advisable to have the Easter week meeting of the Academy changed from the Friday and Saturday preceding Easter to the Friday and Saturday following Easter, the time to be decided by the host institution.

The sixteenth annual meeting of the Pennsylvania Academy of Science was called to order by President R. W. Stone, Friday, March 22, at 9 A. M. R. C. Hutchinson, President of Washington and Jefferson College, welcomed the group and gave a brief history of the College. O. F. H. Bert, Professor of Applied Mathematics at W. and J., spoke on the subject "Local and Industrial Interest." Six papers were presented by members of the Academy followed by the Presidential address, "The Waters Under the Earth," by R. W. Stone.

The Friday afternoon section of Geology presented seven papers, and the Biology section presented a total of ten papers.

The Annual Dinner of the Senior Academy was held in the George Washington Hotel, Friday evening at 6:30 P. M., with 66 persons in attendance. Edgar T. Wherry, of the University of Pennsylvania, delivered the public address, illustrated with colored slides, on the subject "Notable Native Plants of Pennsylvania." The Junior Academy banquet was held in the First Baptist Church with 258 persons in attendance.

President Stone called the general session of the Academy to order at 9 A. M., Saturday, March 23, at which time the regular business meeting of the Academy was conducted. After the reading of the minutes of the summer meeting the treasurer presented the following report:

Treasurer's Report—April 1, 1939 to March 20, 1940

Receipts		
H. W. Thurston, Jr., former treasurer		
Senior Academy funds	$ 449.24	
Junior Academy funds	49.29	
		$ 498.53
A. A. A. S. grant		100.00
Postage		.25
Sale of Proceedings		14.00
Extra printing by members in Proceedings		59 02
Membership fees		755.00
Total		$ 1,426.80
Expenditures		
Bursar, Pennsylvania State College—1939 meeting expenses		$ 42.05
Karl F. Oerlein, Junior Academy		49.29
Addressograph Company—Cabinet and 6 drawers		20.49
Secretary's account—Postage and supplies		104.50
Secretary's Honorarium		75.00
A. A. A. S. grants		
Robert T. Hance	$ 50.00	
Charles B. Wurtz	25.00	
Clarence T. Van Meter	25 00	
		100.00

Church Center Press			
Printing Vol. 13 Proceedings	$ 378.58		
Printing 600—4 page programs	7.20		
		385.78	
Balance on hand		649.69	
Total			$ 1,426.80

The Auditing Committee presented the following report:

The committee appointed to audit the financial statement of the secretary-treasurer V. Earl Light, have examined his report of the financial transactions of the Pennsylvania Academy of Science from April 1, 1939 to March 20, 1940 and find his report in accord with his bank record, his cancelled checks and his receipted bills. The committee commends Dr. Light for clarity, accuracy and simplicity in his bookkeeping.

Signed,

KENNETH DEAROLF, Chairman
LeROY K. HENRY
GEORGE W. BENNETT
Auditing Committee.

The Resolutions Committee presented the following report:

Whereas the sixteenth annual meeting of the Pennsylvania Academy of Science has been held at Washington and Jefferson College, at Washington, Pennsylvania

The Pennsylvania Academy of Science wishes to express its especial appreciation to the Administration of the College and to the Local Committee on Arrangements for the courtesies extended to the Academy members during the Spring meeting of 1940.

Be it further resolved that the Academy express its appreciation to those who have contributed papers and who have, in other ways, made this meeting a most successful one.

Respectfully submitted,
Committee on Resolutions,

MARLIN ESPENSHADE, Chairman
RICHARD M. FOOSE

The Committee on Necrology, having studied the records of the Secretary, finds that during the year 1939-1940 the following members of the Academy have passed away:

Porter W. Shimer
94 Pennsylvania Avenue
Easton, Pa.

William R. Johnston
505 W. King Street
Shippensburg, Pa.

Arthur W. Leeds
1025 Westview Street
Mt. Airy, Philadelphia, Pa.

Stella M. Hughes
Annville, Pa.

Respectfully submitted
EDNA HIGBEE, Chairman
WARREN S. BUCK

In order to show our respect for the deceased members, all the members present stood in silent meditation for a few moments.

R. W. Stone reported for the committee on publications that because of the increased cost of printing, and postage rates, it was not deemed wise at the present time to publish four copies of the Proceedings each year as had been suggested at the 1939 Pennsylvania State College meeting of the Academy. He also stated that about 85 packages had been made up, each containing the first five volumes of the Proceedings, and that the packages are offered for sale at $1.00 per package. All other volumes of the Proceedings from Vol. 6 to Vol. 13 are offered for sale at $1.00 per volume except Vol. 8 which is out of print.

H. W. Thurston, Jr., of the Pennsylvania State College, will be president for the year 1940-1941. The Nominating Committee presented the following nominations for other offices of the Academy:

President-elect—E. A. Vuilleumier, Dickinson College, Carlisle.

Vice-president—Anna A. Conn, Uniontown High School (West); Walter S. Lapp, Northeast High School, Philadelphia (East).

Secretary-Treasurer—V. Earl Light, Lebanon Valley College, Annville.

Editor—Robert T. Hance, Duquesne University, Pittsburgh.

Press Secretary—Bradford Willard, Lehigh University, Bethlehem.

Junior Academy Adviser—Karl F. Oerlein, State Teachers College, California.

Nominating Committee,

EDGAR T. WHERRY
L. K. DARBAKER
T. D. HOWE
ANNA A. CONN
C. J. PIETENPOL

Since there were no nominations from the floor, the above officers were elected by acclamation, for the ensuing year.

The following forty-two persons were elected to membership in the Academy:

Paul F. Albright, 1300 Lancaster Avenue, Reading.
Russell B. Alderfer, Soil Conservation Service Experiment Station, State College.
Rhea Olive Baker, South Philadelphia High School for Girls, Philadelphia.
Paul R. Bowen, Beaver College, Jenkintown.
Ruth V. Brenneman, State Teachers College, Indiana.
William F. Butler, 626 Longacre Boulevard, Yeadon, Upper Darby P. O.
Franklin H. Chermock, Masonic Apartments, Wilmerding.
Ralph L. Chermock, 804 Constance Street, Pittsburgh.
John Clark, Carnegie Museum, Pittsburgh.
David L. Cline, 1129 Rosalie Street, Philadelphia.
John I. Cretzinger, 2331 Brownsville Road, Pittsburgh.
Roger O. Dain, 501 Broad Street, Nescopeck.
James G. Davis, 70 Fifth Avenue, New York City.
Palmer DePue, 4209 Longshore Street, Philadelphia.
O. G. Enstrom, Jefferson.
Ernest E. Gulban, 114 Wissinger Road, Windber.
Edward C. Henry, 224 Mineral Industries Building, State College.
Charles B. Hollenbach, 317 Rose Street, Reading.
Mary Kalina, 820 Muhlenberg Street, Reading.
Susan Dorothea Keeney, 318 Lancaster Pike, Wayne.
Harold H. Lanterman, 401 E. Fifth St., Berwick.
William E. Lloyd, 1134 Macon Avenue, Pittsburgh.
Bess Long, Bloomsburg High School, Bloomsburg.
Donald L. MacNeal, 852 S. Main Street, Towanda.
Lawrence Marshall, Duquesne University, Pittsburgh, Pa.
Ralph McCoy, State Teachers College, California.
Alfred Medendorp, 5235 Ravenswood Avenue, Chicago, Illinois.
Ruth A. Merrel, 198 Academy Street, Wilkes-Barre.
Harold C. O'Brien, Division Lane, Beaver.
Wayne Frazier O'Neill, 427 Seneca Street, Bethlehem.
Aura Stiers Pollard, 3008 N. Fifth Street, Harrisburg.
Ethel Ruhling, 1820 Loesel Avenue, Erie.
Donald Griscom Sands, 2424 Grandview Street, Mt. Penn, Reading.
Alta E. Schrock, Salisbury.
Orville Frank Tuttle, Department of Geology, State College.
Peter L. Vissat, Seton Hill College, Greensburg.
Robert N. Walker, Wilson College, Chambersburg.
Kenneth S. Whisler, 140 E. Hanover Street, Hanover.
Melvin L. Whitmire, 300 E. Fifth Street, Berwick.
Joseph L. Williams, Box 90, Lincoln University.
Golda Wood, 95 Ben Lomond Street, Uniontown.
George Johannus Yevick, 1161 Third Avenue, Berwick.

Sixteen papers were presented at the Saturday morning session of the Academy.

Registration of Senior Academy members numbered 96, and of Junior Academy members 216.

Gettysburg, Pennsylvania was selected as the place for the summer meeting of the Academy in 1940.

Respectfully submitted,
V. Earl Light
Secretary-Treasurer.

THE MINUTES OF THE SEVENTH ANNUAL SESSION OF THE PENNSYLVANIA JUNIOR ACADEMY OF SCIENCE

A. The Friday Session.

The sixth annual session of the Pennsylvania Junior Academy of Science was held on March 22 and 23, 1940, at Washington and Jefferson College, Washington, Pennsylvania, president Richard Rohrer, of Alderdice High School, Pittsburgh, presiding. The Friday section was called to order at 2:00 P. M. o'clock, March 22, 1940, by the president, and the roll and minutes of the Sixth Annual Session were read by the Secretary and approved as read. The president announced the appointment of the following committees:

1. The Auditing Committee:
   (a) The Steinmetz Scientific Society, Chairman.
   (b) The Science Forum, Ambridge High School.
   (c) The College Training School Science Club, Indiana State Teachers College.
2. The Nominating Committee:
   (a) The Canonsburg Science Club, Canonsburg High School, Chairman.
   (b) Dr. Karl F. Oerlein.
   (c) Crafton Phy-Chy Club, Crafton High School.
   (d) Johnstown Academy of Science.
3. The Committee on Resolutions:
   (a) Biology Club, Peabody High School, Pittsburgh, Chairman.
   (b) Science Club, Lawrence Park High School.
   (c) Monongahela Science Club, Monongahela High School.

Since there was no old or new business, the Academy was then addressed by Dr. R. W. Stone, President Senior Pennsylvania Academy of Science, who welcomed the members.

The session was addressed by Dr. O. H. Blackwood, of the University of Pittsburgh, who spoke on light and sound. Dr. Blackwood was followed by the second guest speaker, Dr. Paul R. Stewart, who addressed the session on the flowering plants of Washington.

The Junior Academy papers followed:

1. "Primates," by Alan Dougal Jones, Steinmetz Scientific Society, Upper Darby Senior High School.
2. "A Snake Project," by Harold Hawksworth, Pine Township Nature Club, Heilwood, Pennsylvania.
3. "Electric Furnace Construction," by Garvin Metcalf, Science Club, Monongahela High School.

4. "Radiant Energy at Work," by Hubert Custer, Johnstown Academy of Science, Central High School.
5. "Care and Feeding of Armadillos," by Rudolph Kuhn, Science Forum 461, Ambridge High School.
6. "The Cavalcade of the Planets," by James Costanzo, Science Forum 461, Ambridge High School.
7. "Types of Variable Stars," by Joseph Carr, Phy-Chy Club, Crafton High School.
8. "Student-made Specimen Mounts," by Jack Struve, Scope Club, Alderdice High School, Pittsburgh.
9. "Nature the Inventor," by Robert Wright, Biology Club, Uniontown High School.
10. "Timely Notes on Our Convention," by Dr. K. F. Oerlein, California State Teachers College.

B. The Saturday Session.

The Saturday session of the Seventh Annual Session of the Pennsylvania Junior Academy of Science was called to order at 9:00 A. M. o'clock, March 23, 1940, by the president.

The following Junior Academy papers were then presented:

1. "Fun With Photography," by Marcella Wingert, Altoona Junior Academy of Science, Altoona High School.
2. "The Steam-Electric Union Pacific Locomotive," by Bertram Miller and Richard Redpath.
3. "Byrd's Snow Cruiser," by Robert Hayes and Frank Brown.
4. "The Commercial Process of Developing Roll Film," by Gilbert Hoffman.
5. "The Sealed-Beam System," by Edwin Bunny.
6. "Harmful Patent Medicines," by Caroline Emerson, Lawrence Park High School Science Club.
7. "Biographical Sketches of Famous Biologists," by Benna Binstack and Norma Pollack, Biology Club, Peabody High School, Pittsburgh.
8. "Testing Light Bulbs," by Ray Archery, Fraubelin Science Club, Mt. Union High School.
9. "Characteristics of Aircraft Design," by Edward McCarthy, Steinmetz Scientific Society, Upper Darby Senior High School.
10. "Gas Model Airplanes as a Hobby," by Edward Gallagher and Regis Gallagher, Benzine Ring, Canonsburg High School.
11. "Making a Geiger Counter," by Richard Jones, Johnstown Academy of Science, Johnstown Central High School.
12. "Greenhouse Work" (Group Demonstration) Indiana State Teachers College.
13. "The Electric Arc Furnace," by Saul Greenwald, Uniontown Senior High School.

The sponsors of the science clubs now cast their votes for the boy and girl who was to be given an honorary membership in the American Association for the Advancement of Science. The winners were Richard Jones, of Johnstown, and Caroline Emerson, of Lawrence Park, Erie, Pennsylvania.

Mr. G. E. Parfitt, of the Phy-Chy Club, Crafton High School, Chairman of the Nominating Committee then proposed the following officers for next year:

President—The Science Club of Altoona Senior High.
Vice President—The Phi-Beta-Chi Science Club, Chester High School.
Secretary—The Steinmetz Scientific Society, Upper Darby Senior High School.

These nominations were accepted without contest. Miss Marie Knauz then read the report of the Resolutions Committee which was accepted as follows:

Resolved, that the Junior Academy extend its sincere thanks for their splendid cooperation to the following:

1. Dr. Dieter, chairman of the local Arrangements Committee, of Washington and Jefferson College.
2. The speakers Dr. O. H. Blackwood and Dr. Paul Steward.
3. To the First Baptist Church for the Junior Banquet.

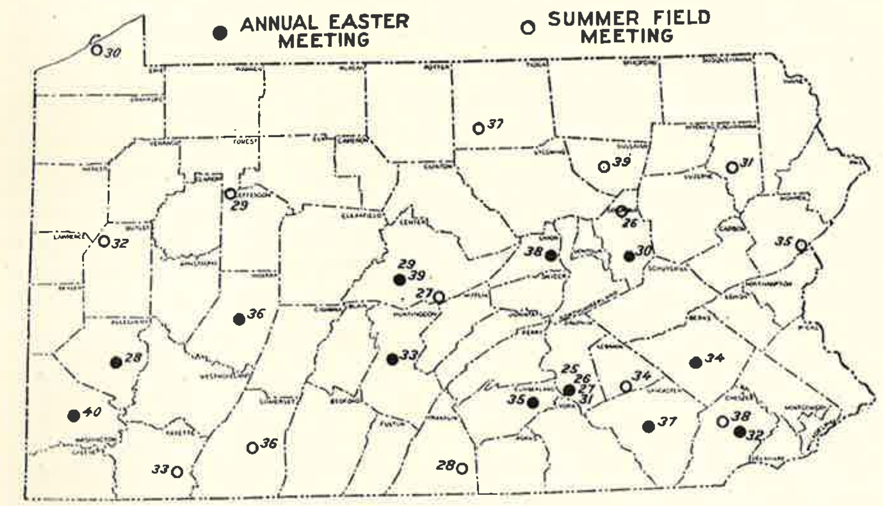
The meeting was then adjourned.

Respectfully submitted,
ALAN DOUGAL JONES, *Secretary.*

"WHERE ACADEMY HAS MET"

R. W. STONE

Pennsylvania Geological Survey



SUMMER MEETINGS		ANNUAL MEETINGS	
		1925	HARRISBURG
1926	BENTON, COLUMBIA CO.	1926	HARRISBURG
1927	STATE COLLEGE	1927	HARRISBURG
1928	MOUNT ALTO	1928	PITTSBURGH
1929	COOKS FOREST	1929	STATE COLLEGE
1930	ERIE	1930	BLOOMSBURG
1931	SCRANTON	1931	HARRISBURG
1932	SLIPPERY ROCK	1932	WEST CHESTER
1933	OHIO PYLE	1933	HUNTINGDON
1934	MOUNT GRETNA	1934	READING
1935	EAST STROUDSBURG	1935	CARLISLE
1936	SOMERSET	1936	INDIANA
1937	WELLSBORO, TIOGA CO.	1937	LANCASTER
1938	COATESVILLE, CHESTER CO.	1938	LEWISBURG
1939	LAPORTE, SULLIVAN CO.	1939	STATE COLLEGE
		1940	WASHINGTON

PIONEER SCIENTIFIC SONS OF WASHINGTON COUNTY

GEORGE W. BENNETT

Washington and Jefferson College

By selecting Washington as the place for this 16th meeting, the Academy has come to a county which has made, in the aggregate, a really notable contribution to the annals of science in Pennsylvania, extending over a period of 130 years. It is not inappropriate, therefore, for a member of the host institution to recount some of the details of this contribution of the scientific sons of Washington County.

The groundwork for scientific effort in Washington County was laid in old Jefferson College at Canonsburg. Here as early as 1806 chemistry was taught; indeed only ten colleges in the United States taught chemistry at an earlier date, and thirteen more years elapsed before chemistry was first taught at the University of Pittsburgh (1).

So keen was enthusiasm for science at old Jefferson that what was very probably the first student science club west of the mountains was founded there in 1831. This club, called the Lyceum of Natural Science of Jefferson College, held meetings, bought scientific journals, and apparatus, and conducted experiments. The rising tide of the Civil War, however, which so depleted the student body of Jefferson College, caused the Lyceum to terminate its activities, and the minutes close with the meeting of January 14, 1861.

Almost from the beginning of scientific instruction in Jefferson College, a progression of inspiring teachers has marched down the years with the eager young men who had their early training in the colleges of Washington County. In 1828 the Administration of Jefferson College brought to the campus at Canonsburg, Jacob Green, M. D., to give a course in chemical lectures in the summer terms. Green was professor of chemistry and pharmacy at the newly founded Jefferson Medical College in Philadelphia, and was the author of six scientific books dealing with chemistry, electricity and medicine. He was also one of the founders of the Lyceum of Natural Science. His summer lectures continued until his death in 1841.

The years 1852-1878 were noteworthy in a scientific sense in Washington County because during this period, scientific training was in the hands of Dr. Samuel Jones. He was a giant intellect. Educated in the classics, a graduate of Trinity College, Dublin, Samuel Jones loved both the classics and the sciences and embellished each by illustrations from the other. He was one of the rare examples in American colleges of the transition period in the history of the sciences, for his education connected two great realms of endeavor. Let anyone begin a quotation, say from the Iliad, and Samuel Jones would complete the passage in the Greek. Not many scientists could have done the same in his day.

When Samuel Jones was called from his labors in this life his work devolved upon a former student of his, Dr. James Ray, who taught the physical sciences from 1885-1910. Ray had studied in Germany where he had been a laboratory assistant to the renowned Kirchoff, co-inventor of the spectroscope.

Meanwhile, in 1882, Dr. Edwin Linton, world famous parasitologist, had commenced his teaching in biology which he continued until 1920. In 1901, Robert Kennedy Duncan, founder of the Mellon Institute, took over the direction of the newly founded department of chemistry which had been split off from the physics department, and he taught here until 1905. Thus for a period of sixty years, students were trained under four outstanding teachers of science.

The first really scientifically trained person to practice in Washington County was Jean Julius LeMoyne de Villiers, a refugee from the terror of the French Revolution. His father had been a botanist of first rank and was curator of the royal botanic gardens under the kings of France. LeMoyne (having since dropped the deVilliers) in 1797 set up in the infant city of Washington the first pharmacy west of the Alleghenies. His scientific training had included seven years of study in medicine in Paris. Jean Julius LeMoyne was also the father of the more famous pioneer cremationist, Francis Julius LeMoyne.

Francis Julius LeMoyne possessed a highly scientific mind. A graduate of Washington College in the class of 1815, he received his M. D. from the University of Pennsylvania in 1823. In 1876 he built the first crematory for the disposal of the human cadaver in the United States. In the little brick building still carefully preserved atop a neighboring hill, LeMoyne, in the face of majority opposition carried out the first formal cremation in the United States on Dec. 6, 1876.

As early as 1865 astronomy benefitted by the pioneering contributions of Daniel Kirkwood, professor of astronomy in Washington and Jefferson College for the two years 1865-67 during an interim in his twenty-eight years of teaching at Indiana University. It was while a professor here that he wrote his book on the comets and meteors that is cited in textbooks of astronomy to this day. His work on the spacing of the rings of Saturn also aroused worldwide discussion among astronomers.

At the turn of the century Robert Kennedy Duncan wrote his books and articles for Harpers magazine which were the beginnings of his life work on industrial research. His book called "The New Knowledge" is described as being "written in a vein of ardor and elation of spirit, rendering it certainly one of the most readable volumes ever composed."

The contributions of the colleges to medicine, biology, and hygiene have been continuous for over a century. An outstanding feature of this service was the founding of one of the leading medical colleges in the United States. In 1824 a group of medical men in Philadelphia petitioned Jefferson College to set up a department of medicine in that city. This was done, and Jefferson College granted M. D. degrees to twenty-three of these graduates prior to 1838, when, by mutual consent, the department secured a charter for an independent school, and thus became the Jefferson Medical College.

A bright chapter in this story is the part which has been played by Washington County men in the achievements of the United States Public Health Service. Thus Dr. Jesse W. Lazear, '88, who as a member of the United States Army Yellow Fever Commission, gave his life in studying that disease, was credited by Dr. Walter Reed with the discovery of the yellow fever mosquito (2). The work of Dr. John D. Long, '84, also, who became Assistant Surgeon General of the United States Public Health Service in 1910, has been outstanding.

The most eminent of these Service doctors, however, was Dr. William B. Wherry, '97, world famous bacteriologist. His public career was with the United States Public Health Service in the Philippines, California, Kentucky and Mexico. His researches were published in eighty-two scientific papers. Wherry was the discoverer of the bacillus of tularemia and the bacillus of rat leprosy. He was a pioneer in recognizing microaerophile bacteria, and in demonstrating that variations in microorganisms are inducible through changes in environment. He was also an authority on immunization, and for twenty-five years (1909-1936) he was a member of the faculty of the Medical School of the University of Cincinnati.

Of the non-medical, biology men, Professor Edwin Linton attained world-wide recognition as a parasitologist, particularly in the field of icthyology. A native son of this county, he graduated from the college in 1879, and received his Ph. D. from Yale in 1890. He began to teach here in 1882, and this labor extended over a period of thirty-eight years. During almost his entire teaching tenure here, Linton was a member of the United States Fish Commission, (1882-1908), and in the summers did field work at Woods Hole, Mass., Yellowstone, Beaufort, N. C., Bermuda, and the Tortugas in the Caribbean. From his laboratory there flowed more than one hundred scientific papers (3). After 1920 Linton did research at the Universities of Missouri, Georgia and Pennsylvania until his death in 1939. He was recipient of the Leidy medal of the Philadelphia Academy of Natural Science.

The most important contribution to technology made in Washington County was the invention of carborundum. This invention was achieved by a native son who did not attend a college, Edward Goodrich Acheson (4). Acheson was born in this city, March 9, 1856, and in 1891 while operating an electric light plant in Monongahela City in this county, made his first carborundum. From this invention there developed the great electrochemical companies at Niagara Falls which were to make Acheson's name a byword in all the world. He also perfected a method for the production of high-grade artificial graphite, the siloxicon refracteries, Egyptianized clay, and the lubricants "Aquadag" and "Oildag." This inventive genius and business organizer began his work in the plant of Thomas A. Edison whose research methods he copied. Acheson was Perkin Medalist of the American Chemical Society, (1910), Rumford Medalist of the American Academy of Arts and Sciences, (1908), and twice recipient of the John Scott Medal of the Franklin Institute, (1894 and 1901).

Radium was first produced in quantity in America at Canonsburg, in this county. The Standard Chemical Company began work in that city in 1911 and continued to operate there until 1926 (5). Industrial methods for the extraction of radium from Colorado and Utah carnotites were worked out here, and from this plant came the 1,010.1 milligrams of radium presented to Madame Curie, in May 1921 by the women of America. The first commercial ferro-uranium in the world was produced in this plant also, in 1916, and was used in the exploratory experimental work on the value of uranium tool steels.

This account of the achievements of the scientific sons of Washington County has been presented in no vainglorious spirit, but an effort has been made to acquaint our guests with the inspiring backgrounds for scientific study pervading these college halls and this community in the hope that you may all may feel surrounded by a warm sympathy for your labors.

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HYPERTROPHIC DEVELOPMENT OF THE INCISOR TEETH IN A RAT

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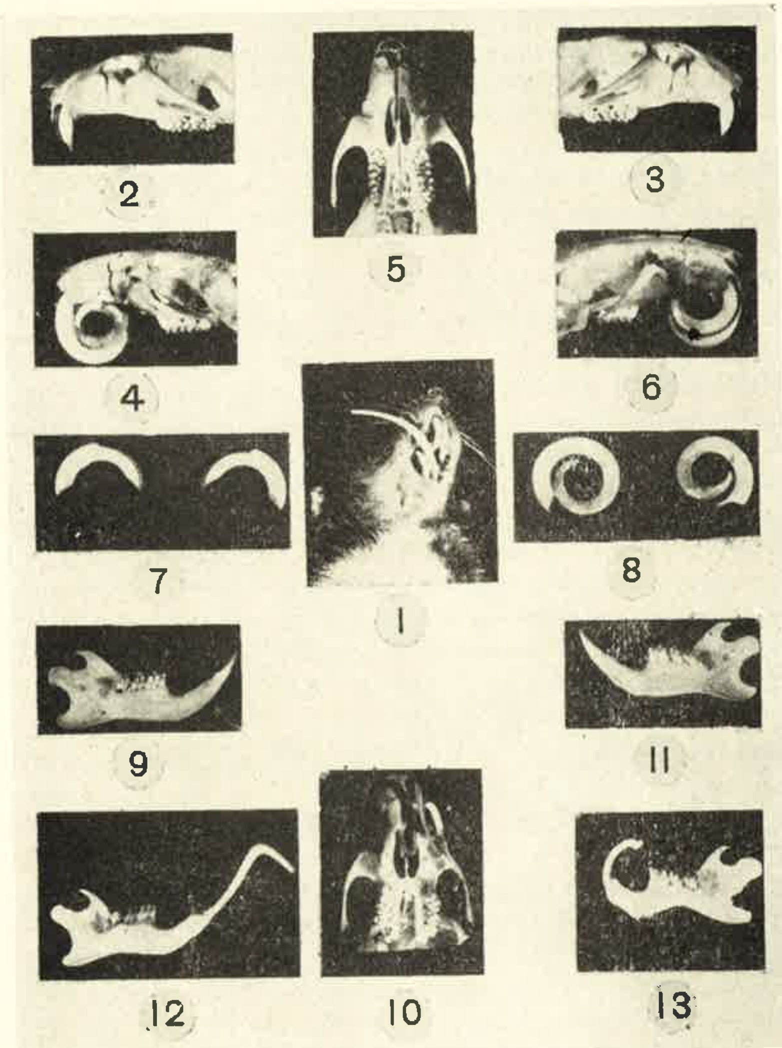
The purpose of this paper is to describe and illustrate the irregularities of the incisor teeth of a rat which are unusual with respect to size and pattern. It is presumptuous, perhaps, on my part to bring the attention of the learned members of the Academy to this type of anomalism which is said to occur fairly frequently. The grotesque physiognomy of the rat (Figure 1) with the upper incisors curling within the buccal cavity and the lower incisor teeth spreading outward from the lower jaw like malformed lower tusks of Trilophodon, are all so striking, however, that I believe the specimen might be of some interest to anatomists. It is no less remarkable that the rat, despite its extreme difficulty in taking food, attained an age of one hundred and eighty-five days. The difficulty in taking food due to these abnormal teeth can be appreciated better, if one refers to figures 4 and 6 which demonstrate the absence of any holding mouth part except, possibly, the lips. The upper incisors not only lack grasping points but partially occlude the mouth cavity as well. During the last two weeks of its life the rat grew very weak, probably in consequence of partial starvation, but it is possible that it would have lived for some time beyond the above-mentioned age, if it was not killed for humane and anatomical reasons.

It is assumed that a defect in the alignment of the upper and lower incisor teeth with each other prevents sufficient wearing off of the biting edges and, in consequence of this, the teeth attain their full growth potentialities. In view of any such assumption, that all rat incisors would grow to a size such as found in the anomaly, if not worn down, would lead us to designate the condition found in the teratism as a pseudo-hypertrophy. Equally speculative, however, is the conclusion that here is a case of true hypertrophy due to some growth disturbances. An experimental study of this problem might clarify it. In some previous work by the writer upon the jaw muscles, neck muscles, bones and nerves of the rat there was much opportunity for the proper alignment of the upper and lower incisors to be thrown out of place, yet no aberrant dention was ever observed in the experimental animals.

The specimen was a male, of the hooded variety and a descendant of several pairs of rats secured from the University of Pittsburgh in 1931. Litter-mates and siblings exhibited no dental deformities.

The lateral aspects of the teratism (Figs. 4 and 6) exhibit plainly the enormous development and unique, rams horn pattern of the upper incisors. The contrast between the incisors of the normal skull and those of the aberrant form is very striking (Figures 2 and 4) (Figures 3 and 6). In figures 7 and 9, the incisor teeth have been removed from the alveoli of both the normal rat and the abnormal one in order that further comparisons can be made. The upper two incisors did not grow ventrad in a perfectly perpendicular plane but were inclined toward the left (Fig. 10). The upper, left incisor simply curved around upon itself and was not contiguous with the skull at any place except in its alveolus. The upper, right incisor, however, entered the left, anterior palatine foramen and pierced the inner wall of the premaxillary bone to enter the socket of the left incisor. Just behind the point of



LEGEND FOR PLATE

Figure 1. Cranio-ventral aspect of rat head showing abnormal tooth growth.
Figure 2. Left side of normal rat skull.
Figure 3. Right side of normal rat skull.
Figure 4. Left side of skull of anomaly.
Figure 5. Ventral aspect of normal rat skull.
Figure 6. Right side of skull of anomaly.
Figure 7. Normal upper incisors removed from alveoli.
Figure 8. Abnormal upper incisors removed from alveoli.

Figure 9. Inner surface of left normal mandible.
Figure 10. Ventral aspect of abnormal rat skull.
Figure 11. Inner surface of right normal mandible.
Figure 12. Inner surface of left abnormal mandible.
Figure 13. Inner surface of right abnormal mandible.

emergence of the left incisor from the premaxillary bone, the right incisor pierced the floor of this bone in the region of the diastema and extended for a short distance into the oral cavity. In the course of its growth, the right upper incisor occluded a part of the naso-pharyngeal canal and pushed the bones lying in that cavity away from their normal locations.

The incisor teeth of the mandible of the anomalous specimen were much thinner than those found in normal lower jaws. The incisor of the left half of the mandible (Fig. 12) of the teras is much longer than that of the normal animal and flares from the mouth like a veritable tusk. On the right half of the mandible, the atypical incisor (Fig. 13) is much shorter than its mate on the right side but is somewhat longer than the normal incisor and possesses a much different shape. All of the molar teeth of the anomaly were apparently normal. The lateral surface of the left premaxillary bone was much thinner, rougher and more porous than the right premaxillary. In general, the skeleton of the head of the teras was smaller and much more fragile than is usually found in rats of the same age.

THE EFFECTS OF TESTOSTERONE-PROPIONATE ON THE GROWTH OF COMB, TESTES AND OVARIES IN CHICKS

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The fact that male hormone substances are responsible for growth, maintenance and function of the male reproductive tract has been known for a long time. It is, however, only during the past several years that the nature of these substances has been successfully investigated. Substances have been synthesized which duplicate the structural and functional changes which take place under the influence of the natural products.

This study deals with the development of the secondary characteristics in the baby chick belonging to the New Hampshire Red variety. Experiments of this kind were conducted successfully by Breneman and Hamilton on the White Leghorn chick and by Domm on Brown Leghorn Chicks.

MATERIALS AND METHODS

One dozen New Hampshire Red, blood tested chicks, 5 days old, were used in this study. The material used was Testosterone-Propionate (Overton), supplied by the Ciba Pharmaceutical Company, through the courtesy of Dr. E. Oppenheimer. The hormone was suspended in sesame oil. Administration was made in two ways. One group of 4 chicks received single doses, while the other experimental group of 4 chicks received multiple doses. All injections were made subcutaneously on the lateral wall of the thorax beneath the wing. Single injections of 2.5 mg of testosterone-propionate were made on the fifth day after hatching. The multiple injections were made on the fifth, seventh, ninth and eleventh days. The latter group received 0.625 mg of the hormone at each injection. Comparisons were made on the basis of comb growth and testes and ovary weights. The comb growth being compared with a comb factor represented by $\sqrt{HxL}$. This factor was used by Breneman in his experiments.

OBSERVATIONS

As early as the eleventh day after hatching, the effectiveness of the testosterone-propionate in producing comb growth was apparent. The combs increased greatly in size and turgidity. Hyperemia caused by the increased blood circulation and evidenced by the deep orange color of the comb soon developed. At this time the injected male chicks assumed the characteristics of the cock. They emitted strident calls in which the sound was a high-pitched monotone. Despite the high canary like tone, there were many indications that the chicks were attempting to crow. Hamilton states that his chicks crowed. While producing this sound, the injected animals assumed the posture and bodily movements of cock engaged in crowing. The head was raised, the head-tail axis of the body assumed a more vertical position with the tail feathers somewhat depressed. The bill was opened and the neck feathers greatly ruffled. At the peak of these movements, vocalization occurred. The injected chicks were prone also to frequent lifting and flapping of their wings accompanied by a raising of the animal upon the ends

of the phalanges of the feet. They also became quite vicious, pecking at any object brought near to them and striking at it with their feet much in the manner of using spurs which were as yet undeveloped. The wattles also began to grow rapidly. It was very interesting to observe the animals which were determined to be females. They did not attempt either crowing or wing flapping. No other actions were observed during the 38 days of observation to indicate male characteristics.

At the end of 25 days, a comparison was made between the comb growth in the 3 different groups and indicated in Table 1.

TABLE I.

Series	Total Dose in mg.	Injections Number	Day	Comb. $\sqrt{HxL}$.
A. (4)	Control	Control	Control	10.5
B. (3)	2.5	1. (0.5cc)	5 only	10.7
C. (3)	2.5	4. (0.125cc)	5, 7, 9, 11.	16.3

From Table 1, it is noted that the multi injected animals appear more fully developed than the single injected animals.

It has been suggested that there is a definite limit beyond which it is impossible to push comb growth in the chick, and that time plays an important factor in limiting comb growth.

Due to the fact that combs of the controls increased rapidly after the fifteenth day (after the fifteenth day sex hormones begin to be secreted which stimulate comb growth) it was decided that injections should be resumed, in order to see just how precocious, the animals would become. Both injected groups received 0.625 mg of the hormone on the twenty-sixth, twenty-seventh, twenty-eighth and thirtieth days. This amount of hormone gave a total dosage of 5.0 mg for each animal. On the thirty-eighth day, the animals were sacrificed with results indicated in Table II and Figure I.

TABLE II.

Males

Series	Total Dose in mg.	Injections Number	Day	Comb. $\sqrt{HxL}$	Testes weight average
A. (1)	Control	Control	Control	15.7	0.070 gm.
B. (2)	5.0	1. (0.5cc)	5		
		4. (0.125cc)	26, 27, 28, 30	17.4	0.053 gm.
C. (2)	5.0	8. (0.125cc)	5, 7, 9, 11,		
			26, 27, 28, 30	18.7	0.070 gm.

Females

Series	Total Dose in mg.	Injections Number	Injections Day	Comb. $\sqrt{HxL}$	Ovary weight average
A. (3)	Control	Control	Control	11.0	0.160 gm.
B. (1)	5.0	1. (0.5cc)	5		
		4. (0.125cc)	26, 27, 28, 30	12.4	0.140 gm.
C. (1)	5.0	8. (0.125cc)	5, 7, 9, 11,		
			26, 27, 28, 30	14.5	0.130 gm.

Conclusions

The testosterone-propionate stimulates the comb growth in the female to a lesser extent than in the male. Multiple injections of the hormone stimulate comb growth to a greater extent than do single doses, even though the single doses were given in greater amounts. It seems that the hormone is moie effective when repeated in smaller doses over a longer period of time. In both males and females the growth of the testes and ovaries were retarded. However, the ovaries were inhibited to a lesser extent than the testes. There must be other unknown factors which accelerate the comb growth and inhibit growth of the testes in the male and unknown factors in the female which accelerate comb growth to a slighter extent and inhibit the growth of the ovary to a greater extent.

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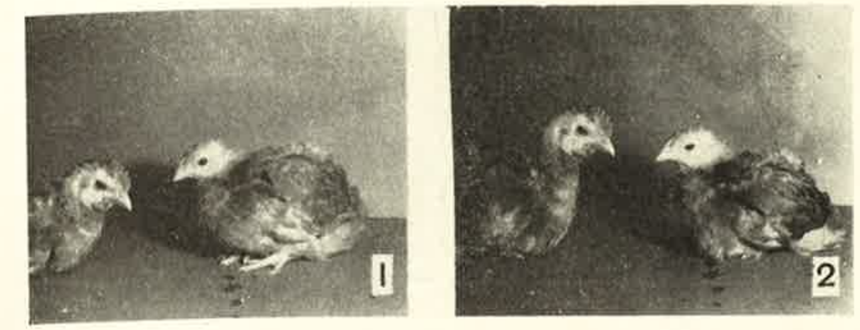

Fig. 1. A. Animal injected with a single dose of 5.0 mg of testosterone-propionate. B. Animal injected with multiple dose of 5.0 mg of testosterone-propionate.

J. PETER LESLEY—GEOLOGIST: WHAT WAS HIS CORRECT NAME?

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The name of J. Peter Lesley is enshrined in the history of geology in Pennsylvania. As an Assistant on the First Survey and as Director of the Second Geological Survey he was long active in an official capacity, at other times he was engaged in the study of the geology of the state as a private individual. Throughout his active years he published many articles dealing with the geology of the state and established a reputation that has long survived him.

It is of particular interest to note that there is a real difference of opinion regarding his correct name. This confusion is nothing new as it existed during his life, and he was largely responsible for it by the various signatures that he used at different times, plus the fact that he had a brother Joseph who was also a geologist and who used at least two signatures. While some people have held that the J. stood for Joseph, confusing him with his brother, others have claimed that it was for John, while a third group, including the present writer, has insisted that the J. stood for Junior and was simply transposed in order to give a distinctive signature.

It was a chance reading of an unpublished manuscript in the closing months of 1939 that started the present investigation. In this paper the name of Joseph P. Lesley appeared and its author said that he was sure that it was correct, citing previous papers by the present geological survey of this state. Not being convinced, other references were hunted up and the problem began to unfold and show its many ramifications. It seems that this Academy is a fitting place to present the results of the investigation.

Of all the many books consulted, the one that gives the most information is the "Life and Letters of Peter and Susan Lesley" edited by their daughter Mary Lesley Ames. (2 vol., 1088 pp., G. P. Putnam's Sons, New York, 1909). One can hardly want a more authentic source. In the opening chapter of this book is found the statement that the editor's father (J. Peter Lesley or J. P. Lesley) was baptized Peter Lesley being the fourth Peter Lesley in direct descent. In a biographical letter to Professor O. N. Rood written in 1882 by J. P. Lesley, which is included among the appendices to this book is the statement, "When I came of age, I adopted the business signature of J. P. Lesley, to distinguish it from that of my father who signed himself, as I did before then, Peter Lesley, Jr." These two statements seem to be the indisputable answer to the problem. Numerous other references are available to substantiate this claim that the J. stood for Junior.

In order to show how widespread the confusion has been in the past, a few of the results of the investigation will be given.

In the Devonian volume published by the Pennsylvania Topographic and Geologic Survey in 1939 there is a picture of Lesley with the title "Joseph P. Lesley, Second State Geologist of Pennsylvania."

In a letter from Dr. R. W. Stone of the present State Survey in answer to a query regarding the name of the Second State Geologist, is the following statement: "Col. H. W. Shoemaker, State Archivist, said John Peter Lesley, and for evidence referred me to the card catalogue in the State Library."

To quote further from this same letter,

"Dr. Ashley said Joseph Peter and referred to an Indiana coal fields map.

"I refer you to a privately printed report of 1874 entitled, "A Collection of Occasional Surveys of Iron, Coal and Oil Districts in the United States," by J. P. Lesley. Some of the papers in this volume were read before the American Philosophical Society in 1872-73 by J. P. Lesley, Professor of Geology in the Department of Science, University of Pennsylvania.

"The last paper in this volume is "The Outcrop Belt of the East Kentucky Coal Field," by Joseph Lesley, formerly Assistant to the Kentucky Geological Survey. The map accompanying this paper bears in its legend—by Jos. Lesley, Jr., Topographic Assistant."

It should now be pointed out that J. P. Lesley's brother Joseph worked as an assistant on the Pennsylvania Survey in 1880-81 and had been an Assistant on the Owen Survey in Kentucky in 1858-59. Joseph could not rightly have been a Junior if his father was named Peter, but he had an uncle Joseph Lesley and evidently sometimes used the Junior, for some of his works are listed as being by Joseph Lesley and others by Joseph Lesley, Jr. The paper referred to above on "The Outcrop Belt of the East Kentucky Coal Field" was really written by Joseph and not J. P. Lesley, a fact that can be checked by study of the bibliographies of the two brothers. Furthermore, the legend of the accompanying map gives the date of the surveys as 1858 and 1859, the years that Joseph Lesley was on the Kentucky Survey.

However if one starts to check the bibliographies, care is needed. In Bulletin 127 of the United States Geological Survey, a bibliography by N. H. Darton, one finds, Lesley, Joseph, one paper published in 1860 and Lesley, Joseph, Jr., three papers published between 1861 and 1877; but in Bulletin 746 of the U. S. G. S. the bibliography by Nickles, all four of these same papers are listed under Lesley, Joseph. Going further one finds a long list of papers by Lesley, Joseph Peter, in the bibliography by Darton and they are listed under Lesley, J. Peter by Nickles. Is there any wonder that there has been confusion? A recent letter from Dr. Darton confirms the belief that the entry in Bulletin 127 was an error and that the J. stood for Junior.

To cite another case in this problem of confused authorship. One of the most astounding mixups is to be found in the volume entitled "Geological Research in Kentucky" by Willard Rouse Jillson, State Geologist of Kentucky, published in 1923. On page 9 under the personnel of the Owen Survey we find the name Joseph P. Lesley, Jr., on page 44 of the same volume is reference to a paper by *Leslie*, Joseph, Jr., and finally on page 118 we find the bibliography of Lesley, Joseph P. Notice the difference in these three entries.

If one now looks up the five items in this bibliography it will be found that the first four are by J. P. Lesley and the fifth is by his brother Joseph Lesley. Of which Lesley is it supposed to be the bibliography?

As has been stated before, it is not surprising that this confusion has existed when one realizes the variety of names under which one man worked. In volume A of the Second Geological Survey of Pennsylvania we find that J. P. Lesley is the author, Peter Lesley the State Geologist and in his sketch of the Rogers Survey he lists Peter Lesley, Jr., as an Assistant.

In summation it should be pointed out that the baptismal name of the Second State Geologist of Pennsylvania was Peter Lesley, but that at various stages of his life he used Peter Lesley, Peter Lesley, Jr., J. Peter Lesley and J. P. Lesley. The brother who worked on the Owen Survey of Kentucky was named Joseph Lesley but also used Joseph Lesley, Jr. These six forms may be considered correct usage for the two brothers. Joseph P. Lesley and Joseph P. Lesley, Jr., both of which have been applied to both brothers and Joseph Peter Lesley and John Peter Lesley, which have been used for J. P. Lesley, of Pennsylvania, are incorrect and their use has caused a great deal of confusion.

It is sincerely hoped that we may see the end of this "Comedy of Errors" in the near future.

THE TERRESTRIAL SHELL-BEARING MOLLUSCA OF WASHINGTON COUNTY, PENNSYLVANIA

GORDON K. MACMILLAN

Carnegie Museum

The physiography of Washington County is characterized by a rolling surface, which, except in the southwestern part, is seldom rugged. The valleys made by the streams are for the most part broad. Harshness of the outline is almost wanting, and in most of the county the land has been cultivated to a great extent as the loss of soil by washing is at a minimum.

This type of physiography has made the competition very keen between the land snails and man for possession of the land. The rich soil of the county, making excellent farming land, has resulted in the destruction of many forests, the natural habitat of land snails.

The first reference of any conchological work having been done in Washington County was in 1827, when Jacob Green collected some snails along Chartiers Creek. Nothing more was done in this phase of science in this county until the close of the nineteenth century. A few specimens of land snails now housed in the Conchological Collection of the Laboratory of Recent Invertebrates at the Carnegie Museum were collected around Charleroi by George A. Ehrmann.

The late A. E. Ortmann, Curator of Recent Invertebrates at the Carnegie Museum collected terrestrial mollusca in Western Pennsylvania and was followed by S. T. Brooks who made collections of land snails at Duvall's Farm, southeast of Washington. This constitutes the last collection of land snails, to my knowledge, that was made in this county, and which was received by the Carnegie Museum.

The list of the terrestrial shell-bearing mollusca of Washington County is given below. Those species marked by an asterisk should occur in this county according to distributional facts, but as yet have not been found.

Family HELICINIDAE

*Helicina (Hendersonia) occulta Say

Family POLYGYRIDAE

Triodopsis tridentata (Say)
Triodopsis tridentata juxtidens (Pilsbry)
Triodopsis fraudulenta (Pilsbry)
Triodopsis fallax (Say)
Triodopsis inflecta (Say)
Triodopsis denotata (Ferussac)
Mesodon profundus (Say)
*Mesodon sayanus (Pilsbry)
Mesodon albolabris (Say)
*Mesodon albolabris dentatus (Tryon)
Mesodon zaletus (A. Binney)
*Mesodon dentiferus (A. Binney)
*Mesodon multilineatus (Say)
*Mesodon appressus (Say)
Mesodon pennsylvanicus (Green)
Mesodon thyroides (Say)
*Mesodon clausus (Say)
*Mesodon mitchellianus (Say)
Stenotrema hirsuta (Say)
*Strenotrema monodon (Rackett)
Stenotrema fraterna (Say)
*Strenotrema fraterna cava (Pilsbry & Vanatta)

Family PUPILLIDAE

Gastrocopta armifera (Say)
Gastrocopta contracta (Say)
*Gastrocopta holzingeri (Sterki)
Gastrocopta pentodon (Say)
*Gastrocopta tappaniana (C. B. Adams)
*Gastrocopta corticaria (Say)
Vertigo ovata Say
*Vertigo ventricosa (Morse)
*Vertigo pygmaea (Draparnaud)
*Vertigo gouldii (A. Binney)
*Vertigo tridentata Wolf
*Vertigo milium (Gould)
*Columella endentula (Draparnaud)
*Pupoides marginatus (Draparnaud)

Family STROBILOPSIDAE

*Strobilops aenea Pilsbry
*Strobilops labyrinthica (Say)
*Strobilops affinis Pilsbry

Family VALLONIIDAE

Vallonia pulchella (Muller)
*Vallonia excentrica Sterki
*Vallonia costata (Muller)

Family COCHLICOPIDAE

Cochlicopa lubrica (Muller)

Family HAPLOTREMATIDAE

Haplotrema concavum (Say)

Family ZONITIDAE

*Euconulus fulvus (Muller)
*Euconulus chersinus (Say)
*Econulus chersinus polygyratus (Pilsbry)

*Oxychilus cellarium (Muller)
Retinella electrina (Gould)
*Retinella rhoadsi (Pilsbry)
Retinella indentata (Say)
Omphalina cuprea Rafinesque
Mesomphix perlaevis vulgatus H. B. Baker
Mesomphix inornatus (Say)
Paravitrea multidentata (A. Binney)
Hawaiia minuscula (A. Binney)
*Striatura exigua (Stimpson)
*Striatura ferrea (Morse)
*Striatura milium (Morse)
*Gastrodonta interna (Say)
Ventridens intertextus (A. Binney)
*Ventridens demissus (A. Binney)
Ventridens ligerus (Say)
*Ventridens gularis (Say)
*Ventridens suppressus (Say)
*Ventridens suppressus virginicum Vanatta
Zonitoides nitidus (Muller)
Zonitoides arboreus (Say)

Family ENDODONTIDAE

Anguispira alternata (Say)
Anguidspira alternata carinata (Pilsbry & Rhoads)
Anguispira kochi (Pheiffer)
Discus patulus (Deshayes)
*Discus patulus carinatus MacMillan
Discus cronkhitei anthonyi (Pilsbry)
Helicodiscus parallelus (Say)
*Punctum pygmaeum minutissimum (Lea)

Family SUCCINEIDAE

*Succinea retusa Lea
*Succinea ovalis Say
*Succinea avara Say
*Succinea aurea Lea

Family CARYCHIIDAE

*Carychium exiguum (Say)
Carychium exile Lea

Family POMATIOPSIDAE

Pomatiopsis lapidaria (Say)

Mesodon pennsylvanicus was collected along Chartiers Creek, Washington County, by Jacob Green in 1826, and described by him as a new species of *Helix* in the Contributions of the Maclurian Lyceum to the Arts and Sciences, vol. 1, no. 1, Jan., 1827. The type locality is not exactly known along Chartiers Creek, but I believe that it was near Canonsburg.

Anguispira kochi is a snail inhabiting mainly the western part of the United States. Washington County represents nearly the easternmost distributional boundary of this species. That it was much more abundant in the past is indicated by its presence in great numbers in the shell heaps of Indian mounds found in some parts of this county. We are rather certain that these snails are not recent immigrants into the shell heaps by attraction of the abundance of calcium carbonate, as the shells are denuded of their epidermis.

The distribution of the terrestrial shell-bearing mollusca into Washington County, either from the north or the south, was along some water course, as this was the path of least resistance and the path that afforded them the maximum protection and food. The southern forms entering this county would be along the Mississippi and Ohio River Valleys and their tributaries, mainly the New-

Kanawha Rivers and the Youghiogheny-Monongahela Rivers. The latter system has its origin in West Virginia, and the former in North Carolina. The path of least resistance for the northern forms of mollusca in their southern migration would be along the Allegheny River, and indirectly along the Susquehanna River and its tributaries.

With the northern migration of the southern species of snails into Washington County we are confronted with two factors explaining their presence in this county. First, that the climatic conditions have been favorable for their existence in this county, that their food has always been available, and that the river courses have made easy routes of distribution to make the northern migration desirable. Second, that this apparent northern migration might be a resettlement or repopulation of territory once occupied by the species before they were destroyed by the encroachment of the last glacier.

Of the 84 species of land snails known to exist in this county, 11 of them are southern forms, 9 of them are northern forms, and the remainder are forms widely distributed throughout the United States.

To have a more complete knowledge of the molluscan fauna of Washington County, and also of the State of Pennsylvania, more thorough collecting must be made throughout the county, and also throughout the state in some of the less accessible places, especially those in the more mountainous sections of the central part.

MANUS IMPRESSION OF *ANCHISUARIPUS* FROM PENNSYLVANIA

BRADFORD WILLARD

Lehigh University

The author has previously reported dinosaur tracks from the Gettysburg formation of the Newark series of Triassic red sandstones and shales at or near Yocumtown, York County, Pennsylvania. Subsequent collecting at the Yocumtown locality has yielded a few more tracks preserved in red, sandy shale. Recently, upon cleaning this material of the adhering mud, impressions were observed which are believed to be those of the manus of *Anchisauripus* which with *Grallator* appears to include all of the genera represented by the tracks at Yocumtown.

Description

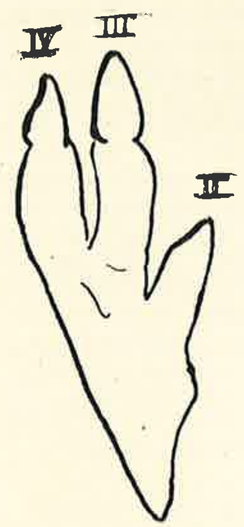

Figure 1. Sketch, x 2, of supposed manus impression of a Triassic dinosaur assigned provisionally to the genus *Anchisauripus.*

The newest material collected by the author consists of several more or less broken slabs containing upon their upper surfaces at least twenty-two complete or partial impressions of the hind feet of small, theropod dinosaurs. Some of these are doubtless those known as *Grallator.* This is deduced from their relatively small size and lack of "spur." The others are larger and appear to have possessed the "spur." Therefore, they are assigned to the genus *Anchisauripus.* On a small, detached slab measuring roughly 8 to 10 cm. is an impression unlike all of the pes imprints so far collected. A second, but poorer, similar impression is associated with other tracks on a larger slab. On still a third slab is part of what appears to be a similar print. Even the best of these three is not particularly well preserved, but deserves description because it is probably unique.

Description of Specimen:

Manus: tridacity; best impression that of left foot. Length of track 32 mm; width of track 17 mm. Length of digits: II, 7 mm; III, 15 mm; IV, 14 mm. Angular divergence between II and III, 15°; III and IV, 9°. The palm is triangular giving the toes a rather blunt ("stumpy") aspect. Toe pads are not clearly defined, nor is the articulation of the digits with the palm distinct. The terminal phalanges (claws?) of III and IV are deeply impressed.

Occurrence:

Gettysburg red shale of Newark series, Triassic system; Yocumtown, Pennsylvania.

Remarks

The impression above described is the best in the collection. The second specimen is less well-preserved, but has the same length (32 mm.) and width (17 mm.) as the first. The third imprint is incomplete and adds nothing to our data. It might not have been recognized and probably would not have been assigned to its present category were it not aligned with a pes impression.

So far as known this is the first impression recorded from Pennsylvania of what is taken to be the manus of a small, theropod dinosaur of Triassic age. It also appears to be the first assignable to either *Grallator* or *Anchisauripus* from the Newark group. Its designation as a manus is based upon its association with numerous imprints of the pes of both genera. Its assignment to the genus *Anchisauripus* is done solely upon the fact that it appears to be larger than what might be expected of the manus of *Grallator.* This concept is based upon trails figured by Hitchcock and others and observed specimens in various collections. That the manus is different from the pes is no surprise. In a number of dinosaur trails where prints of the fore feet are unquestionably associated with the hind, there may be little or no close similarity between the two (*cf.* Hitchcock, 1858). The reason for this difference and the possible use or uses to which the small manus was put are enigmatic.

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THE WATERS UNDER THE EARTH

Abstract of Presidential Address

R. W. Stone

It is raining or snowing somewhere on the earth's surface all the time, about 16,000,000 tons of water falling every second. Most of this huge quantity of water runs directly into the streams and so to the oceans. But a smaller part, depending on the rate of fall and the condition of the surface or soils, sinks into the earth where it becomes available to plants, or deeper into cracks, joints, and minute pores of the rocks, where it becomes ground water, the "waters under the earth." This is the water that comes from springs and seeps from the earth, keeping the streams running when there is no rain. This is the water that saturates the rocks below a level known as the water table, a level that conforms roughly with the surface and fluctuates with the seasons, depending on the amount of precipitation. It is the water supply that is tapped by wells, and on which most of our rural population and many communities, even cities, depend for their needs.

Water evaporated from the oceans is pure, leaving the salt behind, but falling through the atmosphere it picks up a little carbonic acid, and in filtering through the soil it acquires a trace of humic acid. Thus it becomes able, while moving slowly through the rocks seeking its level, to dissolve their more soluble constituents. In a pure silica sandstone it can dissolve little or nothing and remains soft; in limestone it picks up lime and becomes hard; in other rocks it may acquire enough iron to give it an objectionable taste or enough sulphur to give it an objectionable odor.

Many people seem to believe that water occurs beneath the surface in rivers, ponds, or pools of considerable extent. Some even would say there are underground lakes. In some localities in central and northern Pennsylvania one may be told that a sizeable local spring is fed by one of the Finger Lakes in New York, the informant not knowing that the spring is hundreds of feet higher above sea level than the reputed source, and that thousands of feet of impervious rock strata lie across such a course. Water does run in streams in rocks below the surface, but all these streams are above the main drainage level of the region and all of them are in limestone.

Limestone is soluble and ground water slowly percolating through it dissolves the more soluble rock along joints and bedding planes, thus forming open channels and caverns. Occasional wells in limestone pierce open channels filled with water. Those who have visited Penns Cave in Centre County will recall the boat ride on an underground stream. However, save for these open channels in limestone, ground water occurs for the most part saturating the minute voids between the grains composing the rock, or if the rock is impervious, then in the bedding planes, laminae, and joints and minute fractures in the rock. A well drilled in limestone will not yield water unless it encounters either abundant minute spaces or an open channel along which water can move.

That "the water under the earth" is abundant in some areas and moves freely in shown by the copious discharge of large

springs. Silver Spring issuing from limestone near Ocala, Florida, has a measured flow of 150 barrels a second. The water boiling up from many orifices in a circular pool 100 yards across and 30 feet deep unites to form a stream 60 feet wide and 12 feet deep. All this water is derived from rain (and, very exceptionally snow, as in January 1940) that has soaked into the ground and moved along many channels to the point of discharge.

The largest spring in Pennsylvania is small in comparison with the really big springs in the United States. It is at Boiling Springs, in Cumberland County 12 miles west of Harrisburg. Water emerges from limestone at several points within a radius of 100 yards. Some of the springs bubble up in a mill pond, others are feeders to that pond. All united have a discharge of about 5 barrels per second. The big springs at Newville and Bellefonte and all the large springs in Pennsylvania issue from limestone.

The size of underground bodies of water is misinterpreted by laymen perhaps because of the misuse of words by newspaper reporters and other writers. A reporter describing his first experience at subterranean exploration may speak of an abyss (really an unfathomable depth) when the reality is a drop of maybe 30 feet. He may mention an underground lake when a better word would be pool or bird-bath. The so-called lakes in three of our caves hold about as much water a bath-tub, not a swimming pool. Perhaps here is the place to repeat that most of the water under the earth is not in pools or rivers, but in minute pores and cracks in the rocks. The sum of the contents of the pores is enormous, and constitutes our greatest mineral resource.

An abundance of fresh water is of greater value to a region than beds of coal or veins of precious metals. Where to find water becomes a problem of vital importance in some regions, and on the solution of that problem may depend the settlement of an area and the character of its industries.

Most parts of Pennsylvania are well supplied with water, but with the increase in population the surface waters are more and more polluted by sewage and industrial wastes, and underground waters are being sought for municipal and industrial supplies as well as for domestic and farm use. Last fall some communities found their surface water supply so depleted by the prolonged drought that they are planning on augmenting it from wells to ground water.

In response to requests for help in finding ground water, the State Geological Survey undertook a study of our ground water resources in 1926, and completed the investigation in 1938. The field work was done by hydrologists of the Federal government working in cooperation with the State Survey. These men have no faith in the witch hazel stick or divining rod as a means of finding water, and devoted their attention rather to the collection of well records and the interpretation of the facts disclosed by those records when considered in connection with the character and structure of the rocks.

The six reports on ground water published to date cover the State. They discuss precipitation, the storage of water underground, the occurrence of water in different kinds of rocks, the selection of well sites, artesian conditions, chemical character of ground water, and the sequence and water-bearing properties of the rock strata. With all these data in hand the Geological Survey and the intelligent reader of the reports are in better position to consider water problems at specific spots, and with much more basis in fact, if less assurance, than the professional manipulator of the forked twig.

The waters under the earth are a heritage that should not be mistreated. The pumping of great quantities of fresh water from deep-lying gravels along Delaware River and elsewhere for cooling purposes and the wasting of the perfectly good, but slightly warmed water may not be good public policy. Heavy pumping may reduce the underground supply, lower the local water table, and in a few years take the water away from other wells.

Another matter of equal importance is the deliberate discharge of sewage underground in limestone regions. Knowing that in these regions there is greater underground circulation of water than in those underlain by other kinds of rocks, it is readily apparent that pollution may not be localized in a single undrained cavern but may be carried long distances and contaminate the source of water supply for many people.

Unlike our mineral fuels, coal, gas, and oil, our supply of ground water is more or less continuously replenished. Nevertheless, in periods of drought the water table sinks and many wells go dry. The answer to dry wells is deeper wells, an expense which many users can ill afford. With the hope of accumulating data to determine how deep wells should be to meet the drawdown in

protracted drought and still hold water, the Geological Survey has for years been recording the fluctuations of the water table in unused wells in many parts of the State.

The accumulation of data regarding ground water, and these protests against waste and pollution are all looking toward conservation. No longer do natural gas torches burn all day in farmers' yards. Thousands of dollars are being spent in extinguishing fires in coal mines that have been allowed to burn for decades. The time is already here when the flow of water from artesian wells is stopped save when needed, and the time approaches when the waters under the earth must be given more consideration.

Man does not appreciate the value and need of water until he has to do without it, for, in the words of the poet Byron:

> "Till taught by pain
> Men really know not what good water's worth."

MUSCOVITE AND GRAPHITE IN JASPER

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A small float block of jasper found near the southwest edge of Lehigh County about one mile southeast of Sigmund, Pennsylvania, contains flakes of muscovite and graphite. Inasmuch as the origin of the jasper occurring in the Reading Hills area is under discussion* this block is of interest even though the material was not observed in place.

In hand specimen the muscovite and graphite appear as small

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*Myers, P. B. (1934) The origin of jaspers in Lehigh and Northampton counties, Pennsylvania, Pa. Acad. Sci., Pr. vol. 8, p. 87-92.

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scaly particles a millimeter or two in diameter. They give the impression of being present as inclusions inherited from a former different rock type.

Under the microscope the brown jasper groundmass is composed of small grains of quartz, only a fraction of a millimeter in diameter. These are irregularly stained by iron hydroxide which is distributed throughout the specimen, chiefly as intergranular material, but in places as a replacement of the quartz. Small rhombohedrons are found scattered through the jasper. These are now usually made up of quartz aggregates but indicate the former presence of carbonate. Some of the larger quartz grains found as irregular veinlets or patches contain carbonate grains as inclusions.

In a number of places in the thin-sections, areas of several millimeters in diameter show intersecting fracture traces. These are made more conspicuous by the concentration of iron hydroxide along them. They occur in two sets that intersect at angles other than 90° and must indicate the cleavage planes of former large carbonate grains.

Muscovite grains under the microscope show partial replacement by the invading silica. It seems, however, that the solutions that attacked the muscovite did not transport the dissolved material far because small grains of muscovite (sericitic) are found in the jasper. In places these have developed a zone or partial zone of small scales around the larger grain of muscovite undergoing alteration, and in other places are scattered through the jasper. Graphite occurs as streaks and as scales when examined in section. For the most part it shows distortion and small folds are common. Quartz grains have formed bands in the graphite by crystallizing between and spreading the thin layers.

The coarse cleavage pattern inherited by the jasper indicates the replacement of a recrystallized limestone. The presence of graphite suggests an old recrystallized limestone, possibly an equivalent of the Franklin or Greenville. The muscovite too would indicate an old, probably pre-Cambrian limestone and not a Paleozoic type.

In total the evidence points to a pre-Cambrian recrystallized limestone as the replaced material. Such a limestone is known to occur in small amounts at the Seisholtzville iron mines about two miles west of the place where the specimen being discussed, was found.

lin limestone. Contemporaneous or later staining by iron hydroxide resulted in the present coloration. The writer has previously* presented evidence for the replacement of Hardyston quartzite by jasper. The origin from crystalline limestone, as discussed herein, indicates an additional source of jasper. It would seem unlikely that Paleozoic limestones were not replaced in places but proof of the widespread origin of jasper from any single type of original material is still wanting.

STRATIGRAPHY AND STRUCTURE OF GODFREY RIDGE

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Godfrey Ridge extends for ten miles in a NE-SW direction in southeastern Monroe County, Pennsylvania. Its northern end is delimited by Brodhead Creek which after flowing eastward along the northern foot of the ridge, cuts sharply SE through the ridge two and a half miles below Stroudsburg. Marshall Creek here joins Brodhead and together they enter the Delaware River a half mile farther downstream.

Basically, Godfrey Ridge is an anticline, rising to heights of 960′. A. T. with intervening gaps, and dividing into two rolls at its western limits. Here north of Saylorsburg, the anticline appears to die away against the eastern end of the Weir Mountain syncline. But J. P. Lesley[4] states that "it is carried southward four and a half miles to Saylorsburg in two anticlinal and synclinal zigzags, continuing as Cherry Ridge."

The structure of the ridge has never been adequately described, though both Henry D. Rogers[9] and I. C. White[12] give two sections across the ridge and mention the remarkable structures and vertical beds visible along the creek. Bradford Willard[16] gives a much more complete description of the eastern end of the ridge especially in details of stratigraphy, stratigraphic nomenclature, and paleontologic relations. He includes a section about two and a half miles west of the Brodhead gap but goes no farther westward.

STRATIGRAPHY

The oldest unit present in the sections is the Bossardsville limestone of Upper Silurian age. It is sometimes called Ribbon limestone

* op. cit.

It is concluded that this block of jasper containing flakes of musovite and graphite, and having a rhombohedral fracture system in places, was formed by the silica replacement of the Frank-from the peculiar banded appearance of the lowest twenty-five feet made by fine lines of lamination of different colors, gray, whitish, blue, etc. The upper or quarry portion, usually sixty to seventy feet thick, is dark blue to black with thin intersecting calcite veins running through it.

Chonetes jerseyensis, a small brachiopod is found in outcrops at the SE end of the ridge and is an excellent index fossil for the lower part of the Keyser limestone.

The next younger formation illustrated (on section #4) is the Coeymans limestone about 80 feet thick. It is the earliest unit of the Helderberg group, the Keyser limestone having been referred to the Silurian by F. M. Swartz.[15] The Coeymans, dominantly thick-bedded, gray, crystalline, and somewhat crinoidal, is very arenaceous and in part a calcareous sandstone here in Monroe County. *Gypidula coeymanensis* is plentiful and consistent through the beds.

Outcrops of the highest Helderberg (probably Port Ewen and Becraft in age) appear under the Oriskany at the east end of Godfrey Ridge.

In this section the Ridgeley formation (120 feet thick) of the Oriskany lies directly on the Helderberg, for there is no distinguishable Shriver present. The lowest Oriskany beds grade almost imperceptibly into calcareous new Scotland shales.[15]

More than three hundred feet of Esopus shales treated as the lower formation of the Onondage group[13] disconformably overlie the Oriskany.

The Buttermilk Falls limestone[15] (the old Corniferous and Onondaga limestone and renamed by Bradford Willard) is the upper cherty limestone member of the Onondaga group and grades downward into the Esopus shale. The limestone is named for Buttermilk Falls on Marshall Creek and its most characteristic development and maximum thickness of about two hundred feet is found here in Monroe County.

Other formational units than those described above are present and crop out in the region but these were not incorporated in the sections.

TABLE 1—STRATIGRAPHIC SUMMARY

			Thickness
Devonian	Onondaga Group	Buttermilk Falls	200′
		Esopus	316+′
	Disconformity		
	Oriskany Group	Ridgeley	120′
		Schriver	absent
	Helderberg Group	Becraft & Port Ewen	150′
		New Scotland	80′
		Coeymans	80+′
Silurian		Keyser (=Decker)	100±′
		Bossardsville (=Tonoloway)	100±′

The structure sections (Figure 1) are drawn at right angles to the strike and include the entire length of Godfrey Ridge from near Brodhead Creek gap (number one) to the Southwestern end near Bossardsville (number five).

Willard suggests that Brodhead Creek follows the line of a tear fault where it cuts a gap at the east end of Godfrey Ridge. On the eastern bank, the beds in regular order dip rather flatly to the NW. However, on the western side, the strata are definitely compressed by a push from the SE so that the beds have not only been shoved up into steep arches but have been overturned so that formations on the north slope of the ridge have a reverse dip to the SE. This overturning is most pronounced in the Buttermilk Falls, Esopus, and Oriskany beds at the eastern terminus of Godfrey Ridge.

This overturning of the strata is well shown by the sections 1 and 2 and can be seen to die out to the west in the succeeding sections, indicating a decrease in the compressive force in that direction.

Another factor well illustrated by these progressive diagrams is that the Esopus shale is actually the ridge maker and not the Oriskany sandstone as might be imagined. The Oriskany in this area is sandstone bound by calcareous cementing material which breaks down rather easily by solution and weathering so is not the strong, resistant rock as known in other regions.

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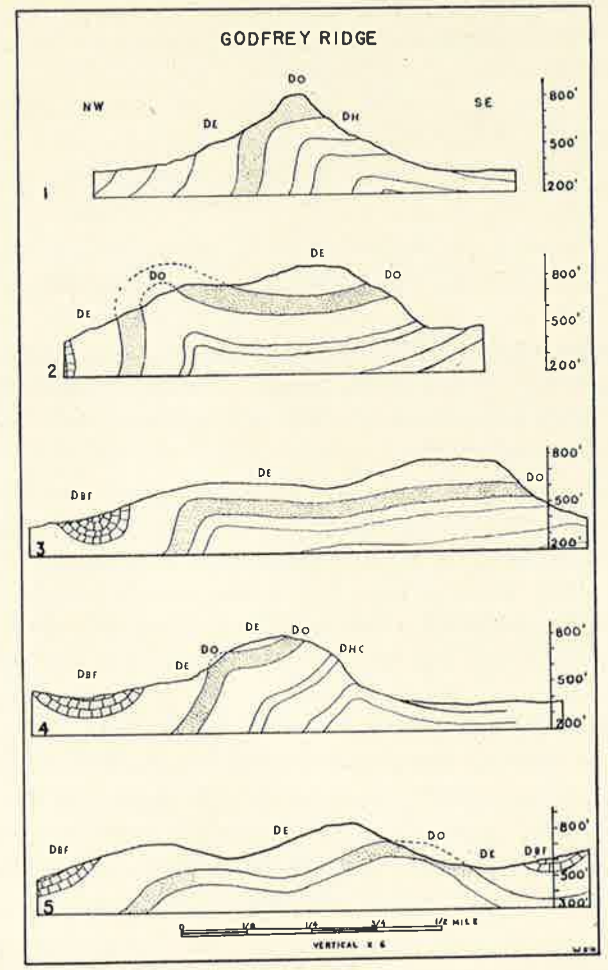
STRUCTURE



SYMBOLS

Dbf—Devonian, Buttermilk Falls ls. (Onondaga)
De —Devonian, Esopus sh.
Do —Devonian, Oriskany ss. (Ridgeley)
Dh —Devonian, Helderberg ls.
Dhc—Devonian, Coeymans ls.

Figure 1: Section 1—East end of Godfrey Ridge, one mile W. of Brodhead Creek Gap.
Section 2—One mile W. of Sect. 1.
Section 3—Foxtown Gap, one-half mile W. of Sect. 2.
Section 4—East of Stormville, three miles W. of Sect. 3.
Section 5—Bossardsville, two and one-half miles W. of Sect. 4.

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A KEY TO COMMON NON-OPAQUE HEAVY MINERALS OF THE EASTERN PENNSYLVANIA REGION

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In the course of the work leading to this paper the writers have examined 42 heavy mineral separations from the Wissahickon schist of eastern Pennsylvania, 17 from the gabbro and granite, 2 from serpentine, 8 from the "Baltimore gneiss" and the Mine Ridge uplift, 5 from the Reading Prong, 11 from the Paleozoic of eastern

Pennsylvania, 41 from the Triassic of Pennsylvania and New Jersey, 52 from various local soils, and 101 separations from the Coastal Plain of New Jersey and Maryland,—a total of 279. This listing shows more clearly than does the title the exact area of work.

A need for a more simplified key arose in teaching graduate students to recognize common heavy minerals. Winchell's tables, though widely employed for work with thin-sections, were found to be too full and complicated for heavy minerals. The tables of Milner and of Pettijohn, also, are too elaborate for the beginner, but it is our belief that their greatest weakness lies in the use of *color* as the fundamental criterion in identification. We believe that *shape* is the most important single character of heavy minerals, and that color is second in importance. One reason for this is that many minerals have so great a range of color that they are found in a number of places in a color table. Another is that the kind of microscope lamp used makes a difference in the apparent color, and added to this variable is the personal element in observing and, especially, in *naming* the color seen. Accordingly, we have drawn up table 1, which we consider to be the more important, on the basis of shape, and table 2, based on color. We have not combined the two for fear of making the resulting key too complicated.

For our definitions of shape, the reader should consult figure 1. Each grain in that figure has beside it a number and | or letter, which refers to that section of the shape table in which such a mineral grain should be sought. The minerals shown are, roughly from top to bottom, and left to right,—NW quadrant: pink zircon, biotite, staurolite, zircon, tourmaline, epidote, garnet, and sillimanite; in the NE: rutile, garnet, zircon, tourmaline, tourmaline, staurolite, chloritoid, and tremolite; in the SW: garnet, apatite, turmaline, titanite, kyanite, epidote, anatase, and hornblende; in the SE: zircon, kyanite, tourmaline, zircon, garnet, and sillimanite.

It should be noted in the tables that *index* has not been employed except in a minor way. In thin-section work, this value may be of paramount importance, but when the different mineral grains do not touch, there is no way of telling accurately their relative indices, and unless immersion methods are employed, there is no way of getting the absolute index of a grain closely enough to have that value of use in identification. Moreover, shape effects may make

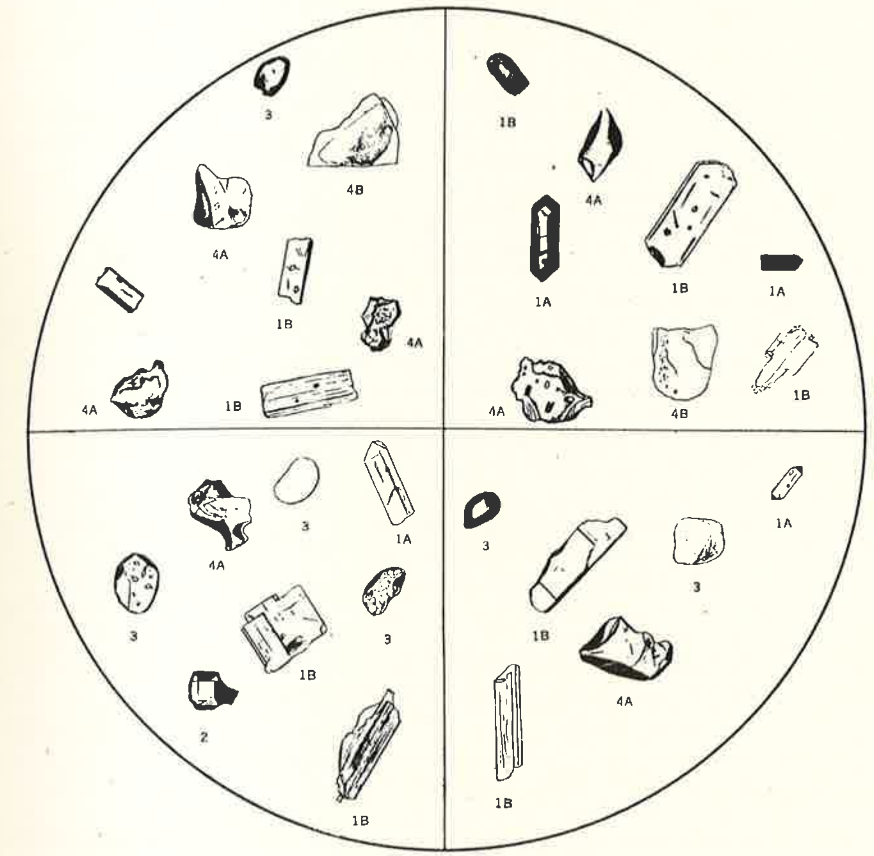

Figure 1

flat grains seem to have a low index, and rounded grains a high one (example, kyanite and rounded zircon).

It should be stressed that no more than local applicability is claimed for the tables, and even for this one area no attempt has been made to describe varietal characters of the different minerals. The writers are extremely interested in these varietal characters, and they hope to publish complete descriptions of them later. Meanwhile, they present these tables for the use of those familiar with optical mineralogy but not with heavy minerals, or for more experienced workers who are not acquainted with the heavy minerals of this area. Opinions as to the utility of the tables, or information which would improve them will be welcomed by the writers.

TABLE 1

SHAPES OF HEAVY MINERALS

1. PRISMATIC
   A. With good terminations
      RUTILE—(strongly colored, yellow or reddish brown; dark outline due to extremely high N)
      TOURMALINE—(strong pl. and absorption)
      ZIRCON—(very high biref.; dark outline due to high N)

   B. Without good terminations
      a. Parallel extinction
         Andalusite—(pl. rose to colorless; negative elongation)
         Anthophyllite—(off-center figure with large 2V; striated)
         Brookite—(very strong cross-dispersion; fails extinguish)
         Enstatite—(biref. low; like hypersthene but colorless)
         Epidote—(see 4A)
         HYPERSTHENE—(pl. pink or pinkish-brown to green)
         RUTILE—(strongly colored, yellow or reddish brown; dark outline due to extremely high N)
         SILLIMANITE—(high biref.; striations due to longitudinal "splitting"; flash figure)
         Staurolite—(see 4A)
         TOURMALINE—(strong pl. and absorption)
         ZIRCON—(very high biref.; dark outline due to high N)

      b. Inclined extinction
         Actinolite—(like hornblende but pale green)
         Aucite—(colorless or pale green; large extinction angle; positive 2V 50-60 deg.; off-center figure)
         HORNBLENDE—(pl. in shades of blue-green, green, brown, or yellow)
         KYANITE—(three good cleavages; gray, yellow, or blue first order interference colors)
         Tremolite—(like hornblende but colorless)

2. TABULAR (squarish)
   Anatase—(extremely high N; usually strongly colored blue or yellow)

3. ROUNDED
   Apatite—(oval to round; very low biref.; uniaxial negative figure)
   Epidote—(see 4A)
   Garnet—(see 4A)
   Staurolite—(see 4A)
   Titanite—(see 4A)
   TOURMALINE—(rounded grains are often basal, with weak pl. and uniaxial negative figure)
   ZIRCON—(round to "tear-drop" shape; dark outline due to high N)

4. IRREGULAR OUTLINE
   A. Uneven surface
      Apatite—(see 3)
      EPIDOTE—(colorless or pale yellow-green to green; slightly pl.; bright interference colors; non-pl. grains show "compass-needle" figure)
      GARNET—(isotropic)
      STAUROLITE—(pl. yellow to yellow-brown; patchy blue, yellow, green and red low order interference colors; grains with very low biref. and showing dispersion have "compass-needle" figure; such grains have very weak pl.)
      TITANITE—(strong dispersion; ultra-blue and yellow interference colors; small positive 2V)

   B. Micaceous habit (broad, flat surface; "flaky" appearance)
      BIOTITE—(brown or yellow-brown; small 2V)
      CHLORITE—(green; low biref.; figure variable)
      CHLORITOID—(pl. smoky-blue to green; low biref.; positive 2V 36-60 deg.)
      MUSCOVITE—(colorless; negative 2V 29-40 deg.)

(N is index of refraction; biref. is birefringence; pl. is pleochroism, or pleochroic; rare or less common occurrences are in small type.)

TABLE 2

COLOR AND PLEOCHROISM OF HEAVY MINERALS

I. COLORLESS
   Andalusite—(pl. colorless to rose; 1B)
   Anthophyllite—(1B)
   Apatite—(3; 4A)
   Augite—(1B)
   Enstatite—(1B)
   EPIDOTE—(3; 4A)
   GARNET—(isotropic; 3; 4A)
   KYANITE—(1B)
   MUSCOVITE—(4B)
   SILLIMANITE—(1B)
   TITANITE—(3; 4A)
   Tremolite—(1B)
   ZIRCON—(1A; 1B; 3)

II. YELLOW
   Anatase—(2)
   BIOTITE—(pl. weak in detrital biotite; 4B)
   Brookite—(1B)
   EPIDOTE—(yellowish-green; pl. weak; 3; 4A)
   Hornblende—(pl. in shades of blue-green, green, brown, or yellow; 1B)

RUTILE—(pl. weak; 1A; 1B)
STAUROLITE—(pl. yellow to brownish-yellow; 1B; 3; 4A)
TITANITE—(3; 4A)
TOURMALINE—(pl. X pale to dark yellow, Z yellowish-brown to black; X colorless, Z pale yellow; 1A; 1B; 3)

III. BROWN
BIOTITE—(pl. weak in detrital biotite; 4B)
Hornblende—(pl. in shades of blue-green, green, brown, or yellow; 1B)
RUTILE—(yellow or reddish-brown; pl. weak; 1A; 1B)
STAUROLITE—(pl. yellow to yellow-brown; 1B; 3; 4A)
TOURMALINE—(pl. X pale to dark yellow, Z yellowish-brown to black; X pinkish brown, Z black; 1A; 1B; 3)
Zircon—(rarely pl. in pink to brown; 1A; 1B; 3)

IV. GREEN
Actinolite—(pl. pale to darker green; 1B)
Augite—(pale green; 1B)
CHLORITE—(color varies; generally not pl.; 4B)
CHLORITOID—(pl. smoky blue to green; 4B)
EPIDOTE—(pl. weak; 3; 4A)
HORNBLENDE—(pl. in shades of blue-green, green, brown, or yellow; 1B)
HYPERSTHENE—(pl. pink or brownish-pink to green; 1B)
Tourmaline—(1A; 1B; 3)

V. BLUE
Anatase—(indigo blue; 2)
CHLORITOID—(pl. smoky-blue to green; 4B)
HORNBLENDE—(pl. in shades of blue-green, green, brown, or yellow; 1B)
Tourmaline—(1A; 1B; 3)

VI. PINK or RED
Andalusite—(pl. colorless to rose; 1B)
GARNET—(pale-pink, rose, salmon-pink, brownish-pink; isotropic; 3; 4A)
HYPERSTHENE—(pl. pink or brownish-pink to green; 1B)
RUTILE—(reddish-brown or "foxy"-red; pl. weak; 1A; 1B)
TOURMALINE—(pl. brownish-pink to black; 1A; 1B; 3)
Zircon—(rarely pl. in pink to brown; 1A; 1B; 3)

VII. MAUVE or VIOLET
Garnet—(4A)
Zircon—(1A; 1B; 3)

VIII. GRAY
Tourmaline—(pl. pale violet gray to blue, or pale gray to black; 1A; 1B; 3)

(pl. is pleochorism, or pleochroic; numbers and letters refer to the appropriate sections in table 1; rare or unusual occurrences are in small type.)

HEAVY MINERALS OF THE ORDOVICIAN-SILURIAN BOUNDARY IN CENTRAL PENNSYLVANIA

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The vexing problem of the Ordovician-Silurian boundary of Pennsylvania is particularly difficult to solve due to the lack of fossil evidence in the formations involved. These formations include, from bottom to top, the dark Oswego sandstone, the Juniata red beds, and the Tuscarora quartzite.

A detailed petrographic examination of these formations in several parts of Central Pennsylvania indicates a definite break, both in general petrology and character of heavy mineral assemblages, between the Juniata and Tuscarora formations and the absence of such a break between the Oswego and Juniata formations.

The present paper deals with a preliminary outline of the heavy minerals of these formations and especially with the heavy minerals of the section at the Susquehanna Gap near Harrisburg, Pennsylvania.

As shown by P. D. Krynine in the following paper the Paleozoic heavy minerals of Central Pennsylvania can be grouped into four distinct assemblages, namely, a crystalline suite, a Cambrian assemblage, a low-rank metamorphic suite, and a non-descript group. An application of this concept to the study of the formations of the Ordovician-Silurian boundary of Central Pennsylvania makes possible the differentiation of these formations.

MINERALOGY

The four fundamental heavy mineral assemblages of the formations of the Ordovician-Silurian boundary are made up of the following minerals:

A) CRYSTALLINE SUITE:

KYANITE: Colorless subrounded grains often surrounded by a cryptocrystalline micaceous material containing abundant inclusions, showing decomposition of the kyanite.

GARNET: Colorless irregular grains often showing "etched" surfaces. An occasional pink grain can be seen; also a dark variety crowded with dusty inclusions.

EPIDOTE: Lemon yellow to greenish yellow irregular grains, and one or two slivers of broken large yellow grains.

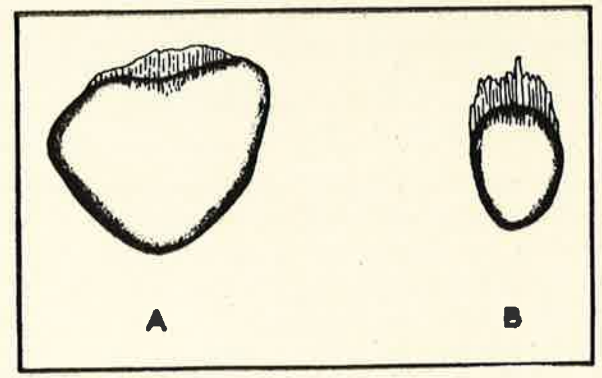

Fig. 1. Camera lucida drawing of authigenic overgrowth on rounded tourmaline grains. (A) represents abraded (broken and reworked) overgrowth in the Tuscarora whereas (B) is a primary untouched overgrowth in the Gatesburg (Upper Cambrian).

HORNBLENDE: Greenish blue to blue elongated cleavage flakes, strongly pleochroic, extinction averaging around 14°.

STAUROLITE: Golden yellow irregular grains showing the characteristic conchoidal fracture.

ZOISITE:? Irregular grains (rare) showing anomalous ultra blue birefringence.

TOURMALINE: Deep blue variety, irregular grains.

TOPAZ:? Irregular colorless grains showing prismatic cleav age and required optical properties, very rare.

B) CAMBRIAN ASSEMBLAGE:

This group of heavy minerals is characterized by grains of extreme roundness, both, the tourmaline and zircon being well rounded. The tourmaline has been divided into 13 tangible varieties based on color and types of inclusions and the zircon is divided into three groups on the basis of color. For a description of these 13 varieties the reader is referred to the following paper by P. D. Krynine.

The percentages of tourmaline in the 13 different varieties is remarkably similar to those found in Cambrian rocks[°], the only difference being in the nature of the authigenic overgrowths which show, in the Tuscarora, evidence of subsequent breaking and rounding.

The colorless authigenic portion of the grains are easily identified against the colored and pleochroic detrital grains. (Fig. 1).

These overgrowths consist of parallel fibrous crystals that are always in optical continuity with the original grain and nearly always occur on one end of the grain only. The indices of refraction of the overgrowths were determined by the oil immersion method and were found to be $^{n}e = 1.612 \pm 2$ and $^{n}o = 1.630 \pm 2$ which is unusually low and suggests a tourmaline rich in alkalies.

These overgrowths in the Gatesburg (Cambrian) are very prominent, some grains having over-growths two or three times the size of the original detrital grain. There is little doubt as to the authigenic origin of the overgrowths, because of the fragile nature of some of the grains. Subsequent reworking of these grains would result in breaking off of the overgrowths and, the tourmaline of the Tuscarora exhibits this feature. A large percentage of the tourmaline of the Tuscarora shows pitted surfaces on one end of the grain, these pits being scars of the broken off authigenic parts. In many cases (Fig. 1) small amounts of the overgrowths are preserved if they happened to occur on a grain where the original overgrowth grew in a protected indentation of the detrital tourmaline grain. Grains such as these are good evidence of the Cambrian source for much of the Tuscarora.

The zircon has been divided into three varieties, colorless, dark (nearly opaque), and pink.

D) METAMORPHIC SUITE:

Characterized by idiomorphic or angular fragmental grains showing little or no rounding. These may be divided into the following varieties:

TOURMALINE: a) Brown,-pleochroic from light brown to deep brown or reddish brown often showing fracture or parting lines; b) golden brown,-deep golden brown to yellowish brown; c) colorless,-colorless, occasionally slightly pleochroic to light brown, often containing numerous inclusions of bubbles and dark carbonaceous? material.

ZIRCON: Colorless, dark, and pink varieties were distinguished.

E) NON-DESCRIPT SUITE:

The following minerals may be included in this group: Apatite, rutile, fluorite, pyrite, and opaque "Iron Ores": magnetite, il-

[°]Thesis, Pennsylvania State College, 1939, O. F. Tuttle. Now in preparation for publication.

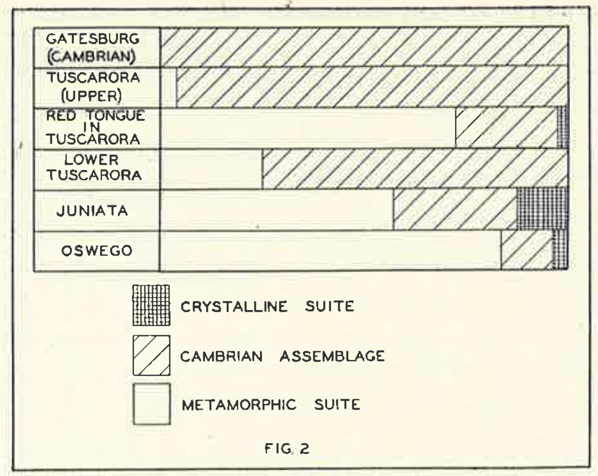

Fig. 2. Relative distribution of the different mineral assemblages in Cambrian, Ordovician, and Silurian formations. Diagram is graphic adaptation of exact frequencies counts on a percentage basis.

menite, leucoxene, limonite, and hematite. Some of the fluorite is opaque and appears black in transmitted light. It can be identified by the typical cleavage and its low index of refraction. Although the minerals of this group were present in all samples and were extremely variable in amount, their presence in large percentages (90 to 95%) when group "C" (Metamorphic Suite) became prominent is significant. When the Cambrian suite predominated the non-descript minerals became subordinate or almost non existant.

Stratigraphy and Conclusions

By dividing the heavy minerals of the formations of the Ordovician-Silurian boundary into the four groups mentioned before, the relative amounts of the different types can easily be computed within each formation. The rock types in the source area can also be inferred. This also leads, of course, to a differentiation between the different formations involved.

It was found that practically all diagnostic minerals are concentrated in the very fine sand fraction (0.125 - 0.062 mm. in diameter, i. e. the 230 mesh grade size) and this size was the one used exclusively for all quantitative determinations.

Figure 2 illustrates the relative amounts of the different heavy mineral assemblages in the Oswego, Juniata, and Tuscarora formations. Probably the distribution of rocks in the source area bears a certain relation, possibly a very close one to these figures. The "Metamorphic suite" probably represents slates, phyllites and possibly small amounts of mica schists. The "Crystalline group" represents higher rank metamorphics and possibly some igneous rocks. The "Cambrian assemblage" indicates a source area of Cambrian quartzites.

Hence, during Oswego time the source area was composed largely of slates and phyllites with small areas of crystalline rocks (possibly schists, igneous and contact metamorphic). This area changed but little throughout Oswego and Juniata time. At the beginning of Tuscarora time the character of the source area changed radically and the Cambrian quartzites became the predominent source for the detritus that was carried westward to form the Tuscarora.

Proof that the Tuscarora was derived from Cambrian source rocks lies in the well rounded tourmaline grains. Table 1 illustrates the similarity of the 13 varieties in the two formations and the abraded authigenic overgrowths (Fig. 1) are conclusive proof of the Cambrian origin of the Tuscarora.

The red tongues within the Tuscarora appear to be either locally reworked Juniata (most probable) or possibly final flare ups of declining isolated source area of red detritus (less probable).

This brief paper is an advance resume of a larger publication now in preparation. The writer wishes to express his sincere thanks to Dr. P. D. Krynine, of the Pennsylvania State College for suggesting the problem, and for helpful suggestions and criticisms. Thanks are also due Mr. Randall Jacobs for assistance in the laboratory.

TABLE 1

	I	II	111	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
GATESBURG	1	7	4	13	×	14	35	2	19	×	4	1	×
LOWER TUSCARORA	×	4	3	17	×	7	33	3	16	1	12	2	1
UPPER TUSCARORA	1	3	5	13	×	7	34	2	17	2	17	1	1

This table represents the frequencies (percentage distribution) of the 13 types of tourmaline in the Cambrian (Gatesburg) and the Lower Silurian (Tuscarora) formations. For a description of the types see preceding paper by P. D. Krynine.

× Indicates amounts less than one percent.

PALEOZOIC HEAVY MINERALS FROM CENTRAL PENNSYLVANIA AND THEIR RELATION TO APPALACHIAN STRUCTURE

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BASIC CONCEPTS. The examination of a series of samples of clastic sediments of Paleozoic Age from Central Pennsylvania shows that they contain four main types of heavy mineral assemblages.

1. *The first suite* consists of angular fragments of minerals typical of strongly metamorphosed or igneous rocks; garnet, hornblende, kyanite, staurolite, epidote, zoisite, augite, orthorhombic pyroxenes, topaz and blue and reddish tourmaline. The minerals occur as fragments rather than as entire grains and vary in size from 0.25 mm down to 0.04 mm in diameter, although much larger or much smaller pieces may occur occasionally. This suite will be referred to as the *crystalline group*, and, as readily seen, it could be subdivided into igneous, high rank dynamic metamorphic, contact metamorphic and pegmatitic subgroups. However such subdivision is impracticable because as a whole the crystalline suite is subordinate quantitatively, rarely exceeding ten per cent of the total of non-opaque heavies and is altogether missing in some specimens. The pegmatitic subgroups, characterized by the blue sodium tourmaline and by smaller amounts of a reddish tourmaline is quantitatively the most important.

The age of the source area responsible for the crystalline suite is complex, but apparently it falls mostly in the Pre-Cambrian or in the highly metamorphosed Cambrian, depending upon what age be assigned to the somewhat dubious crystalline rocks of Eastern Pennsylvania. Some of the pegmatites may be of later, Ordovician Age.

2. *The second assemblage* is composed of extremely well rounded grains of tourmaline and zircon. The size of the grains varies generally between 0.20 and 0.06 mm in diameter, although the zircons can be much larger, reaching in some instances 0.5 mm, and a few are smaller. The tourmaline is mostly concentrated in the very fine sand fraction (0.125 — 0.062 mm = i. e., the 230 mesh fraction). The zircons can be divided into three varieties: (a) a very distinctive purplish-pink shade, most common in the coarser sizes, although equally sharply visible in the smallest grains; (b) a yellowish shade, very uncommon and (c) a series of colorless varieties ranging from water clear to bluish gray or almost dark. These colorless varieties are the most common, although at some places the pink and purple zircons predominate. Most of the zircons show frosted surfaces.

The tourmaline can be divided into at least 13 tangible varieties, all of which can be easily and independently identified by any person moderately well acquainted with the use of the petrographic microscope. These varieties, based on six basic colors and the character of inclusions, are as follows:

Type I	Colorless tourmaline, containing inclusions.
Type II	Colorless tourmaline, without inclusions.
Type III	Colorless tourmaline, with an extremely faint yellowish pleochroism.
Type IV	Black, non pleochroic tourmaline, opaque, but gives good interference figures.
Type V	Brown tourmaline with rutile inclusions.
Type VI	Brown tourmaline of a typical GOLDEN ORANGE brown shade, which cannot be confused with any other shade of brown.
Type VII	Brown tourmaline with few inclusions.
Type VIII	Brown tourmaline with many inclusions. In practice there are almost no transitional gradations between Types VII and VIII.
Type IX	Green tourmaline with few inclusion, easily differentiated from:
Type X	Green tourmaline with many inclusions.
Type XI	Blue tourmaline, pleochroic in shades of mauve to blue.
Type XII	Blue tourmaline, weakly or non pleochroic in pale blue.
Type XIII	Varicolored tourmaline ("watermelon" variety) showing several colors in one grain, the most common one being half blue, half yellow.

At many places these rounded grains of tourmaline have developed authigenic overgrowths of a secondary colorless tourmaline. These striking overgrowths, which vary from long slender needles, frequently longer than the original grain itself, to well developed terminations, are in optical continuity with the grain and follow the direction of the c-axis. Such authigenic overgrowths have been discovered in the Cambrian, Ordovician, Silurian and Devonian. Primary authigenic overgrowths are extremely abundant in the Gatesburg formation (Upper Cambrian), in the Oriskany (Lower Devonian) and to some extent in the Tuscarora (Lower Silurian). The Oriskany occurrences have been reported previously by Stow. Reworked authigenic tourmaline, i. e., tourmaline showing authigenic overgrowths modified by abrasion is found in the

Bellefonte sandstone (Middle Ordovician), and in the Tuscarora, thus leaving little doubt that these formations consist to a large extent of reworked Cambrian sediments.

Statistical analysis and numerous frequency counts indicate that the relative percentages of the 13 rounded tourmaline types as established in the Cambrian (specifically in the Gatesburg formation) hold true with an astonishing degree of accuracy throughout the Paleozoic section, thus again indicating the Cambrian as the source of later sediments. Such computations are published in the following paper by O. F. Tuttle in an application of the principles of the present paper to the study of the Ordovician-Silurian boundary.

On the basis of this, and other evidence from the light fraction, it is concluded that the rounded tourmaline and zircon group is essentially of Cambrian derivation and will be referred to as the *Cambrian assemblage*. This suite recurs at many horizons and is the dominant one at several of them.

3. *The third suite* of heavy minerals consists of small idiomorphic grains or angular fragmental pieces of brown and green tourmaline and idiomorphic or fractured zircon grains of varying colors. From the general character of the sediments in which this assemblage occurs uncontaminated, i. e., practically with no admixture of suites (1) and (2), it is surmised that this assemblage characterizes a source area consisting of low rank metamorphic rocks: slates, phyllites and some mica schists. These metamorphic rocks apparently are the result of low dynamic or load metamorphism of shales with some very subordinate contact or hydrothermal action.

This assemblage will be referred to as the *metamorphic suite*. Chlorite, muscovite and biotite, although not generally considered as typically heavy minerals, can also be included in this suite. The non-opaques of the metamorphic suite generally do not occur by themselves, but are associated with large amounts of ilmenite, leucoxene and some magnetite from the next (fourth) mineral suite. This metamorphic suite predominates at most horizons of the Paleozoic.

The age of the source rocks which furnished this low rank metamorphic assemblage can be interpreted as being either: (1) Pre-Cambrian (or Cambrian!), or (2) Middle-Ordovician (for instance the Martinsburg shale). The second hypothesis involves the acceptance of the concept of a period of Middle or Upper Ordovician metamorphism (Taconic orogeny). Probably both of these sources contributed to the metamorphic suite but from the results of his work so far, the writer is inclined to favor the hypothesis that the bulk of the material which furnished the metamorphic assemblage came from low rank metamorphic rocks of Lower Ordovician age. This concept is tentative and subject to possible revision in the light of future detailed work.

4. *The fourth* and last mineral assemblage can be termed the *non-descript group* inasmuch as it includes minerals of variable paragenesis, or authigenic minerals, or minerals whose provenance is not clear as yet for Central Pennsylvania. This group consists of apatite (remarkably abundant at some horizons), rutile, anatase, fluorite, siderite, sphalerite, galena, pyrite, and the ubiquitous opaque minerals or "iron ores": magnetite, ilmenite, leucoxene, hematite and limonite.

Among these minerals anatase, fluorite, sphalerite, galena, pyrite and part of the iron oxides are authigenic, the others are allogenic.

Although the minerals of the non-descript group are difficult to interpret, nevertheless they are at many places quite valuable for empirical correlation and differentation of strata.

STRATIGRAPHIC AND STRUCTURAL APPLICATIONS.

The interpretation of the four heavy mineral suites outlined above, reinforced by the examination of several hundred thin sections, leads to the conclusion that the Paleozoic Rocks of Central and Western Pennsylvania consist essentially of a mixture of reworked Cambrian and Middle Ordovicion sediments with a slight admixture of Pre-Cambrian material. The bulk of the Pre-Cambrian apparently was already incorporated directly into the Cambrian and Lower Ordovician strata.

The original Cambrian quartzitic series ionsist of Pre-Cambrian detritus in the form of rounded grains formed in the beaches and shore dunes which swept across the gigantic Pre-Cambrian peneplain and supplied once and for all the material out of which all the subsequent Paleozoic quartzites were made. The frequently advocated theory of recurrent large peneplanation, enormous dunes and deserts said to have been necessary to produce the quartzites and glass sands of the Silurian and Devonian appears to be untenable inasmuch as each of these quartzites is only the reworked remnant of an older one.

This re-emergence of the old Cambrian sediments as a large scale source area of more modern beds is seen very well in the Ordovician-Silurian boundary, a problem discussed by O. F. Tuttle in a paper which is the companion to the present paper.

The Paleozoic orogenic pulsations which brought into the zone of erosions at recurrent intervals either Cambrian quartzites or Lower Ordovician slates, or (rarely!) small Pre-Cambrian areas were probably divers in origin. These pulsations may have manifested themselves as reversible tilting, or travelling folds (as in the Dutch East Indies) or most probably a combination of both. These pulsations, contemporary with the filling of the Appalachian trough further west, took place in Eastern Pennsylvania. These folds are gone, but the products of their activity,—the Paleozoic strata of Central and Western Pennsylvania are still here. A detailed petrographic study in the West should be of considerable help in understanding the structure and paleogeography of the East. In a series of detailed papers, now nearing completion and covering the Paleozoic from the Cambrian to the Pennsylvanian the writer and his associates hope to attempt such a study.

The writer is grateful for splendid assistance in the field and laboratory over the period of the last two years to Mr. O. F. Tuttle, of The Pennsylvania State College, and for assistance at other times to Messrs. Randall Jacobs, Jr., and J. M. Kellberg, also of The Pennsylvania State College and Mr. M. R. Klepper, now of Yale University.

A CROSS-SYNCLINAL STRUCTURE NEAR LOCK HAVEN, PENNSYLVANIA[1]

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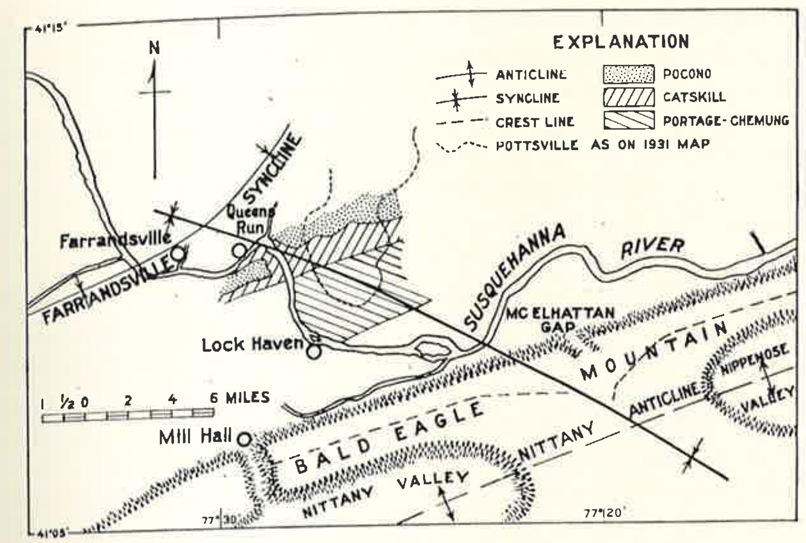
During the fall of 1939 the writer had occasion to map the areal geology in the vicinity of Lock Haven in Clinton County, Pennsylvania. As a result of this mapping, a small revision in the geologic map of Pennsylvania (1931) can be made. On the State geologic map the Pottsville conglomerate series of Lower Pennsylvanian age extends southward as a large spur just north of Lock

[1]Published by permission of the State Geologist.



Haven. (See fig. 1.) This area has been mapped by the author as the Chemung, Portage, Catskill, and Pocono formations, completely replacing the Pottsville series which does not appear south and east of Queens Run.

STRUCTURE

MAJOR STRUCTURAL FEATURES

The main structure of the region is the Nittany anticline, the axis of which trends approximately N. 70° E. This is the broadest anticline of the folded Appalachian province in Pennsylvania and the last prominent structure as one approaches the Applachian Plateau. Erosion has exposed the Ordovicion Salona-Coburn limestone[2] along the axis in Nittany and Nippenose Valleys, and formations up to Mississippian age are exposed on its flanks. The resistant Oswego and Tuscarora sandstones form Bald Eagle Mountain on the anticline's north flank. The anticline plunges toward the northeast at the east end of Nittany Valley and is domed through Nippenose Valley, creating a structural saddle between the two valleys. This saddle is caused by a synclinal cross-fold.

About nine miles northwest of the Nittany anticline the Farrandsville syncline trends about N. 70° E. and toward the northeast changes its course to about N. 45° E. This structure, also

[2]Whitcomb, Lawrence, Correlation of Ordovician limestone at Salona, Clinton County, Pennsylvania: Penna. Topo. and Geol. Survey Bull. G-5, 1932.

called the Snowshoe or Ramseyville syncline, is a gentle depression in the Appalachian Plateau with dips of three to five degrees on its flanks. Near Farrandsville (fig. 1) the Pottsville series crops out along the axis only 300 feet above the river, rising higher and higher along the axis both northeast and southwest of this place. Hence, this is another structural saddle, also indicating a synclinal cross-fold.

Cross-Structure

The major cross-folds of the folded Appalachian province trend at right angles, or nearly so, to the regular structures of the province[3]. Because of this, the author plotted a synclinal axis through the saddle between Nittany and Nippenose Valleys and at right angles to the anticline in order to study the relation of this structure to other features in the region. It was found that the plotted syncline did not satisfy certain of the features in the region.

A syncline crossing north-dipping strata at right angles would create a deflection in the trend of the crest formed by those strata which would be symmetrical on both sides. A simple experiment performed by folding a pack of cards held at an angle illustrates this principle. The crest of Bald Eagle Mountain is not deflected in this manner; instead, there is a gentle deflection of the crest on the west side of McElhattan Gap and a sharper deflection on the east side of the gap (fig. 1). This anomalous relationship may be seen on the topographic map and is strikingly visible in the field. Further, a similar trend may be noted in the curved northern flanks of Nittany and Nippenose Valleys, the former being gentle, the latter being sharper.

If the syncline plotted at right angles to Nittany anticline were extended to intersect the Farrandsville syncline at the north, it would cross that structure eight to ten miles northeast of Farrandsville, a considerable distance from the structural saddle and at a place where the Pottsville series crops out relatively high on the axis and is still rising toward the northeast. It seems certain, therefore, that a cross-syncline through the saddle of Nittany anticline at right angles to that structure does not satisfy the existing conditions.

As a matter of experiment, a cross-syncline was plotted oblique to the folded Appalachian province in such a way that it passed

[3]Keith, Arthur, Outlines of Appalachian structure: Geol. Soc. Am. Bull., vol. 34, pp. 326-328, 1923.

through the structural saddles of both the Nittany anticline and the Farrandsville syncline. This cross-structure, it was found, adequately explains the topographic and structural features of the region. Experiments, with a pack of cards again, show that an oblique structure crossing north-dipping strata would deflect the crest formed by those strata: gently on one side of the cross-structure, more sharply on the other side. This is exactly the relation shown by the crest trends of Bald Eagle Mountain at McElhattan Gap. In addition, this cross-syncline would satisfy the gentle curve along the north flank of Nittany Valley and the sharper curve on the north flank of Nippenose Valley.

The extent of this cross-syncline, as far as known, is 14 miles from the structural saddle at Farrandsville to the saddle south of McElhattan Gap. (Fig. 1.) Sufficient field work has not been done to determine how much farther in either direction it may extend.

Hypothesis Concerning Cross-Structure

Two questions are naturally raised if we accept the existence of such a structure: When was it formed, especially with what time relation to the Appalachian folds, and what was the direction and origin of the deforming stress?

The writer is not prepared to answer either question. However, it is his opinion that mere statement-of-existence in a scientific paper has little value if there is no attempt to answer the WHYS and WHENS and other questions that accompany the statement-of-existence. A few suggestions may be offered, then, that may throw light upon the questions, bearing in mind that they are suggestions and nothing more.

The direction of the stress which crumpled the thick Paleozoic sediments into the folded Appalachians moved from the southeast toward the northwest. In view of the abundant evidence and experimental work, few would disagree with this statement. The northwestward-moving stress was able to push the sediments farther to the northwest in some places than in others due to differential resistance[4]. One of these places is the Pennsylvania salient where the folds of the Appalachian system sweep north and west in a great arc.

The force was dissipated as it moved toward the northwest, "building" fold after fold. Each fold that was made may have ser-

[4]Keith, op cit, pp. 313, 314.

ved as a buttress against further advance of the stress toward the northwest. If this was so, the Nittany anticline probably acted as a giant buttress and may have caused an already much-dissipated stress operating through the Pennsylvania salient to "turn aside."

The greatest line of relief for a stress moving toward the northwest, next to a vertical line, would be parallel to the newly made folds, northeast-southwest. It seems likely that a new relief-seeking stress may have been developed, moving in such a direction that its components were the original line of force toward the northwest, and the line of relief toward the northeast. If this is so, any folds that the "new" stress would create would trend in a general direction like the described cross-syncline. Also if this is so, the age of the cross-syncline would be later than the Appalachian folds, but it would be part of the same period of deformation.

REVISION OF THE CONCEPT OF UNIFORMITARIANISM

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The last century in geology has witnessed a complete repudiation of the doctrine of catastrophism, which dominated geologic thought in the early days of the science. Cuvier and many other pioneers in earth-science were imbued with the concept that geologic changes were wrought by world-shaking catastrophies, exceeding in violence anything we experience at the present day. Cuvier pictured these catastrophies as being in the nature of vast floods which engulfed the lands, destroying life and altering landscapes. After each cataclysm new forms of life arose, and the physical surface of the earth presented a changed aspect.

When Hutton and Playfair demonstrated that valleys are cut by the streams which occupy them, and that valley formation is still going on, they gave the death blow to catastrophism as an all-embracing geologic philosophy. The new school of thought, founded on the early studies of Hutton, was later developed and elaborated by Lyell as the principle of uniformitarianism. Lyell maintained that changes of the earth and its inhabitants in the remote past are explicable in terms of the same processes now operative, and that there has been a uniformity in the *nature* and *energy* of geologic processes throughout geologic time.

Uniformitarianism has consciously or unconsciously become

inculcated into the thinking of almost all modern geologists. It does appear than an increment of change measured in the present multiplied by the vast stretches of time available in the past is sufficient to explain even the most profound and revolutionary geologic events. The broad principle thus delineated is unquestionably valid, but supplementary concepts have become attached to uniformitarianism, which are unwarranted and in many instances prejudicial to unbiased geologic interpretation.

Three aspects of the over-expansion of the main principle are worthy of consideration. (1) Uniformitarianism, as enunciated by Lyell and accepted by many modern geologists, precludes the operation of processes or the occurrence of events in the past which are not represented in the modern geologic scene. (2) The assumption is made that the strength of geologic forces operative in the past has always been of the same order of magnitude as now observable. (3) In the revulsion from the manifestly unsound tenets of catastrophism, many uniformitarians have slipped into the equally dangerous viewpoint that catastrophic events even on a reduced scale are unimportant in the geologic scheme. The first two of these doctrines need but brief discussion, the third will be considered at greater length.

I. NATURE OF GEOLOGIC PROCESSES

There is an overwhelming tendency on the part of the geologic fraternity to be ultra-conservative, whenever agencies are suggested which transcend our experience in our present surroundings. This state of mind is undoubtedly the safer one in that it causes us to reject immediately many extravagant theories, but it may cause us at the same time to reject a few revolutionary concepts which time will prove to be as well-founded as were Hutton's unconventional views on the origin of valleys. Two dangers are immediately encountered when our experience in the present is permitted to dictate the acceptance or the rejection of new ideas. We assume first that our experience in studying the operation of geologic processes in the modern scene has progressed to the extent that we recognize all the major changes which are taking place, obviously an unwarranted assumption. We assume further that all the geologic processes which have operated in the past are still in operation today, which can by no means be demonstrated as a law of nature. The most notable exception which passes unchallenged is the highly spectacular and catastrophic origin we ascribe to the solar system by disruption of the sun by a passing star. There may be other equally startling exceptions which future research will reveal. Advanced students of geology spend much time painfully unlearning many theories which have been mistakenly interpreted as laws in their beginning days. Many other theories are still accepted by most advanced students as though they were laws which had been amply demonstrated, as for example the theory of isostasy, or the theory of the essential immutability of continents and ocean basins.

The popular expression of the doctrine of uniformitarianism that "the present is the key to the past," places this doctrine in the category of a highly questionable theory. It is suggested that the doctrine be reworded to state that *the present is a clue to the past*, which will then permit us to accept uniformitarianism as a law without the embarrassment of admitting the existence of or possibility of exceptions to the law.

II. Strength of Geologic Processes

The second respect in which the principle of uniformitarianism, as enunciated by Lyell, operates to the detriment of geology lies in the acceptance of the statement that there has been a uniformity in the energy with which geologic processes have operated throughout geologic time. This would imply not only that the present moment in earth history represents a norm in geologic activity for all geologic time, but also that there have been only minor deviations from that norm. This is so obviously inadmissible on the basis of our present knowledge of the geologic past as to require no elucidation. For example, the erosion and transportation of terrestrial material must have proceeded at a greatly accelerated rate in Pre-Cambrian and lower Paleozoic time before the development of land plants to furnish a protective covering of vegetation. Extreme caution is therefore necessary in extrapolating from quantitative measurements in the limited geologic present to quantitative conclusions in the vast geologic past. Here again the present must be accepted only as a clue to the past, not as the key to the past.

III. Limited Geologic Catastrophies

A third unfortunate development of the theory of uniformitarianism arises as the result of the violence with which catastrophism was finally rejected. When the inadequacy of catastrophism to explain all geologic phenomena became apparent, the pendulum swung to the opposite extreme and geologists tended to discount the importance of any geologic processes of a catastrophic nature. There is still a tendency among most modern geologists to minimize the effects produced by geologic catastrophies, even though they be minor compared with those Cuvier envisaged, in favor of the results produced by small but inexorable forces continuously operative. This tendency is no doubt reinforced by the obligation geologists feel to disillusion the layman, the newspaper reporter and the elementary student of the lurid ideas with which most of them approach the science. The truth lies in the middle ground between the two extremes. In some geologic processes, catastrophic events are important in altering landscapes. Changes produced during the infrequent and brief operation of forces at their peak of violence may far outweigh the cumulative effect produced by small forces continuously operative. The only difference between catastrophies of this type and those of Cuvier is that the former are limited in areal scope, and rarely if ever produce worldwide changes. Examples from a number of different types of geologic processes will illustrate the nature and importance of *limited geologic catastrophies*.

It is well known that the power of waves and currents is increased many fold during times of storm. This is true to such a degree that one severe storm may radically alter or completely destroy bars and beaches which have been slowly built up during years of normal marine activity. The undermining of sea-cliffs is not only at a maximum during storms but the amount of work accomplished during a few days of severe storm may exceed that accomplished during months of average conditions.

Between 1931 and 1938 the off-shore bar of southern Long Island presented a seaward front interrupted by only one inlet. During the hurricane of September 21, 1938, the bar was breached in eleven places by the unprecedented waves accompanying that storm. Material carried over the bar by waves and through the newly formed inlets by currents built fans and deltas into the lagoon behind, and produced a crenulate shoreline which still persists on the lagoonal side of the bar. Great difficulty was experienced in artificially closing the new inlets formed by the storm[1]. Many other

[1] Arthur D. Howard: Hurricane Modification of the Offshore Bar of Long Island, New York. The Geographical Review, Vol. XXIX, No. 3, 1939, pp. 400-415.

cases might be sighted to illustrate the potency of storm waves and currents for accomplishing both constructional and destructional geological work. Three only will be mentioned, in each of which no work whatever is accomplished by the waves except at times of catastrophic violence. (a) The first of these is the erosion, transportation and deposition as the result of wave action in water exceeding the depth which may be agitated by normal waves. At the maximum this is not in excess of 100 feet. Storm waves are capable of disturbing fine sediments to depths as great as 600 feet[2], so that the considerable amount of work accomplished by waves at depths between 100 and 600 feet may be taken as being entirely the result of storm waves. (b) Many sea cliffs have the nip at the base of the cliff above high tide level, so that they are not reached at all by normal waves. They nevertheless retreat under the active attack by storm waves which are able to cross the gently sloping protective platform and hurl themselves at the base of the cliff with a vigor only slightly diminished. (c) The third instance is of a comparatively rare type of wave which is always regarded as catastrophic. This is a wave formed by a submarine earthquake, called a tsunami, or more commonly a tidal wave. The capacity of tsunamis for destruction along low lying coasts is well known to all.

The work of streams displays a similar tendency toward long periods of normal activity on a small scale interspersed with short periods of violent activity. Table I shows the order of increase of flood discharge over average discharge for four large rivers. Using the Youghiogheny and Susquehanna Rivers as examples, it may be seen that large rivers in humid regions are subject to annual floods in which the discharge increases to several times the normal. They are subject to occasional floods in which the discharge may increase as much as 35 times the normal. Considering the Green and Columbia Rivers as examples, it appears that large rivers flowing across semi-arid regions are not subject to such extreme increases in flood discharge. If records were available for small streams in semi-arid regions, and especially for intermittent streams, the ratio of flood discharge to average discharge would increase to figures far above the ratios for humid regions.

In a general way the larger the discharge of a stream, the

[2]Douglas Johnson: Shore Processes and Shoreline Development. Pg. 81. Wiley, 1919.

TABLE I

River	Ratio of smallest annual flood to average discharge	No. of floods with discharge more than 10 times average	No. of floods with discharge more than 20 times average	No. of floods with discharge more than 30 times average	Discharge ratio of greatest flood
Youghiogheny River Connellsville, Pa. 1891-1936	6.0	71	3	2	37.4
Susquehanna River Harrisburg, Pa. 1875-1936	4.2	13	2	0	21.3
Green River Greenriver, Utah 1895-1934	2.6	0	0	0	9.5
Columbia River The Dalles, Ore. 1858-1934	1.4	0	0	0	5.8

greater is its capacity for doing work. The load-carrying capacity cannot be measured, however, in terms of discharge, but depends rather on the bed velocity of the stream. Rubey[4] states that the unit width load of a stream, free to pick up much sand and gravel, will vary roughly as the third power of the bed velocity. Thus an increase in bed velocity of two times would enlarge the load carrying capacity eight times. The ratio of increase in bed velocity with increasing discharge will vary with different streams, depending on the slope, shape of channel, depth of water and nature of load. Thus the figures in Table I for flood discharge cannot be translated

[4]W. W. Rubey: The Force Required to Move Particles on a Stream Bed. U. S. G. S. Prof. Paper. 189 E, 1937. P. 139.

directly into measurements of the increase in erosive or of transporting power.

A description of the results produced by flooded streams at different stages in their life cycle and under different environmental conditions will indicate, however, the geologic changes which may be wrought by streams swollen to many times their normal size. Considering first initial slope wash and gullying, major changes are produced almost entirely during brief periods of exceptionally hard rain. In the hurricane of September, 1938, Bennett[5] reports that damage in New England ranged all the way from deep gullying to the removal of an inch of topsoil from entire fields. "On one farm, typical of hundreds in the Connecticut Valley and adjacent areas, about an inch of topsoil was swept more or less cleanly from a seven acre field. This and the soil removed by gullying possibly amounted together to more than 1000 tons." In young streams with steep gradient much of the load is so coarse that it cannot be moved by the normal hydraulic force of the water, and consequently young streams are greatly underloaded. In times of flood, however, the increase in velocity permits extremely large boulders to be rolled along, thrown against each other and broken, and so transported downstream and also reduced to a more convenient size for further transportation. The load carrying capacity of young streams is increased by floods more than of mature streams, because a young stream is confined to a narrow channel. Increase in the amount of water supplied must be accommodated by a rise in water level which results in increased velocity at the same slope.

In the case of mature streams, when the rise in water level is sufficient for the stream to leave its banks it spreads out over a vastly increased area with consequent loss in velocity. There may be deposition rather than erosion unless the flood is sufficiently great to give a considerable depth of water and consequent velocity over the entire flood plain. At the same time there is greatly increased velocity and consequent erosion of the stream bed and banks by the waters which remain within the main channel. Because flood plain deposits are usually unconsolidated and because the area of flooding is far greater, the results produced by floods in

[5]Hugh Hammond Bennett: A Permanent Loss to New England—Soil Erosion Resulting from the Hurricane. Geographical Review, Vol. XXIX, No. 2, pp. 199 and 200.

mature streams are much more apparent than in young streams. Besides the erosion of the banks and both erosion of and deposition on the floodplain, the cutting-off of meanders and changes in stream courses are usually accomplished during floods. Judging from the action of the Mississippi it would appear that many meanders are cut off by flood waters escaping from the channel across the neck of the meander before actual intercision takes place.

In semi-arid and arid regions where streams are at very low ebb or completely dry except following rains, the erosion and transportation accomplished by streams take place almost entirely during brief periods of flood. Most of the annual rainfall is concentrated in a few torrential storms, in which the proportion of runoff is extremely high and the geologic work accomplished is proportionally greater than for the same amount of precipitation in humid regions.

The process of erosion and transportation by wind is largely catastrophic in nature, in that practically no results are produced until wind velocity has increased to a figure far above normal. The geologic work accomplished during the brief duration of a sand storm will far outweigh the results produced by normal wind velocities in all the intervening time since the last previous sand storm. The same might be said for dust storms, from which the agricultural sections of the great plains now suffer, and which in the geologic past produced extensive loess deposits.

Other geologic processes which are infrequent and catastrophic in operation are volcanic eruptions and earthquakes. In the geologic past the former have produced extensive deposits of igneous rock and the latter have probably been the accompaniment of all faulting. Cavern collapse to form sink holes and karst topography, and landslides are additional examples. Even with such a process as frost action, it seems probable that more wedging and fracturing of rocks is accomplished during a severe ice storm such as northern New Jersey and southern New York experienced on March 3-4, 1940 than during months of normal winter weather.

The theory of organic evolution could not have developed until catastrophism was disproved. It is now known, however, that new species arise through mutations which are infrequent in occurrence rather than as the result of continuous operation of the environment to change the genes of heredity. The discovery that x-ray and cosmic ray bombardment will accelerate the frequency with which mutations appear, would seem to indicate that the birth of a new species is the result of a changing of the genes within the chromosomes under the influence of collision with the particles of some form of radiation. Considered in this light the appearance of a new character is a catastrophic event, the result of a bombardment which is normally completely ineffectual but at rare intervals operates to produce changes in the factors of inheritance. This is tempered by the control exercised by the environment in determining whether the mutant will survive to breed and thus perpetuate the change.

Most of the geologic processes which go on beneath the surface of the earth, such as fusion of rocks and regional metamorphism, are essentially non-catastrophic even in the restricted sense used in this paper. Other geologic processes which operate at or near the surface, such as chemical weathering and glaciation, are likewise non-catastrophic. Evidence has been adduced, however, to demonstrate that a considerable measure of the geologic work accomplished in the alteration of the earth's surface features is the result of infrequently occurring natural events operating with devastating force for short intervals of time. Nothing in Lyell's concept of uniformitarianism precludes the operation of natural catastrophies on a limited scale. Their importance in the geologic scheme has been underestimated because of the conservative tendency of geologists to avoid the spectacular and to explain phenomena of the geologic past in terms of *every day* experience in the present. It is not possible to estimate what proportion of surficial geologic change is the result of limited natural catastrophies, but the sum total is believed to be large.

Conclusions

The underlying philosophy of uniformitarianism is fundamentally sound, but the interpretation of the principle by Lyell and by most modern geologists is dangerously rigid and confining. It seems quite possible that geologic processes have operated in the past, which are unknown or inoperative in the modern scene. It is highly probable that they have operated at times in the past with a potency and at a rate quite at variance with their modern quantitative characteristics. With these factors in mind the suggestion is made that uniformitarianism be redefined to state that *the present is a clue to the past* rather than *the key to the past.* Finally the rejection of the all inclusive concept of catastrophism should not obscure the significance of limited geologic catastrophies. The effects produced by limited catastrophies are important in the operation of many geologic processes. In some types of geologic processes they may even be dominant over the cumulative effects produced by the normal smaller forces which operate continuously.

THE AMES LIMESTONE OF WESTERN PENNSYLVANIA

DAVID M. SEAMAN

Carnegie Museum

The Ames limestone is found almost half way between the top and the bottom of the Conemaugh series of the Pennsylvania period in western Pennsylvania. The Conemaugh is about six hundred feet thick in the vicinity of Pittsburgh. It is underlain by the Allegheny and Pottsville series and overlain by the Monongahela series. The Pittsburgh Coal marks the top of the Conemaugh series and the Upper Freeport Coal the bottom. The Monongahela series crops out only near the tops of the highest hills in the Pittsburgh region, while the Conemaugh beds are extensively exposed. The Allegheny and Pottsville series do not appear at the surface in the Pittsburgh district.

The Ames is a hard, grayish-green limestone averaging from two to four feet in thickness. It is the most important stratum for collecting fossils of Pennsylvanian age in western Pennsylvania. More than eighty species have been found in it. The limestone layer is very persistent and has been traced from western Pennsylvania, west into Ohio, and south into West Virginia and Maryland.

The fauna of the Ames limestone has been little studied in western Pennsylvania since Doctor P. E. Raymond worked in this area from about 1907 to 1911. Only a few incomplete lists of fossils from the Ames limestone have been published in recent years.

The recent work of Doctor Carl O. Dunbar and G. E. Condra on the Pennsylvanian brachiopods in Nebraska, and of A. K. Miller, Dunbar and Condra on the nautiloid cephalopods of the Pennsylvanian series in the mid-continent region, necessitates the re-identification and correction of many of the genera and species of these two groups in western Pennsylvania. The work of Doctor J. B. Knight on various groups of the gastropods of the Pennsylvanian outlier in Missouri, necessitates the same changes in this group also. Very little study has been made of the other groups of invertebrate fossils of the Pennsylvanian period in western Pennsylvania and they will remain unchanged in this paper.

The writer is indebted to Doctor Carl O. Dunbar, of Yale University, to whom a collection of local Pennsylvanian brachiopods was sent some time ago, for his kindness in identifying several species.

Through the kindness of Doctor I. P. Tolmachoff and Mr. E. R. Eller, of the Carnegie Museum, the writer was given the privilege to study the material in the Pennsylvanian collections of the museum, in the preparation of the following list. The material on which this list is based is to be found in either the collections of the Carnegie Museum or in the writer's personal collection. Some thirty-five localities were studied in the preparation of the faunal list.

Ames Limestone Faunal List

c common r rare

Coelenterata

Lophophyllum profundum (M, E, & Haime)	c
Cyathaxonia? distorta? (Worthen)	r

Bryozoa

Fistulipora nodulifera (Meek)	r
Septopora biserialis (Swallow)	r
Rhombopora lepidendroides (Meek)	r

Brachiopoda

Orbiculoidea capuliformis (McChesney)	r
Derbya bennetti? (Hall & Clarke)	r
D. robusta? (Hall)	r
Chonetes granulifer (Owen)	c
Linoproductus aff, platyumbonus (D & C)	c
L. prattenianus (Norwood & Pratten)	r
Marginifera wabashensis (N. & P.)	c
Composita subtilita (Hall)	c
C. ovata (Mather)	r
Orbiculoidea missouriensis (Shumard)	r
Crania modesta (White & St. John)	r
Cancrinella boonensis (Swallow)	r
Derbya crassa (Meek & Hayden)	c
Chonetes aff. chouteauensis (Mather)	r
Squamalaria perplexa (McChesney)	r
Dictyoclostus portlockianus (D&C)	c
Neospirifer triplicatus (Hall)	c
Hustedia mormoni (Marcou)	c
Rhipidomella carbonaria (Swallow)	c
Ambocoelia planoconvexa (Shumard)	c
Punctospirifer kentuckyensis (Shumard)	r
Enteletes hemiplicatus plattsburgensis (Newell)	r
Dielasma bovidens (Morton)	r
Wellerella osagensis (Swallow)	c
W. tetrahedra (Dunbar & Condra)	c
W. n. sp.	r
Cleiothyridina orbicularis (McChesney)	r
Juresania nebrascensis (Owen)	c

Gastropoda

Phanerotrema grayvillensis (N. & P.)	c
Pharkidonatus percarinatus (Conrad)	c
Patellostium montfortianum (N. & P.)	c
Orthonychia parva (Swallow)	r
Bellerophon stevensianus (McChesney)	r
Phymatopleura nodosa (Girty)	r
Loxonema scitulum (Whitfield)	r
Trepospira depressa (Cox)	r
Worthenia? tabulata? (Conrad)	r
Euphemites carbonarius (Cox)	c
Straparollus cattiloides (Conrad)	r
Soleniscus primogenius (Conrad)	c
S. paludiniformis (Hall)	c
Pleurotomaria carbonaria (N. & P.)	r

Pelecypoda

Edmondia aspenwallensis (Meek)	r
Anthraconeilo? taffiana? (Girty)	r
Parallelodon obsoletus (Meek)	r
Pseudomonotis hawni (Meek & Hayden)	r
Astartella concentrica (Conrad)	r
A. vera (Hall)	c
Eumicrotis? sp.	r
Nucula wewokana (Girty)	r
Yoldia glabra? (Beede & Rogers)	r
Pinna? peracuta? (Shumard)	r
Deltopecten occidentalis (Shumard)	r
Allorisma subcuneatum (Meek & Hayden)	r
Solenomya? trapezoides? (Meek)	r
Nuculopsis ventricosus (Hall)	r

Cephalopoda

Pseudorthoceras knoxense (McChesney)	c
Mooreoceras sp.	r
Temnocheilus winslowi (Meek & Worthen)	r
Tainoceras monilifer (M., D., & C.)	c
Metacoceras (Temnocheilus) crassus (Hyatt)	r

Amphineura

Glaphurochiton carbonarius (Stevens)	r
Chiton? sp.	r

Crinoidea

Hydreinocrinus sp.	r
Delocrinus hemisphericus (Shumard)	c
D. allegheniensis (Burke)	r
Ulocrinus sp.	r
Delocrinus craigi (Worthen)	r

Vermes

Serpulopsis insita (White)	r

Porifera?

Borings in crinoid column type A (Burke)	r

Trilobata

Griffithides? scitula? (Meek)	r

Pices

Deltodus angularis (Newberry & Worthen)	r
Fissodus inaequalis (St. John & Worthen)	r
Peripristis semicircularis (Newberry & Worthen)	r
Agassizodus virginianus (St. John & Worthen)	r
Petalodus ohioensis (Safford)	c
Cladodus occidentalis (Leidy)	r
Agassizodus variabilis (St. John & Worthen)	r

The brachiopods are the dominant group in the Ames limestone of western Pennsylvania. Certain characteristic brachiopods have been found in abundance wherever the Ames crops out and are sufficient to identify this limestone. These are Ambocoelia planoconvexa (Shumard), Chonetes granulifer (Owen), and Derbya crassa (Meek & Hayden). In addition, Hustedia mormoni (Marcou), Rhipidomella carbonaria (Swallow), and several species of the genus Wellerella are also generally present. They are all very rare in any of the fossil-bearing horizons below the Ames limestone in Pennsylvania.

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SOME EGG PARASITES OF OECANTHUS QUADRIPUNCTATUS BEUT. AND OF A SPECIES OF ORCHELIMUM[1]

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In the course of investigations on the parasites of the hessian fly (*Phytophaga destructor* (Say) conducted at Carlisle, Pa., it was thought that some of the parasites might have hosts other than the hessian fly. To check this possibility a project was undertaken to rear various insects which in some stage of their development resembled the hessian fly puparium. Notable among the insects investigated was the four spotted tree cricket (*Oecanthus quadripunctatus* Beut.), the eggs of which were found in abundance in the stems of wild carrot or Queen Anne's lace (*Daucus carota* L.). A total of 5,849 eggs of this species were reared from various localities in Pennsylvania, Virginia, and North Carolina, and 9 species of parasites were obtained from them. These parasites are as follows:

Cacellus oecanthi (Riley)	(Serphoidea, Scelionidae)
Leptoteleia oecanthi (Riley)	(Serphoidea, Scelionidae)
Polynema bifasciatipenne Girault	(Chalcidoide, Mymaridae)
Tetrastichus oecanthivorus var. compar Gahan	(Chalcidoide, Eulophidae)
Tetrastichus sp.	(Chalcidoide, Eulophidae)
Eupelmus allynii French	(Chalcidoide, Eupelmidae)
Eupelmus, n. sp.	(Chalcidoide, Eupelmidae)
Eurytoma sp.	(Chalcidoide, Eurytomidae)
Macrorileya oecanthi Ashmead	(Chalcidoide, Eurytomidae)

Eggs of *Orchelimum*, the specific identity of which is undetermined, were also collected, though less abundantly, from the stems of *Daucus carota*. From the 153 eggs reared from localities in Pennsylvania and Virginia four species of parasites were obtained. One was identified as Eupelminus sp. and the other three were new. These parasites are as follows:

Eupelmus, n. sp.	(Chalcidoidea, Eupelmidae)
Tumidiscapus orchelimumis Gahan	(Chalcidoidea, Aphelinidae)
Eupelminus sp.	(Chalcidoidea, Eupelmidae)
Macroteleia, n. sp.	(Serphoidea, Scelionidae)

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[1]Read at the 1939 meeting of the Pennsylvania Academy of Science.

[2]Acknowledgment is due C. C. Hill, under whose direction this work was carried out, for aid in collecting, rearing, and identifying some of the material.

Casual observation of the stems of *Daucus carota* in the field readily revealed the egg punctures of both orthopterons discussed in this paper. The egg punctures of *Oecanthus quadripunctatus* were small, uniform and deposited in a row more or less parallel with the stem. The average number of egg punctures in each row was eight although there was considerable variation. Several such rows could be found on the same plant and even on the same stem. *Orchelimum*, on the other hand, did not lay eggs in rows, but more often singly, and these punctures were characterized by a definite

Table 1.—The distribution and abundance of the parasites of the eggs of *Oecanthus quadripunctatus.*

Localities	Number of samples	Number of eggs	Parasites reared: Cacellus oecanthi	Tetrastichus oecanthivorus var. compar	Polnema bifasciatipenne	Eupelmus allynii	Leptoteleia oecanthi	Macrorileya oecanthi	Tetrastichus sp.	Eupelmus, n. sp.	Eurytoma sp.
Pennsylvania											
Carlisle	9	1,132	75	3	4	7			1	1	
Lewistown	1	63	5			1					
Mt. Holly Springs	6	1,121	63	38	1	2					
Boiling Springs	2	1,288	48	11	8	7	7				
Washington	3	118				1	4		1		
Duncannon	1	337				1					
Honey Brook	1	80					1				
Hickorytown	1	346	2	4		2					
Totals	24	4,485	193	56	13	21	12	0	2	1	0
Virginia											
Gretna	2	245			13	3					1
Ashland	1	9	3		1						
Warrenton	1	97			5		4				
Montross	1	376	5		17			2			
Marion	1	229	19		1	5		3	1		
Christiansburg	1	152		No parasites emerged							
Woodstock	1	202				2			4		
North Carolina											
Salisbury	1	19			3						
Raleigh	1	7						1			
Guilford College	1	28		No parasites emerged							
Totals	11	1,364	27	0	40	10	4	6	5	0	1

Table 2.—The distribution and abundance of the parasites of the eggs of *Orchelimum* sp.

Locality	Number of samples	Number of eggs	Parasites: Eupelmus, n. sp.	Tumidiscapus orchelimumis	Macroteleia, n. sp.	Eupelmus sp.
Pennsylvania						
Carlisle	4	39	11	12	1	
Mt. Holly Springs	3	52	9		4	2
Wagner's Gap	1	4		28		
Total	8	95	20	40	5	2
Virginia						
Montross	1	28	7	19	1	0

roughened area caused by the gnawing of the stem at the point selected for oviposition by the adult. Stems containing these egg punctures were brought into the laboratory, where they were cut into sections to fit homeopathic vials, the open ends of which were plugged with cotton and inserted into holes bored into a plaster of paris block. This block was kept moist to maintain a constant source of humidity. Accurate records were kept of the number of egg punctures and the emergencies from them. The parasites that issued from this material were identified by C. F. W. Meusebeck and A. B. Gahan, of the Division of Insect Identification of the Bureau of Entomology and Plant Quarantine.

The distribution and abundance of the parasites are tabulated in the following tables according to localities.

Cacellus oecanthi was the predominant parasite of *Oecanthus quadripunctatus* in Pennsylvania (table 1), but was less important in Virginia. No specimens emerged from the North Carolina material. *Tetrastichus oecanthirorus* variety *compar* was second in abundance in Pennsylvania, but was not obtained from any material collected in the two southern States, although a species of *Tetrastichus* was obtained from Virginia. *Polynema bifasciatipenne* was the major parasite in North Carolina and Virginia and was found in much less abundance in Pennsylvania. *Leptoteleia oecanthi* and *Eupelmus allynii* were reared in small numbers from all three States, whereas *Macrorileya oecanthi* was reared only from Virginia and North Carolina. A single specimen of *Eurytoma* sp. was reared from Virginia and a single specimen of *Eupelmus*, n. sp. was reared from Pennsylvania.

Tumidiscapus orchelimumis was the predominant parasite reared from eggs of *Orchelimum* sp. (table 2). With the exception of two specimens of *Eupelminus* sp. reared from Pennsylvania the remaining three parasites were common to Pennsylvania and Virginia.

Eupelmus allynii was the only species parasitic on the hessian fly that was reared from the eggs of the two orthopterons.

BIOLOGICAL GENERALIZATIONS APPEARING IN SECONDARY TEXTS PUBLISHED BETWEEN 1800 AND 1933

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The purpose of this study was to trace the appearance and nature of the outstanding biological generalizations in secondary school science textbooks from 1800 to 1933. An analysis was made of the changes in conceptions held by the various authors in chronological order, and their effect on the content of biological textbooks used in the secondary schools in the United States during that period.

No study has been made to show the development of the generalizations of biology and their treatment in biological textbooks written during that period. Such a study, therefore, is a contribution to the history of education and to biological science.

Fifty-four textbooks covering the period from 1800 to 1933, inclusive, were selected to be analyzed in this study. An examination of the content of these books led the writer to believe that all of them have been used as texts, or as collateral reading in secondary schools, some time during that period.

The technique was that of enumerating the various generalizations that seemed to have some bearing upon the content of biological texts used in secondary schools in the United States in recent times.

The study is designed to show concisely when these principles and generalizations originated and the approximate time thereafter that they were introduced into the texts of this nature. An attempt was also made to ascertain what the various authors thought of them as content material of value to biological science.

The study traces the changes in biological generalizations in the following order:

Chapter II. Theories on the Origin of Life.
III. The Cell Theory.
IV. The Germ Theory of Disease.
V. The Concept of Anatomy.
VI. The Concept of Health.
VII. The Concept of Heredity.
VIII. The Thtory of Evolution.
IX. Taxonomy.

Each chapter was divided into three periods that seemed to show marked changes in the type of content found in the textbooks. These periods comprise the years from 1800 to 1850; 1851 to 1900; and from 1901 to 1933, inclusive.

The data of this study warrant making certain generalizations. Some of the more important ones follow:

1. Development of Biology as a Subject

This study showed that prior to 1900 there were four distinct branches of biological science. These branches were known as Natural History, Zoology, Botany and Physiology. After the beginning of the twentieth century all of these separate branches were combined into one which was called Biology. This unified study included several new divisions: namely, Embryology, Protozoology, Bacteriology, Entomology, etc., that have resulted from the more intensified studies of the original fields.

2. Development of Biological Theories and Generalizations

The development of the teaching of biological science in the secondary schools in the United States moved slowly. The early biological textbook writers showed little interest in scientifically formulated theories or discoveries that opposed deepseated established opinions or superstitious beliefs. Such opinions and beliefs caused many scientific theories to be kept out of the textbooks for many years until these theories were finally accepted and included in textbook material of secondary level. The originator of a biological theory seldom lived to see his work fully accepted by writers of contemporary textbooks.

On the other hand, textbook writers seemed willing to present in their books any new discovery of biological science that they thought would be generally accepted by the public.

Abiogenesis, ran through the texts as an accepted fact until the latter part of the nineteenth century when it began to disappear from the content. The vanishing of this generalization was caused by the gradual acceptance, by textbook writers, of the Germ Theory. It was definitely replaced in the content of the textbooks by the theory of Biogenesis when the work of such men as Wolff and Pasteur was wholly accepted by 1910 as valuable information for children of secondary school age.

The theory of Epigenesis was of a nature that made it acceptable to secondary school textbook writers as early as 1851. Metagenesis was also given credence by these writers at the early date. It may be presumed that neither of these latter theories conflicted with any existing belief or practice of that period.

The cell theory was talked about since Hooke discovered the "Little Box" in 1665, but was not formulated until the work of Schleiden and Schwann in 1838-9. This work did not get into the secondary school textbooks, however, until after Mohl discovered the protoplasmic content of the cell in 1846.

The laws of heredity, first formulated by Gregor Mendel about 1860, did not appear in texts until after their rediscovery in 1900 by DeVries and others. The theory of evolution, published by Charles Darwin in 1858, had little acceptance in secondary school books until after 1900 when the weight of evidence made this theory acceptable to secondary science.

It was found that many of the practices involved in the programs of health in the present secondary school curriculum are merely revisions and re-introductions of ideas that were taught nearly a century ago in the same type of school.

3. The Relation of Scientific Methods to Scientific Findings

The nature of the content in more recent texts showed that there was a positive relationship between the development of scientific methods and the scientific findings.

The later texts showed also that the development of the X-ray, the high powered microscope, and other laboratory equipment have

improved the scientific technique of research in the field of finer anatomy. These texts showed further that the conclusions of the later scientists regarding life processes were based upon actual findings rather than upon the rough calculations resulting from mere observations made by the naked eye.

The more scientific methods of research brought the general acceptance, by these textbook writers, of the Cell and Germ Theories in 1846 and 1910 respectively. The discoveries relating to the cell were shown by these writers to come in chronological sequence —first the cell itself, next the protoplasmic content, then the tissue, and lastly, the organ.

The writers also showed how the later methods of experimentation revealed that the influences of environment have replaced many of the older ideas regarding predisposed diseases. The texts also showed that the principles of heredity have been applied to the lower animals and to plants to a greater extent than to the improvement of man; thus keeping too largely Euthenics and Eugenics as unappreciated branches of biological sciences.

Finally the study shows how every new thought was gradually added to the content of the textbooks while any prevailing beliefs that failed to stand the test of scientific investigation, were dropped.

RESPONSE OF THE IMMATURE FEMALE CAT UTERUS TO ESTRADIOL BENZOATE (ESTRONE)

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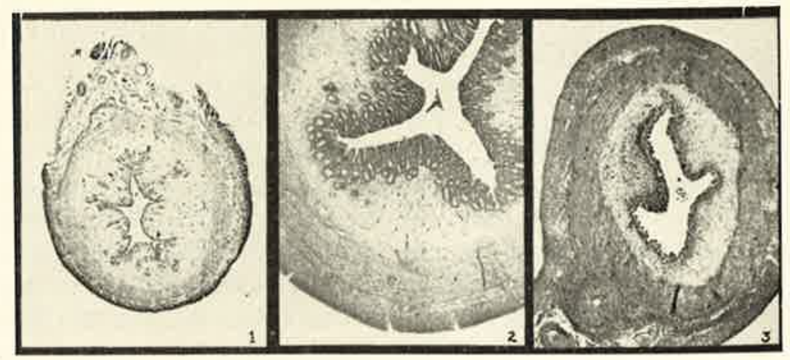
The state of uterine stimulation, in immature female cats, has been found to parallel closely the condition of the ovary following the administration of gonadotropic extracts [1], [2], [3]. In previous investigations, we have found that in several animals injected with a normal male urine extract the ovaries showed only a mild stimulation of the follicles, but the uterine endometrium had been stimulated to a proestrous or estrous type [3]. It was of interest to investigate the effect of several dosages of estrogen (follicular hormone) on the endometrium, and also to consider the response in relation to the period of administration. Rowlands and McPhail[4] injected three immature cats with estradiol and obtained a good endometrial reaction (estrous type) in two of these animals.



PLATE

Fig. 1. Normal immature cat uterus.

Fig. 2. Uterus of immature cat following injection of 100 r. u. estradiol benzoate daily for 14 days.

Fig. 3. Uterus of immature cat following injection of 2000 r. u. estradiol benzoate for 5 days.

MATERIAL AND METHODS

Twenty immature female cats ranging from 5 to 13 weeks of age were used in these experiments. The body weights of these animals varied from 340 to 810 grams. Fifteen animals were injected intramuscularly with estradiol benzoate (Progynon-B*) and 5 served as litter mate controls in the groups in which they were employed. The cats were either sacrificed the day following cessation of treatment or the animal was operated and a portion of the uterus removed. The operated animals were sacrificed 9 or 10 days later. Ovarian weights were taken at autopsy. Histological sections of the ovaries, uteri, and vaginae were prepared.

RESULTS AND DISCUSSION

Seven immature female cats were injected with 100 rat units (0.0166 mg.) of estradiol benzoate daily for a period of five to fourteen days. After 5 or 6 injections there was only a suggestion of stimulation in the endometrium as indicated by an increase in the number of crypt glands around the lumen of the uterus, but they were without depth. The endometrial glands extended well into the endometrium (proestrous type) after 9 or 10 injections

* Estradiol benzoate (Progynon-B) was generously supplied through the courtesy of Dr. Max Gilbert of the Schering Corporation.

whereas when injections were continued for 14 days an estrous type of endometrium was observed. Hypertrophy of the myometrium was observed in all cases.

A portion of the uterus was removed from two cats after 6 and 9 daily injections of 100 rat units of estradiol benzoate. A mild stimulation was observed with the shorter treatment whereas a good reaction was evident in the latter cases. The hormone was discontinued and the cats were killed 9 and 10 days later respectively. The endometrium was virtually depleted of glands in the cat which had shown only a slight reaction whereas little regression of the endometrial glands had occurred in the cat which had shown good stimulation.

Three animals, all litter mates, were injected with 100 rat units daily for 13 days and were sacrificed on day fifteen. An estrous type of endometrium was observed in one animal but the stimulation was not identical with that of normal estrous. The endometrium of the other animals was only slightly hypertrophied although the glands had increased in number and depth.

Two cats were injected with 1000 rat units of estradiol benzoate daily and three cats received 1000 rat units twice daily for five days, all animals being killed on the sixth day. In spite of the large dose, in no case had the uterine endometrium reached an estrous development. Only one cat had a proestrous endometrium while the others exhibited a fringe of crypt glands around the lumen which extended only a slight distance into the endometrium.

Rowlands and McPhail[4] reported obtaining good stimulation of the endometrium (estrous type) in two immature cats with estradiol, one of which was treated for only five days. In our experiments, a proestrous endometrium was observed in only one of seven cats treated with this hormone for a five day period, although as much as 2000 rat units was administered daily. Vaginal cornification occurred more readily than did uterine stimulation. A marked hypertrophy of the vaginal mucosa was observed after five days treatment with all dosages used.

Ovarian weights of experimental and litter mate control animals showed no significant differences and the ovaries appeared to be unaffected histologically. Follicles, with or without antrum, were present in the absence of abnormal degeneration. No corpora lutea were observed.

Summary

The effect of estradiol benzoate on the uterus of 15 immature female cats was considered in comparison with five litter mate control animals. Treatment for five day periods resulted in slight endometrial stimulation of the proestrous type whereas an estrous endometrium could be induced when injections were continued for 10 to 15 days. Large amounts of this hormone administered in 5 days failed to induce an estrous type of endometrium. The ovaries were not affected.

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THE AMPHIBIANS OF BLAIR COUNTY

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Blair County is situated nearly in the center of the state. The county is very irregular in shape and has a total area of 594 square miles. A large portion of the county is mountainous. The drainage is of the Susquehanna basin.

The records for the amphibians of the county were obtained between 1936 and 1939. The specimens were collected as soon as the appearance was noted in the spring and collections were made both day and night throughout the year. I am indebted to Dr. A. H. Wright, of Cornell University, and Mr. M. Graham Netting, of the Carnegie Museum, for the identification of certain specimens.

Records of amphibians not found in Blair County as yet, but listed from neighboring counties have been included in several cases where there may be a possibility of its discovery later.

Salamanders

1. *Necturus maculosus* (Rafinesque). Mudpuppy; Waterdog.
This species is most common in the Ohio drainage. It has been reported by fishermen from the Frankstown Branch of the Juniata River in the vicinity of Reese.

2. *Cryptobranchus alleganiensis* (Daudin). Hellbender.
This species has been found in streams of the Ohio drainage and has reached the Susquehanna drainage by stream capture. As yet I have not collected it, but have included it in the list as it may be found in the Frankstown Branch of the Juniata River.

3. *Triturus viridescens viridescens* (Rafinesque). Newt; Evet; Eft.
This seems to be the commonest salamander in the county and has been found in all parts.

4. *Ambystoma jeffersonianum* (Green). Jefferson's Salamander.
This species has been reported from Bedford county to the south and possibly will be recorded for Blair County.

5. *Ambystoma maculatum* (Shaw). Spotted Salamander.
This species is fairly common at Reese along the Frankstown Branch of the Juniata River and also in Homer Gap.

6. *Ambystoma opacum* (Gravenhorst). Marbled Salamander.
I have collected one specimen from Centre County at Voneida State Park and believe that it will eventually be found in Blair County.

7. *Desmognathus fuscus fuscus* (Rafinesque). Dusky Salamander.
Common. Specimens have been taken from nearly every part of the county.

8. *Desmognathus ochrophaeus ochrophaeus* (Cope). Mountain Salamander.
It is fairly abundant in Homer's, Riggles and Bells Gaps.

9. *Desmognathus phoca* (Matthes). Seal Salamander.
This species has been recorded from Clearfield County and may be found in Blair County.

10. *Plethodon cinereus* (Green). Redbacked Salamander.
Although this species has been reported from 54 counties it has not been recorded for Blair County. I feel certain that it is present.

11. *Plethodon glutinosus* (Green). Slimy Salamander.
This species seems to be the commonest terrestrial salamander in the county. Collections have been made at Sproul, Reese, Homer Gap, Riggles Gap, Sugar Run between Riggles and Bells Gaps, Bells and Tipton Gaps. In all of these places it has been numerous.

12. *Plethodon richmondi* Netting and Mittleman. Ravine Salamander.
Specimens have been taken from under stones and small logs in the vicinity of Sproul, along the Frankstown Branch east of Hollidaysburg, Homer and Riggles Gaps. The first specimen collected in 1939 was on April 7th.

13. *Gyrinophilus porphyriticus porphyriticus* (Green). Purple Salamander.
Specimens have been taken from Brush Mountain, Homer's, Riggles and Tipton Gaps.

14. *Pseudotriton ruber ruber* (Sonnini). Common Red Salamander.
Collections have been made from Sinking Valley, Homer's, Riggles and Bells Gaps.

15. *Eurycea bislineata bislineata* (Green). Two-lined Salamander.
I have collected this species from Riggles and Tipton Gaps under small stones and logs along the water.

16. *Eurycea longicauda longicauda* (Green). Long-tailed Salamander.
This species is fairly common in parts of the County. Collections have been from Bells Gap, Homer Gap, Sproul, and Reese.

Toads and Frogs

17. *Bufo americanus americanus* (Holbrook). American Toad.
Collections have been made in fields along the Frankstown Branch of the Juniata River. The first appearance in 1939 was on the night of April 5th, in some rain pools near Reese.
18. *Bufo fowleri* Hinckley. Fowler's Toad.
This species has been found to be an inhabitant of fields and gardens along with *B. americanus*.
19. *Pseudacris brachyphona* (Cope). Mountain Chorus Frog.
Egg masses were collected from a conical hole about two feet deep in the vicinity of Reightown on April 22, 1939. On the evening of June 30, 1939 a single specimen was collected from a ditch in a field adjacent to the highway between Homer and Riggles Gaps.
20. *Pseudacris nigrata feriarum* (Baird). Eastern Chorus Frog.
This species has been recorded from Huntingdon county and may be found in Blair.
21. *Hyla crucifer* Wied. Spring-peeper.
Collections were made in pools in Juniata Gap during the evening of March 3, 1939. Specimens have also been taken from Eldorado and near Reese.
22. *Hyla versicolor versicolor* (LeConte). Common Tree Toad.
I have heard the call of this species but have not been able to collect it.
23. *Rana catesbeiana* Shaw. The Bullfrog.
This species is common along the Frankstown Branch of the Juniata River.
24. *Rana clamitans* Latreille. Green Frog.
Collections have been made from Arch Spring and from along the Frankstown Branch of the Juniata River.
25. *Rana palustris* LeConte. Pickerel Frog.
Specimens have been collected from along the Frankstown Branch, Brush Mountain, Wopsononock, Sandy Run and Tipton.
26. *Rana pipiens* Schreber. Leopard Frog.
Collections have been made in Homer's Gap and near Reese where it is common.
27. *Rana sylvatica sylvatica* (LeConte). Wood Frog.
Specimens have been taken in Juniata Gap, Wopsononock, Sugar Run between Riggles and Bells Gaps, and at Reese along the Frankstown Branch.

A COLOR VARIANT OF SARCINA SP.

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A lemon-yellow Sarcina was isolated from air and maintained in a stock culture collection for over a year. During a routine test for growth under anaerobic conditions the Sarcina grew readily but produced no pigment. Transfers from this growth kept under

aerobic conditions yielded variants that produced yellow pigment to a lesser degree than the original. A sector of one of the less pigmented yellow variants gradually became pink. In poured plates material from this pink area produced pure yellow and pure pink colonies with an occasional partly pink, partly yellow colony. At this time also an occasional colony became greenish yellow but

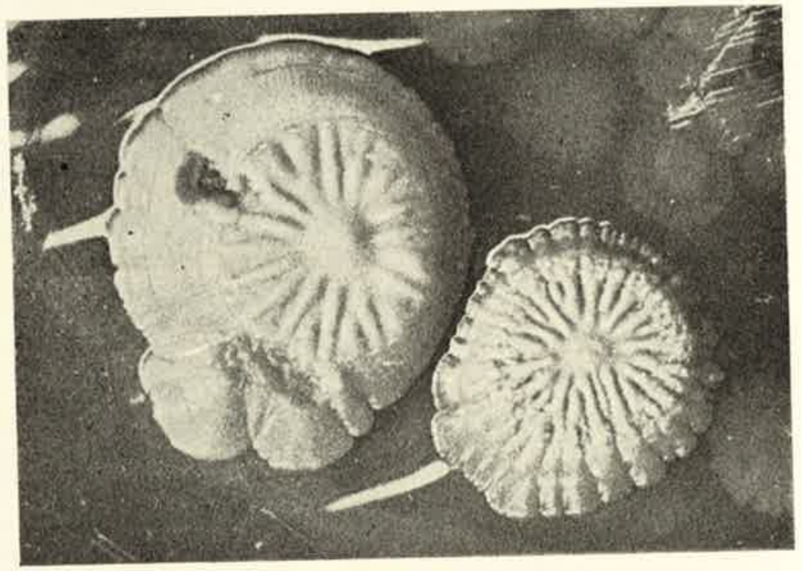

Figure 1—Colonies of yellow isolate of *Sarcina sp.*—2 weeks old. Note rugose surface and fringe of smooth growth on colony to left.

this type always lost its greenish hue after a few transfers. The pink isolate has not reverted to the yellow type in twelve months of cultivation on various culture media. Neither has the yellow again yielded any pink though it has since been grown anaerobically and treated in other ways thought to favor variation.

A comparative study has been made of the original yellow strain, the pink variant, and a culture of *Sarcina flava* from the American Type Culture Collection, the species most closely resembling the original isolate.

The pink variant is identical with the yellow original in all characters so far investigated except pigmentation. The cells are spheres of 1.5 to 3 microns, occurring in packets of four or eight, in short straps two cells wide and one or two cells deep, or in larger druse-like masses. Both yellow and pink types are somewhat Gram variable but more positive than negative. The agar colonies are circular, at first smooth with a vitreous luster. (See fig. 1.) Later the centers become contoured, rugose and dull. The margins grow out usually maintaining the circle but sometimes some points grow more vigorously producing an irregularly scalloped margin. The new margins possess the original smooth vitreous surface. Streaks on agar slants are rugose and beaded or are scalloped. Older slants sector readily near the bottom yielding types of the same color but differing in opacity. All agar colonies are of brittle, waxy consistency. Broth slowly becomes turbid with whitish sediment, later becoming pigmented. Growth is retarded and pigment is slow in forming and reduced on starch agar. Starch is not hydrolyzed. No growth occurs on potato. There is no growth on 1-1,000,000 crystal violet agar.

Slight acid but no gas is produced from dextrose and maltose and sometimes from lactose. Neither acid nor gas is produced from sucrose, levulose, galactose, xylose, raffinose, arabinose, glycerol, inositol, dulcitol, salicin, or inulin. Gelatine liquefaction is at first napiform becoming stratiform. No indole is produced. Nitrates are not reduced to nitrites. Hydrogen sulphide is not produced. Optimum growth occurs at about 30°C.

Litmus milk becomes slightly alkaline in a few days; the upper portion later clarifies somewhat with the surface becoming entirely clear; still later four or five distinct strata appear increasing in opacity downward. The separation lines of these strata move gradually downward until the clear upper layer at the surface fills all except the curved bottom of the tube, which is occupied by a dense yellow-white creamy precipitate. During this process there is a change from the neutral color to purple to brown and finally to brownish yellow. The complete changes may require from two to ten weeks.

Sarcina flava proved to be different from the species described above. *S. flava* has orange rather than lemon-yellow pigment, lacks the vitreous luster, and does not become rugose. Vigorous growth occurs on potato. Acid is produced only in dextrose. Gelatine liquifaction occurs more quickly. *S. flava* produces the stratification of litmus milk in less time (often in four days) with irregular separation lines, but with no change in color.

Summary:

1. A lemon-yellow species of Sarcina differing from *S. flava* in a number of characters is described.

2. A pink variant arose from this Sarcina during tests for anaerobic growth. This has not reverted to the yellow type in twelve months.

CENANGIUM ABIETIS, BRUNCHORSTIA DESTRUENS, AND CRUMENULA ABIETINA[1]

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Beaver College

An investigation was started concerning the disputed parasitism of *Cenangium abietis* (Pers.) Duby[3] and *Brunchorstia destruens* Erikss.[4], two fungi occurring on Pinus, Picea, and Abies, and the reported relation between them. Their relationship to *Crumenula abietina* Lagerberg was also studied.

CENANGIUM ABIETIS

Von Thümen (1883) hinted that *Cenangium Abietis* could become parasitic on weakened twigs of *Pinus austriaca* Hoss in Austria. Schwarz (1895) reported parasitic action of the fungus in Germany on pines which were weakened by environmental conditions. In *P. sylvestris* L. the disease was only temporary; in *P. austriaca* it continued. Although discovered fructifications of *Brunchorstia destruens* were not in association with the apothecia of *C. Abietis*, Schwarz concluded that *B. destruens* was the conidial

[1]This paper is a digest of a dissertation presented for the degree of Doctor of Philosophy and for a Sterling Fellowship award at Yale University.

[2]The writer wishes to acknowledge his indebtedness to the late G. P. Clinton for suggesting this problem, to J. S. Boyce for directing, and to Florence A. McCormick for suggestions in the culture work. Thanks are given to G. G. Hahn for advising the method of inoculations and for contributing specimens; also to E. J. Eliason, J. Liese, A. van Luijk, I. Jorstad, T. Lagerberg, and C. A. Jorgensen who have contributed specimens.

[3]According to the synonymy *Cenangium Abietis* should be called *C. ferruginosum* Fr. Since throughout the literature the name *C. Abietis* has predominated, the writer has chosen to use it.

[4]Throughout the literature *Brunchorstia destruens* has mostly been referred to as such, and since the name has become so commonly established, the writer has used it instead of the correct name *B. pinea* (Karst.) v. Hohn., which since its introduction has only been used, according to the writer's knowledge, by Jorstad (1929).

stage. Waldie (1926) said that *C. Abietis* was common in Scotland on *P. sylvestris* but that there was doubt as to its parasitism. Jorstad (1925, 1929, 1931) stated that *C. Abietis* in Norway had proved to be only a saprophyte or weak parasite, and that *C. Abietis* was not associated with *B. destruens* there.[5]

Although *Cenangium Abietis* has been reported as a saprophyte in the United States according to host indices and a few specimens in exsiccati and herbaria, very little is known about the fungus in America. Fink (1911) recorded the first evidence of *C. Abietis* parasitizing three trees of *Pinus Strobus* L. in Ohio, and concluded that death of two trees was not caused by the fungus alone, but was influenced by drought. Weir (1921) found in a stand of *P. ponderosa* Dougl. in Montana only a tree here and there showing the fungus. Long (1924) observed in New Mexico and Arizona that the fungus attacked only the lower branches of *P. ponderosa* which were weakened by drought and shade.

Collections of *Cenangium Abietis* in United States, made and identified by the writer, were found in every case to be saprophytic. These collections agreed with those obtained from mycologists of Germany, Holland, Norway, and Sweden.

Cultures of *Cenangium Abietis* were obtained from the Centraalbureau voor Schimmelcultures in Holland, also by the writer from apothecia found in the United States, and from a specimen sent by Jorstad of Norway. Attempts to obtain single spore cultures were not successful. Van Luijk (1927) in Holland was unable to obtain single spore cultures of *C. Abietis*. The mycelium rapidly covered the entire surface of malt agar slants, forming a thin coating which appeared like white flour dusted over the surface.

Since no fruiting could be produced in *Cenangium Abietis* on malt agar under usual laboratory conditions, cultures were subjected to the following conditions in an attempt to induce fruiting. Some cultures were placed in the dark; others in the light for a year. Some were put in an electric refrigerator which had a constant temperature of 5 degrees C.; others in warm temperatures

[5]Reports of other investigators on the occurrence of *Cenangium Abietis* and *Brunchorstia destruens* in various European countries, and synonymy and exsiccati of the fungi, are included in the writer's complete dissertation on the subject in Sterling Memorial Library, Yale University, New Haven, Connecticut.

for a year. To some were added a 3% solution of Taka-Diastase. To others a pine extract solution was used. Cultures were also grown on malt having differences in moisture, ranging in content from 1 to 5% agar.

Besides malt agar, tubes of bean pods, prune, peanut, oat, corn, potato, and dextrose agars were inoculated. The best vegetative growth occurred on malt. Ranking next was that on oat, followed by that on potato. The remaining growths from the best to the poorest were on dextrose, corn, and prune agars, bean pods, and peanut agar. Never were spores produced. No investigator, according to the writer's knowledge, reported the occurrence of spores of *Cenangium Abietis* in culture.

Brunchorstia Destruens

Brunchorst (1888) found *Brunchorstia destruens* attacking *Pinus austriaca* in Norway, and also Waldie (1926) observed it in England and Scotland. Von Vloten (1929) reported the disease on *P. sylvestris* as not severe in Great Britain. Liese (1922) considered the disease temporary in Germany on *P. sylvestris*. In Belgium, Biourge (1928) considered that *B. destruens* was not the pycnidial stage of *Cenangium Abietis* since no fruiting of *C. Abietis* was found in association. Lagerberg (1913) in Sweden advanced plausible reason to show that it was the pycnidial stage of a new species, *Crumenula abietina*. Jorgensen (1930) observed *B. destruens* with much *Cr. abietina* on young shoots of languishing *P. austriaca* in Denmark. He concluded from his experiments that *B. destruens* was the pycnidial stage of *Cr. abietina*. Jorstad in a letter to the writer confirmed the statement of Jorgensen.

Nowhere in America is there any definite record of *Brunchorstia destruens*. Since it is practically unknown here, specimens from Scotland were studied.

Cultures of *Brunchorstia destruens* were secured from the Centraalbureau voor Schimmelcultures and transferred to malt agar. The mycelium became a definite green. The growth in comparison with that of *Cenangium Abietis* was slower and less extensive. The hyphae being long, produced a fluffy growth. The old mycelium which was directly in contact with the upper surface of the agar became massed into a blackish-green sclerotial layer.

The same series of experiments used for the cultures of *Cenangium Abietis* was employed for *Brunchorstia destruens*. In cultures which were six months old, an abundance of the slightly crescent-shaped spores of *B. destruens,* containing one to four septa were discovered in pycnidia.

Cultures of *Brunchorstia destruens* on peanut agar produced the best vegetative growth. Second for growth production was bean pods, followed in turn by malt and oat agars. The remaining growths from the best to the poorest were on corn, potato, dextrose, and prune agars. Single spore cultures were obtained from conidia produced in pycnidia in the cultures.

Further attempt to get fruiting in cultures of *Cenangium Abietis* was made by crossing this fungus with *Brunchorstia destruens* on the various kinds of media used. No fruiting bodies or spores of *C. Abietis* were produced. In the crosses where each fungus advanced toward the other, retardation of growth, the so-called "antagonism" produced by some fungi when in the presence of others, was very noticeable. This hostile effect as exhibited by each fungus for the other, and each one showing no signs of producing structures of the other, seemed to indicate that no relationship existed.

Inoculations with CENANGIUM ABIETIS *and* BRUNCHORSTIA DESTRUENS

Inoculations with *Cenangium Abietis* and *Brunchorstia destruens* were made at different seasons to see if periods of activity and dormancy of young *Pinus sylvestris, P. Strobus,* and *P. resinosa* Solander would have any effect upon the possible attack. The wounds made by inoculations and the inoculum present seemed to weaken certain twigs which withered and died. Observations made throughout the next year indicated no spreading or fruiting of the fungous organisms.

CRUMENULA ABIETINA

The writer received from Jorgensen of Denmark material of *Crumenula abietina* on twigs of *Pinus sylvestris.* Cultures were obtained from the crushed apothecia, and also single spore cultures were secured. Also a culture was received from the Centraalbureau. Mycelial growth appeared like that for *Brunchorstia destruens.* Twigs of *P. sylvestris, P. Strobus,* and *P. resinosa,* were inoculated with *Cr. abietina.* About a year later pycnidia were found which had the same kind of conidia as *B. destruens.* This study confirmed the opinion of Jorgensen that *B. destruens* is the conidial stage of *Cr. abietina.*

Conclusions are that *Cenangium Abietis* and *Brunchorstia destruens* are not parasitic to young *Pinus sylvestris, P. Strobus,* and *P. resinosa* in the United States; that *C. Abietis* and *B. destruens* are two distinct species of fungi; and that *B. destruens* is the conidial stage of *Crumenula abietina.*

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NEW AND RECENT RECORDS OF PENNSYLVANIA FUNGI FOR THE CARNEGIE MUSEUM HERBARIUM

LEROY K. HENRY

Carnegie Museum Herbarium

The collections reported here, the majority of which are from Western Pennsylvania, have been made between the years 1934-1939 inclusive. Some of them are rather rare, while others show that intensive collecting from year to year will add to our records. Those species preceded by an asterisk have additional specimens collected prior to 1934. These recent collections after a long period of time may indicate a lack of collecting during the intervening years or the sporadic occurrence of many fungi. Many species that were collected for the first time in 1934-1935 have been occurring in each successive year's collections, thus adding to our knowledge of their distribution.

Unless otherwise stated, the collections are those of the author.

MYXOMYCETES

FULIGO SEPTICA var. CANDIDA Pers. No. 1692, on log in mixed woods; near Leasuresville, Butler County, Pa. September 10, 1937.

FULIGO SEPTICA var. RUFA Pers. No. 842, on log in mixed woods; near Lisbon, Venango County, Pa. September 19, 1937.

PHYSARUM PULCHERRIPES Pk. No. 746, on log in deciduous woods; near Harmony, Butler County, Pa. September 11, 1936.

STEMONITIS AXIFERA (Bull.) Macbr. No. 763, on mossy log in deciduous woods; near Harmony, Butler County, Pa. September 11, 1936.

STEMONITIS FENESTRATA Macbr. No. 541, on log in deciduous woods; near Harmony, Butler County, Pa. September 12, 1935.

STEMONITIS HERBATICA Pk. No. 1258, on dead leaves in deciduous woods; 4 miles N. E. of Harmony, Butler County, Pa. July 6, 1937.

ASCOMYCETES

ALEURINA ATROVINOSA (Cke.) Seaver No. 1024, on soil in deciduous woods, often among mosses; near South Greensburg, Westmoreland County, Pa. June 21, 1937.

PATELLA ALBIDA (Schaeff.) Seaver No. 724, on soil among moss; Antietum Dam, Berks County, Pa. September 3, 1936. Collected yearly since 1936.

PAXINA ACETABULUM (L.) Kuntze. On soil in Scotch Pine Plantation, Juneau, Indiana County, Pa. July 11, 1939. Coll. by H. Roslund.

*PAXINA FUSICARPA (Ger.) Seaver No. 1505, on soil in mixed woods; 10 miles N. E. of Sinnemahoning, Cameron County, Pa. August 15, 1937. Also at Hillside, Westmoreland County, Pa. Coll. by D. R. Sumstine, 1906.

PAXINA HISPIDA (Schaeff.) Seaver No. 402, on soil in deciduous woods; North Park, Allegheny County, Pa. August 24, 1935; No. 1000, mixed woods along Little Buffalo Creek near Monroe Station, Butler County, Pa. October 25, 1936; No. 1214, woods 1 mile N. E. of Ben Avon Heights, Allegheny County, Pa. July 19, 1937; and No. 1753, mixed woods, along Muddy Creek Falls, Lawrence County, Pa. October 7, 1937.

PECKIELLA CAMPHORATI (Pk.) Seaver No. 2917, on Lactarius camphoratus, Temple Hollow woods behind Aliquippa, Beaver County, Pa. July 13, 1939.

POLYPORACEAE

FOMES FRAXINOPHILUS Williams. On dying White Ash tree, woods around Warden Mine, opposite Sutersville, Allegheny County, Pa. July 30, 1939. Coll. by H. Roslund.

FOMES SCUTELLATUS Fr. No. 2802, on twigs lying on ground under shrubs along Cucumber Run, Ohiopye, Fayette County, Pa. June 24, 1939.

POLYPORUS ALBICEPS Pk. On rotted wood, in mixed woods along Big Buffalo Creek, across from West Winfield, Armstrong County, Pa. August 12, 1939. Coll. by M. B. Knauz.

One of the rarest polypores. Murrill, in North American Flora, Vol. 9, says "known only from type locality," but a few other specimens have been reported since then.

*POLYPORUS CAESIUS (Schrad.) Fr. On log in mixed woods near Saxonburg, Butler County, Pa. October 19, 1935; and near Philadelphia, Philadelphia County, Pa. November 9, 1935. Coll. by D. R. Sumstine. On log in Fallen Timber Hollow opposite Sutersville, Allegheny County, Pa. August 3, 1939. Coll. by H. Roslund. Also, near Kittanning, Armstrong County, Pa. October, 1904. Coll. by D. R. Sumstine.

POLYPORUS CIRCINATUS Fr. Near Scotia, Center County, Pa. June 22, 1909. Coll. by O. E. Jennings. Immature specimen coll. by D. R. Sumstine at Ohiopyle, Fayette County, Pa. September, 1906.

*POLYPORUS CUTICULARIS (Bull.) Fr. No. 923, on log in deciduous woods along the Conemaugh River across from Saltsburg, Westmoreland County, Pa. October 10, 1936. Also on Presque Isle, Erie County, Pa. July 15, 1933. Coll. by O. E. Jennings; and near Sandy Creek, Allegheny County, Pa. November 3, 1906. Coll. by D. R. Sumstine.

*POLYPORUS CUTIFRACTUS Murr. No. 2984, on rotted log in deciduous woods, 1 mile N. E. of Ben Avon Heights, Allegheny County, Pa. August 1, 1939; Pocono Mts., near Blakeslee, Monroe County, Pa. August 11, 1939; near Butler, Butler County, Pa. August 21, 1939; and near Saxonburg, Butler County, Pa. August 24, 1939. Last three coll. by D. R. Sumstine. Determinations by L. O. Overholts.

POLYPORUS DISTORTUS (Schw.) Fr. At base of stump in Frick Park, Pittsburgh, Allegheny County, Pa. August 31, 1937. Coll. by D. R. Sumstine. This is the normal form.

*POLYPORUS DURASCENS Ovlts. On log in deciduous woods, near Aliquippa, Beaver County, Pa. August 15, 1938. Coll. by Sam Ristich. Also 2 miles E. of Ambridge, Allegheny County, Pa. September 16, 1923. Coll. by E. H. Graham.

*POLYPORUS FAGICOLUS Murr. On log, in deciduous woods, Fox Chapel, above Cable Bridge, Allegheny County, Pa. May 29, 1936. Coll. by Marie Knauz. Also Darlington Hollow, Aspinwall, June 10, 1908; Sandy Creek, June 29, 1906; and Frick Park, June 19, 1906. The latter is the Type. All three Allegheny County, Pa. Coll. by D. R. Sumstine.

POLYPORUS GALACTINUS Berk. Nine-Mile Run, Allegheny County, Pa. October 6, 1935. Coll. by H. S. Wieand and determined by L. O. Overholts.

POLYPORUS GUTTULATUS Pk. On rotted log, near Woodward, Center County, Pa. September 7, 1939. Coll. by D. R. Sumstine.

POLYPORUS MONTAGNEI Fr. On soil in mixed woods near Pocono Manor, Monroe County, Pa. August 8, 1938. Coll. by D. R. Sumstine.

*POLYPORUS OSSEUS Kalchbr. Woodward, Center County, Pa. September 8, 1939. Coll. by D. R. Sumstine; and on burried wood in mixed woods, Cook Forest, Jefferson County, Pa. August 4, 1932. Coll. by Mrs. C. K. Henlen.

*POLYPORUS RADICATUS Schw. In clay loam soil, in deciduous woods, Warden Mine opposite Sutersville, Allegheny County, Pa. August 12, 1939. Coll. by H. Roslund. Also, on root of stump, Latrobe, Westmoreland County, Pa. July 1903; and near Corry, Erie County, Pa. July 1, 1908. Both coll. by D. R. Sumstine.

*POLYPORUS SEMISUPINUS B. & C. No. 653, on log in mixed woods, Blue Mountains, N. of Schubert, Berks County, Pa. August 31, 1936; and near Cresson, Cambria County, Pa. September 5, 1939. Also, near Kittanning, Armstrong County, Pa. August, 1905; Idlewild, Westmoreland County, Pa. August 10, 1906. Last three coll. by D. R. Sumstine.

POLYPORUS SPUMEUS (Sow.) Horne. On dying Maple tree, Holbrook, Greene County, Pa. Coll. by Sarah Marley. November 11, 1935. Det. by L. O. Overholts.

POLYPORUS SPUMEUS var. MALICOLUS Lloyd. No. 2202, on old log in mixed woods, around Dollar Lake, Hartstown, Crawford County, Pa. September 10, 1938.

*POLYPORUS SQUAMOSUS (Huds.) Fr. Growing from wound on living tree, Heinz House Camp, Slippery Rock Creek, 10 miles E. of Ellwood, Lawrence County, Pa. July 22, 1936. Coll. by H. S. Wieand. Also, Guyasuta Hollow, Sharpsburg, Allegheny County, Pa. June 10, 1908. Coll. by D. R. Sumstine.

TRAMETES TROGI Berk. On log in mixed woods near Pocono Manor, Monroe County, Pa. July 15, 1939. Coll. by D. R. Sumstine.

BOLETACEAE

*BOLETINUS CASTANELLUS (Pk.) Murr. No. 1465, on decaying logs in mixed woods; 7 miles N. E. of Austin, Potter County, Pa. August 15, 1937. Also at Weiss Library Woods, Erie County, Pa. Coll. by O. E. Jennings, 1931.

BOLETINUS SPECTABILIS Pk. No. 494, on soil in swamp, Hartstown, Crawford County, Pa. September 19, 1935.

*BOLETUS BADIUS Pk. No. 2666, on soil under conifers, Cook Forest, Clarion County, Pa. October 7, 1938. Also near Kittanning, Armstrong County, Pa. Coll. by D. R. Sumstine, 1902.

*BOLETUS GRACILIS Pk. No. 1605, on soil in mixed woods; near Freeport, Butler County, Pa. September 9, 1937. Also near Kittanning, Armstrong County, Pa. Coll. by D. R. Sumstine, 1905.

*BOLETUS GRISEUS Frost. No. 298, on soil in deciduous woods; Sandy Lake, Mercer County, Pa. June 30, 1935. Also near Kittanning, Armstrong County, Pa. Coll. by D. R. Sumstine, 1901.

BOLETUS SPECIOSUS Frost. No. 670, on soil in deciduous woods; Antietum Dam, Berks County, Pa. September 3, 1936.

BOLETUS SUBGLABRIPES Pk. No. 1264, on soil in deciduous woods; South Greensburg, Westmoreland County, Pa. June 21, 1937.

*BOLETUS SUBTOMENTOSUS L. No. 1263, on soil in mixed woods; near Freeport, Butler County, Pa. June 23, 1937. Also near Kittanning, Armstrong County, Pa. Coll. by D. R. Sumstine, 1902. Has been found frequently during the last two years.

BOLETUS VARIIPES Pk. No. 2909, on soil in mixed woods, Temple Hollow, 1 mile N. W. of Aliquippa, Beaver County, Pa. July 13, 1939.

AGARICACEAE

AGARICUS HAEMORRHOIDARIUS Schulz. On soil in deciduous woods, Warden Mine region, opposite Sutersville, Allegheny County, Pa. August 13, 1939. Coll. by H. Roslund.

AMANITA CHRYSOBLEMA Atk. No. 1329, on soil in deciduous woods; South Greensburg, Westmoreland County, Pa. July 29, 1937.

AMANITA GLABRICEPS Pk. No. 1328, on soil in deciduous woods; South Greensburg, Westmoreland County, Pa. July 29, 1937.

AMANITA MORRISII Pk. No. 1254, on soil in deciduous woods; Ben Avon Heights, Allegheny County, Pa. July 19, 1937. Somewhat smaller specimen than given in Murrill's descriptions.

AMANITA SPISSA Fr. No. 2135, in mixed woods near Glen Campbell, Indiana County, Pa. August 4, 1938.

CANTHARELLUS UMBONATUS Fr. No. 200, on soil among moss, Morrison Cove region, 7 miles N. E. of Everett, Bedford County, Pa. November 24, 1934.

CLAUDOPUS DEPLUENS Fr. No. 2141, on rotted log in mixed woods near Glen Campbell, Indiana County, Pa. August 4, 1938; and No. 2167, on rotted log, upland woods E. of Yellow Creek, 4 miles N. E. of Harmony, Butler County, Pa. August 6, 1938.

CLITOCYBE CLAVIPES Fr. No. 830, on soil in mixed woods; near Lisbon, Venango County, Pa. September 19, 1937; and No. 2608, Cook Forest, Clarion County, Pa. October 7, 1938.

CLITOCYBE PARILIS Fr. No. 1681, on soil in mixed woods; near Leasuresville, Butler County, Pa. September 15, 1937.

CLITOCYBE PICEINA Pk. No. 228, on soil in deciduous woods; near Harmony, Butler County, Pa. October 7, 1934; and No. 831, woods along Little Scrubgrass Creek, 1 mile N. E. of Lisbon, Venango County, Pa. September 19, 1936.

CLITOPILUS ORCELLA Fr. No. 1697, on soil in mixed woods, along Watson's Run, 2 miles S. of Leasuresville, Butler County, Pa. September 15, 1937. Determined by A. H. Smith.

COLLYBIA ABUNDANS Pk. No. 1467, on old log in mixed woods, along Route 872, 7 miles N. E. of Austin, Potter County, Pa. August 15, 1937.

COLLYBIA ALCOLINOLENS Pk. No. 2620, among debris in Cook Forest, Clarion County, Pa. October 7, 1938.

*COLLYBIA CIRRATA Fr. No. 1437, on old Agaric in mixed woods, along Route 84, 5 miles N. of Salladasburg, Lycoming County, Pa. August 14, 1937. Determined by A. H. Smith. Also Fern Hollow, Allegheny County, Pa. 1909. Coll. by O. E. Jennings.

COLLYBIA CONIGENOIDES E. & E. No. 1728, on fruits of Magnolia acuminata, woods along Muddy Creek Falls, Lawrence County, Pa. October 7, 1937. Determined by A. H. Smith.

COLLYBIA COOKEI (Bres.) Arnold. No. 1726, on soil in mixed woods among moss, leaves and other debris, Muddy Creek Falls, Lawrence County, Pa. October 7, 1937. Determined by A. H. Smith.

*COLLYBIA TUBEROSA Fr. No. 2710, on pieces of rotted wood and decayed fungus, Cook Forest, Forest County, Pa. October 6, 1938. Also, Fern Hollow in Frick Park, Pittsburgh, Allegheny County, Pa. September 25, 1909. Coll. by D. R. Sumstine.

COLLYBIA ZONATA Pk. On decaying wood, Warden Mine region, opposite Sutersville, Allegheny County, Pa. August 12, 1939. Coll. by H. Roslund.

COPRINUS BRASSICAE Pk. On cornstalks, Warden Mine region, opposite Sutersville, Allegheny County, Pa. July 27, 1939. Coll. by H. Roslund.

CORTINARIUS CAMPHORATUS Fr. No. 1544. On soil in mixed woods, 2 miles E. of Medix Run, on Route 555 Elk County, Pa. August 15, 1937.

CREPIDOTUS CALOLEPIS Fr. No. 851, on log, Little Scrubgrass Creek, 1 mile N. E. of Lisbon, Venango County, Pa. September 19, 1936; also Scrubgrass Creek, N. E. of Sutton's Mills, Venango County, Pa. November 8, 1936. Coll. by M. B. Knauz.

ECCILIA UNICOLOR Pk. No. 656, on soil in woods growing among or even attached to mosses. Blue Mountains, North of Schubert, Berks County, Pa. August 31, 1936. Reported once only from other than type locality. (Notes on Southern Appalachian Fungi, II, by L. R. Hesler, Jour. of the Tenn. Acad. of Sci., Vol. XII, No. 3, p. 245, July, 1937.)

ENTOLOMA FUMOSIALBUM Murr. No. 1742, on soil in woods, along Muddy Creek Falls, Lawrence County, Pa. October 7, 1937.

ENTOLOMA GRISEUM Pk. No. 969, among sphagnum or on soil in moist woods, Possum Pond, S. E. edge of Tamarack Swamp, 2 miles N. W. of Pine Valley, Warren County, Pa. October 15, 1936.

ENTOLOMA RHODOPOLIUM Fr. No. 678, on soil in mixed woods, Antietum Dam, near Stony Creek Mills, Berks County, Pa. September 3, 1936.

FLAMMULA CARBONARIA Fr. No. 492, on sticks, stumps, etc., in low, swampy woods or wet places, Dollar Lake, Crawford County, Pa. September 19, 1935; and No. 979, woods around Mercer Bog, 1 mile W. of Mercer, Mercer County, Pa. September 16, 1936.

FLAMMULA FLAVIDELLA Murr. No. 847, on log in woods, Little Scrubgrass Creek, Venango County, 1 mile N. of Lisbon, Pa. September 19, 1936; and No. 1007, on log, Little Buffalo Creek near Monroe Station, Butler County, Pa. October 25, 1936.

GALERA CAPILLARIPES Pk. No. 1386, on lawn, Cathedral of Learning, Pittsburgh, Allegheny County, Pa. August 12, 1937.

*GALERA HYPNORUM Fr. No. 273, on mosses, especially sphagnum, Pymatuning Swamp, Linesville, Crawford County, Pa. June 2, 1935; and No. 271, Swamp near Swamp Root, Mercer County, Pa. June 8, 1935; and Sulphur Springs Bog, Warren County, Pa. September 12, 1934. Coll. by E. H. Graham. Has been recorded from several localities since 1935.

GALERA SILIGINEA Fr. No. 1390, on new lawn of Cathedral of Learning, Pittsburgh, Allegheny County, Pa. August 12, 1937. Determined by A. H. Smith.

GALERA TENERELLA Atk. No. 1387, on lawn, Cathedral of Learning, Pittsburgh, Allegheny County, Pa. August 12, 1937.

HEBELOMA CRUSTULINIFORME Fr. No. 2638, on soil in woods, Cook Forest, Clarion County, Pa. October 7, 1938.

*HYGROPHORUS CHRYSODON Fr. No. 2664, on soil, Cook Forest, Clarion County, Pa. October 7, 1938. Also near Kittanning, Armstrong County, Pa. October, 1904. Coll. by D. R. Sumstine.

HYGROPHORUS MARGINATUS Pk. No. 706, on soil in moist places in deciduous woods, Antietam Dam, near Stony Creek Mills, Berks County, Pa. September 3, 1936.

HYGROPHORUS MINIATUS Fr. var. CANTHERELLUS Schw. No. 646, on soil in mixed woods, Blue Mountains, Berks County, Pa. August 31, 1936.

HYGROPHORUS MINIATUS var. SPHAGNOPHILUS Pk. No. 514, among sphagnum, Mercer Bog, W. of Mercer, Mercer County, Pa. September 11, 1935.

HYGROPHORUS NIVEUS Fr. On soil in low or moist woods, Antietum Dam, near Stony Creek Mills, Berks County, Pa. September 3, 1936.

*HYGROPHORUS PECKII Atk. No. 641, on soil in woods, Blue Mountains, N. of Schubert, Berks County, Pa. August 31, 1936; also Venango County, Pa. July 10, 1936. Coll. by H. S. Wieand. Occasional specimens have been collected since 1936.

HYGROPHORUS VIRGINEUS Fr. var. No. 505, on soil in deciduous woods, 5 miles N. of Zelienople, Butler County, Pa. September 12, 1935.

HYPHOLOMA DELINEATA Pk. On log in mixed woods, along Big Buffalo Creek across from West Winfield, Armstrong County, Pa. September 23, 1939. Coll. by M. B. Knauz.

HYPHOLOMA HYDROPHILUM Fr. (sense of Ricken). No. 771, on decayed wood in mixed and deciduous woods, along tributary to Crab Run, 4 miles N. E. of Harmony, Butler, County, Pa. September 11, 1936; and No. 791, along Little Scrubgrass Creek, 1 mile N. E. of Lisbon, Venango County, Pa. September 19, 1936. Has been collected in many localities during the successive years.

HYPHOLOMA POPULINUM Bretz. var. On Elm log in deciduous woods, Warden Mine region, opposite Sutersville, Allegheny County, Pa. July, 1939. Coll. by H. Roslund.

INOCYBE CALAMISTRATA Fr. Alan Seeger region and Shingletown Gap, Center County, Pa. July 7 and 31, 1936. Coll. by M. B. Knauz; also near Cresson, Cambria County, Pa. September 11, 1939. Coll. by D. R. Sumstine.

INOCYBE FASTIGIATA Bres. Reitz Gap, Center County, Pa. July 26, 1936; also Ohiopyle, Fayette County, Pa. 1936. Coll. by M. B. Knauz.

INOCYBE GEOPHYLLA (Fr.) Karst. No. 230, on soil in deciduous woods, Frick Park, Allegheny County, Pa. October 5, 1934; and No. 2650, Cook Forest, Clarion County, Pa. October 7, 1938.

INOCYBE HYSTRIX (Fr.) Karst. No. 1606, on soil in mixed woods, along Little Buffalo Creek, near Monroe Station, Butler County, Pa. September 9, 1937.

INOCYBE LANATODISCA Kauff. Alan Seeger region, Center County, Pa. July 7, 1936. Coll. by M. B. Knauz.

INOCYBE PALLIDOBRUNNEA Kauff. No. 216, on soil in woods, Frick Park, Allegheny County, Pa. October 5, 1934.

INOCYBE RADIATA Pk. No. 98, on lawn, 4 miles N. E. of Harmony, Butler County, Pa. August 25, 1934.

INOCYBE VIRGATA Atk. No. 1725, on soil in woods along Muddy Creek Falls, Lawrence County, Pa. October 7, 1937.

*LACTARIUS GRISEUS Pk. No. 1506, on decayed logs among mosses, in woods along Route 872, 10 miles N. E. of Sinnamahoning, Cameron County, Pa. August 15, 1937; also, Venango County, 1 mile N. of Lisbon, Pa. 1936. Coll. by H. S. Wieand. A few have been found during the last two years.

LACTARIUS HYSIGNUS Fr. No. 903, on soil in mixed woods, Little Buffalo Creek, near Monroe Station, Butler County, Pa. September 26, 1936.

LACTARIUS LILIACINUS Lasch. No. 1438, on soil in mixed woods along Route 84, 5 miles N. of Salladasburg, Lycoming County, Pa., August 14, 1937. Determined by A. H. Smith who considers it to be apparently very rare and poorly known in North America.

LACTARIUS PYROGALUS Fr. No. 760, on soil in deciduous woods along Tributary to Crab Run, 4 miles N. E. of Harmony, Butler County, Pa. September 11, 1936.

LACTARIUS TRIVIALIS Fr. No. 991, on soil in mixed woods, Little Buffalo Creek, near Monroe Station, Butler County, Pa. October 25, 1936. Also collected at two locations during 1937.

LEPIOTA RUBROTINCTA Pk. No. 1394, on soil in woods, along Route 220 at Lamar, Clinton County, Pa. August 13, 1937.

MARASMIUS ALBICEPS Pk. No. 2192, on dead leaves, upland woods E. of Yellow Creek, 4 miles N. E. of Harmony, Butler County, Pa., August 6, 1938.

MARASMIUS CAPILLARIS Morg. No. 520, on fallen leaves, twigs, etc. Upland woods, 4 miles N. E. of Harmony, Butler County, Pa. September 12, 1935; and No. 772, woods along tributary to Crab Run, 4 miles N. E. of Harmony, Butler County, September 11, 1936. Has been collected at several localities since 1936.

*MARASMIUS DELECTANS Morg. No. 667, on fallen leaves in woods, Antietum Dam, near Stony Creek Mills, Berks County, Pa. September 3, 1936; also Shades Ravine, Trafford, Westmoreland County, Pa. 1935. Coll. by H. S. Wieand. Has been recorded from other localities during the successive years.

MARASMIUS ELONGATIPES Pk. No. 765, on leaves, woods along tributary of Crab Run, 4 miles N. E. of Harmony, Butler County, Pa. September 11, 1936.

MARASMIUS SEMIHIRTIPES Pk. No. 697, on decaying wood on ground, Antietum Dam, near Stony Creek Mills, Berks County, Pa. September 3, 1936.

MYCENA CLAVICULARIS (Fr.) Quel. No. 2780, on Pine needles, Cook Forest, Forest County, Pa. October 5, 1938.

MYCENA CORTICOLA Fr. No. 1256, on trunk of living tree, woods along Raccoon Creek, 2 miles W. of Aliquippa, Beaver County, Pa. July 13, 1937.

MYCENA EPIPTERYGIA (Fr.) Quel. var. A. No. 2625, on Pine needles, Cook Forest, Clarion County, Pa. October 7, 1938.

*MYCENA PARABOLICA Fr. No. 2735, on rotted wood and debris, Cook Forest, Forest County, Pa. October 5, 1938; also Shades Ravine, near Trafford, Westmoreland County, Pa. October 18, 1936. Coll. by H. S. Wieand.

*MYCENA ROSELLA Fr. No. 1261, on rotted wood in woods along Little Buffalo Creek, near Monroe Station, Butler County, Pa. June 23, 1937; and No. 2776, on Pine needles, Cook Forest, Forest County, Pa. October 5, 1938; also on decaying trunk near Kittanning, Armstrong County, Pa. June, 1905. Coll. by D. R. Sumstine.

MYCENA STANNEA (Fr.) Quel. No. 1765, on soil in mixed woods along Muddy Creek Falls, Lawrence County, Pa. October 7, 1937. Determined by A. H. Smith.

NAUCORIA PALLIDOMARGINATA (Pk.) Murr. No. 978, on wet ground in woods around Mercer Bog, 1 mile W. of Mercer, Mercer County, Pa. October 16, 1936.

PANEOLUS SUBBALTEATUS Berk. No. 1048, on new lawn, Board of Education, Pittsburgh, Allegheny County, Pa. June 24, 1937. Determined by A. H. Smith. Coll. by L. K. Henry and D. R. Sumstine. Also No. 1389 from Cathedral of Learning lawn, Pittsburgh, Allegheny County, Pa. August 12, 1937. Has occurred on same lawns during the successive years.

PANUS TORULOSUS var. CONCHATUS Fr. (Acc. to Kauff.) No. 1257, on stump in woods along Raccoon Creek, 2 miles W. of Aliquippa, Beaver County, Pa. July 13, 1937.

PHOLIOTA ACERICOLA (Pk.) Sacc. No. 2707, on rotted wood, Cook Forest, Forest County, Pa. October 5, 1938.

PHOLIOTA DUROIDES Pk. No. 233, on soil in open woods, near Kregar, Westmoreland County, Pa. October 14, 1934; and No. 756, along tributary of Crab Run, 4 miles N. E. of Harmony, Butler County, September 11, 1936.

PHOLIOTA UNICOLOR (Vahl.) Fr. No. 879, on decaying logs and wood, woods along Little Buffalo Creek, near Monroe Station, Butler County, Pa. September 24, 1935; also Shades Ravine, Trafford, Westmoreland County, Pa. October 25, 1936. Coll. by H. S. Wieand.

PLEUROTUS ALBOLANATUS Pk. On rotted log in woods along Little Scrubgrass Creek, N. E. of Sutton's Mills, Venango County, Pa. November 8, 1936. Coll. by M. B. Knauz.

PLEUROTUS PORRIGENS Fr. No. 2685, on rotted log (probably hemlock), Cook Forest, Forest County, Pa. October 5, 1938.

PLEUROTUS SUBPALMATUS Fr. On Elm log in deciduous woods, Warden Mine region, opposite Sutersville, Allegheny County, Pa. July 15, 1939. Coll. by H. Roslund.

PSILOCYBE AGARIELLA Atk. No. 219, on soil in woods, Frick Park, Allegheny County, Pa. October 4, 1934. Determined by A. H. Smith.

PSILOCYBE ATROBRUNNEA Fr. No. 498, on soil among sphagnum in bogs, Mercer Bog, Mercer County, Pa. September 11, 1935.

PSILOCYBE MERDARIA Fr. No. 971, on horse manure in fields near Possum Pond, at S. E. edge of Tamarack Swamp, 2 miles N. W. of Pine Valley, Warren County, Pa. October 15, 1936.

RUSSULA AERUGINEA Lindb. No. 366, on soil in woods 4 miles N. E. of Parker's Landing, Clarion County, Pa. July 27, 1935. Has been collected each successive year.

RUSSULA ALUTACEA Fr. No. 797, in mixed woods along Little Scrubgrass Creek, Venango County, Pa. September 19, 1936; and No. 865, along Little Buffalo Creek, Butler County, Pa. September 26, 1936.

RUSSULA ATROPURPUREA Marie. No. 290, on soil or on decayed logs, Forbes Forest, Westmoreland County, Pa. July 6, 1935. Our first record, but now a rather common species with us.

*RUSSULA DECOLORANS Fr. No. 1693, on soil in hemlock ravine, Watson's Run, 2 miles S. of Leasuresville, Butler County, Pa. September 25, 1937; also 1 mile N. of Lisbon, Little Scrubgrass Creek, Venango County, Pa. 1936. Coll. by H. S. Wieand.

RUSSULA FLAVA Romell. No. 859, on soil in mixed woods, Little Buffalo Creek, near Monroe Station, Butler County, Pa. September 26, 1936; also from same locality, September 28, 1935. Coll. by H. S. Wieand. Has been recorded several times since 1936.

RUSSULA FOETENTULA Pk. No. 417, on soil in frondose woods, 5 miles N. of Zelienople, Butler County, Pa. September 12, 1935. Many collections during the successive years.

RUSSULA LUTEA (Huds.) Fr. No. 1464, on soil in mixed woods, along Route 872, 7 miles N. E. of Austin, Potter County, Pa. August 15, 1937.

RUSSULA OCHRALEUCA Pers. No. 1262, on soil in mixed woods, Little Buffalo Creek, near Monroe Station, Butler County, Pa. June 23, 1937.

RUSSULA PECTINATOIDES Pk. No. 695, on grassy place in woods, Antietum Dam, near Stony Creek Mills, Berks County, Pa. September 3, 1936; and No. 751, along tributary to Crab Run, 4 miles N. E. of Harmony, Butler County, Pa. September 11, 1936. Our first record, but now have many collections.

RUSSULA SERICEONITENS Kauff. No. 785, on soil in mixed woods, (maple, birch, hemlock, pine), 5 miles N. of Zelienople, Butler County, Pa. September 13, 1936: and No. 970, Possum Pond, Tamarack Swamp, 2 miles N. W. of Pine Valley, Warren County, Pa. October 15, 1936. Have three more collections to date.

RUSSULA SUBDEPALLENS Pk. No. 1327, on soil in woods, below South Greensburg's swimming pool, Westmoreland County, Pa. July 29, 1937; and No. 1265, woods 1½ miles E. of New Alexandria off Route 22, Westmoreland County, Pa. July 29, 1937.

RUSSULA UNCIALIS Pk. No. 764, on soil in frondose woods, along tributary to Crab Run, 4 miles N. E. of Harmony, Butler County, Pa. September 11, 1936; and No. 1223, woods 1 mile N. E. of Ben Avon Heights, Allegheny County, Pa. July 19, 1937. Found occasionally during the successive years.

RUSSULA VETERNOSA Fr. No. 870, scattered or gregarious in frondose woods, Little Buffalo Creek, near Monroe Station, Butler County, Pa. September 26, 1936.

STROPHARIA DEPILATA Fr. No. 2610, at base of stump, Cook Forest, Clarion County, Pa. October 7, 1938.

TRICHOLOMA MICROSPERMUM Ellis. No. 727, on leaves in mixed woods, Antietum Dam, near Stony Creek Mills, Berks County, Pa. September 3, 1936. Determined by A. H. Smith.

GASTEROMYCETES

LYCOPERDON COLORATUM Pk. No. 2801, on soil in mixed woods along Cucumber Run, Ohiopyle, Fayette County, Pa., June 24, 1939.

CONCLUSION

Herein are recorded 136 species in the following groups: 6 Myxomycetes, 6 Ascomycetes, 20 Polyporaceae, 9 Boletaceae, 94 Agaricaceae, and 1 Gasteromycete. Reported from one collection only, are: 6 Myxomycetes, 2 Ascomycetes, 8 Polypores, 4 Boletes, 1 Gasteromycete, and 46 Agarics.

REACTION OF IMMATURE FEMALE GUINEA PIGS TO GONADOTROPIC EXTRACTS

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Previous investigations with gonadotropic extracts indicated that vaginal opening could be induced in the immature guinea pig. However, one finds varied reports as to the effect of these materials on the ovaries. Greep[1] found that vaginal opening occurred in 5 to 8 days with injections of pituitary follicle stimulating hormone and that as much as a 1000% increase in ovarian weight resulted. It was also stated that mare serum hormone produced similar effects. Recently, Rowlands[2] reported that mare serum hormone produced comparatively little increase in ovarian weight in the immature guinea pig but that the uterus was greatly enlarged. In neither instance was the histology of the ovary considered. Castrate urine extract produced ovarian enlargement with a general follicle stimulating effect, with only 1 of the 5 animals tested exhibiting corpora lutea[3]. Guyenot et al.[4] reported that vaginal opening resulted in most cases when castrate urine was injected but the vaginal condition was atypical. The ovaries exhibited a general growth of follicles but none reached ovulating size and pseudo corpora lutea formed.

In our experiments, mare serum hormone and an extract of castrate urine were used to determine whether vaginal opening could be induced and also to consider the effect on the ovaries, uteri and vaginae.

Methods and Materials

Immature female guinea pigs weighing between 170 and 235 grams were used in these experiments. Twelve animals were injected with mare serum hormone, 4 with castrate urine extract, and 3 served as controls (Table I.). Injections were made daily until vaginal opening resulted or the animals were sacrificed after various total dosages had been administered. The animals were sacrificed 1 or 2 days following cessation of treatment (#27 excepted.) The ovaries and uteri were weighed at autopsy and histological sections of the ovaries, uteri and vaginae were prepared. Ovaries were sectioned serially.

The writers are indebted to Dr. D. H. Wonder, Cutter Laboratories, for the extract of pregnant mare's serum and to Dr. Louis Levin, Department of Anatomy, College of Physicians and Surgeons, Columbia University, for the extract of castrate urine (L531AK.)

Results

Mare serum hormone was administered either subcutaneously or interperitoneally in 2.5, 5, 10 or 20 rat unit dosages daily. Eight of the 12 animals exhibited vaginal opening which occurred between the 5th and 12th days after the initial injection. The vaginae had a cornified epithelium in only 2 cases whereas intense mucification of the vaginal epithelium was observed in other animals.

The uterus was stimulated in every case (#33 excepted) with a general hypertrophy of the myometrium and stroma. There was an increase in the endometrial glands and the epithelium surrounding the lumen of the uterus was increased in height to a tall, columnar type. An extensive increase in vascularity was grossly apparent in some cases. Uterine weight was more than 4 times that of the controls in one animal.

Five of the 12 animals receiving mare serum hormone showed a marked ovarian weight increase and 3 others a definite weight increase. Ovarian weight of the 3 controls averaged 38 mgm. for both ovaries whereas in one animal that had received 5 r. u. of

mare serum hormone daily for 10 days the ovaries weighed 235 mgm.

The ovaries of 2 of the 3 animals injected with 2.5 r. u. daily for 6 or 7 days exhibited the stimulation of 2 or 3 follicles to a large size and contained normal ova. A fair number of medium size vesicular follicles were also present. Evidence of slight thecal luteinization was observed in several follicles and a single small atretic corpora was present in each ovary.

The administration of 5 r. u. of mare serum hormone daily for 5 or 8 days also stimulated 2 or 3 follicles to large size. Corpora lutea were absent but evidence of thecal luteinization was observed in a few cases. Small vesicular follicles appeared to be undergoing normal atresia.

The injection of 5 r. u. daily for periods of 10 or 11 days induced mostly lutein tissue in the ovary in one case (#34.) The corpora were small and seemingly involving largely thecal luteinization, but one large corpora lutea atretica also was present indicating the luteinization of the granulosa. A few small vesicular follicles were observed. The other animal had ovaries which were largely composed of vesicular follicles of essentially the same size and entirely normal in appearance. However, large corpora lutea atretica were also observed.

A daily dosage of 10 r. u. of this hormone administered over 9 or 10 day periods caused no greater increase in ovarian weight than resulted with a 5 r. u. dose. The ovaries varied from a predominant composition of vesicular follicles to one virtually completely composed of lutein tissue. In general, some stimulation of follicles resulted in addition to both thecal and granulosa luteinization. Large corpora lutea were present in the ovaries of one animal (#45.)

Twenty r. u. daily for 5 days caused primarily the formation of large atretic corpora lutea.

Four immature female guinea pigs were tested with an extract of castrate urine (L531AK) prepared according to the method of Levin and Tyndale[5] and was assayed by the mouse uterus technic.[6] A solution of this material was made so that 1 cc was equivalent to 5.93 mgm and contained approximately 8.5 mouse uterine units. Doses of 2.1, 4.2 or 8.4 mouse uterine units were injected daily for 5 days and the animals sacrificed on the 6th day. The two animals on the lowest dosage failed to show vaginal opening but the others exhibited vaginal opening on the 4th day after the first injection. The vaginal epithelium was mucified in all but one animal on the highest dose in which case it was cornified. The uterus was stimulated in correspondence with the ovarian condition. The ovarian weight was increased to 95 mgm with 4.2 M. U. U. per day and to 135 mgm with 8.4 M. U. U. per day. Ovaries of the animals on the lowest dosage showed a stimulation of 1 or 2 follicles with an indication of atresia in one follicle but no other lutein tissue was observed. With increased dosage several large follicles undergoing atresia were observed but many small vesicular follicles were present. The highest dosage caused the formation of large atretic corpora lutea and also many small vesicular follicles. With this extract the lutein tissue present was the result of atresia of large follicles which appeared to have been previously stimulated and an absence of general thecal luteinization.

Discussion

Gonadotropic extracts, namely, anterior pituitary FSH and castrate urine extracts have been shown to be capable of inducing vaginal opening in the immature guinea pig. [1, 4] In these experiments another gonadotropic substance, mare serum hormone, has been shown to be capable of inducing vaginal opening 5 to 12 days after the initial injection. The vaginal epithelium was cornified in only 2 animals whereas intense mucification was observed in other cases. A similar result was obtained with castrate urine.[4]

In 3 animals receiving mare serum hormone the vaginae remained closed although ovarian weight was increased. However, in every instance the ovaries were composed primarily of lutein tissue.

Rowlands[2] reported that the uterus was greatly enlarged in immature guinea pigs injected with mare serum hormone and a similar result was obtained in these experiments in which as much as a 4 times increase in uterine weight was obtained.

Although comparatively little increase in ovarian weight was obtained with mare serum hormone by Rowland[2], as much as a 6-fold ovarian weight increase was obtained with the same hormone in this investigation. Castrate urine also produced an ovarian weight increase as has been shown previously by Leonard[3].

A varied ovarian histology resulted in spite of identical dosage administration with mare serum hormone. With low doses 2 to 3 follicles were stimulated to large size but with some evidence

of thecal luteinization. Larger doses either stimulated the predominant formation of follicles or lutein tissue. The lutein tissue resulting from castrate urine injections was confined to large atretic corpora lutea whereas with mare serum hormone thecal luteinization was generally most predominant.

The hypophysectomized immature female rat ovary can be markedly stimulated with castrate urine in the absence of the formation of lutein tissue[7]. Mare serum hormone effect on the ovary of the hypophysectomized immature rat has been shown to depend upon the dose used and differs from castrate urine in causing the formation of luteinized thecal tissue at low doses[8].

Although the guinea pig hypophysis has been shown to be very low in gonadotropic potency, what part this gland plays in altering the response of the ovary to injected materials can only be determined by hypophysectomy. Furthermore, a difference in response of the immature guinea pig ovary to gonadotropic extracts as compared to the rat ovary may be anticipated because of the large number of medium size vesicular follicles present in the ovary of the immature guinea pig. These factors may account for the varied ovarian stimulation obtained and also may partially explain the difference between the response of the guinea pig and rat ovaries to the same materials.

Summary

Mare serum hormone caused vaginal opening, uterine hypertrophy and ovarian stimulation in immature female guinea pigs. Similar effects were obtained with an extract of castrate urine. The stimulation of follicles and the formation of lutein tissue resulted from the administration of both gonadotropic extracts.

Table I

Responses of Immature Female Guinea Pigs to Gonadotropic Extracts

Animal number	Body weight, grams	Daily dose	Total dose	Vaginal opening, day	Ovarian weight, mgm.
	Animals receiving mare serum hormone				
43	218	2.5 r. u.	15	7	61
50	235	2.5	17.5	9	105
33	200	2.5	27.5	—	27
22	200	5.0	25	5	49

25	212	5.0	25	7	47
27	212	5.0	40	12	40
34	200	5.0	55	—	148
44	218	5.0	50	12	235
21	192	10.0	90	11	151
35	230	10.0	100	11	138
45	222	10.0	90	—	75
23	230	20.0	100	—	69
Animals receiving castrate urine extract					
51	170	2.1 MUU	10.5	—	30
52	210	2.1	10.5	—	40
48	200	4.2	21.0	4	95
49	245	8.4	42.0	4	135

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EXPERIMENTS ON MICROLOGICAL TECHNIQUE

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A report on the work accomplished under a grant from the Pennsylvania Academy of Science during the years 1938-1939 and 1939-1940.

The goal of these experiments has been to secure the penetration of living tissues by the various killing, dehydrating, and supporting media by methods as little harmful to the natural structure as possible.

This seemed most likely to be accomplished by speeding up the entire sequence of micrological procedure from fixation to the impregnation with a wax compound that would remain waxy instead of becoming crystalline.

This has been accomplished by the following methods:

Fixation. The penetration of all killing agents has been facilitated by the addition to them of 0.5 percent or less of the detergent "Tergitol #7," a product of The Carbide and Carbon Chemicals Corporation, 30 East 42nd Street, New York, N. Y.

This wetting agent, by reducing surface tension, increases the speed of penetration of the fixing fluid.

This operation is still further speeded up by the carrying out of fixation under vacuum (produced by a filter pump.) Penetration of the fluid to the center of spongy tissue—such as a one and one-half inch mushroom—required only fifteen minutes. Fixation, in this case, was complete in about two hours.

Dehydration. "Cellosolve" (ethylene glycol monoethyl ether), another product of the Carbide and Carbon Chemicals Corporation, has proven superior as a dehydrating agent. It need not be broken down into a series of percentages as necessary with ethyl alcohol. Tissue may be placed directly from water or the fixing solution into "Cellosolve." After one or more hours the tissue should be transferred to fresh "Cellosolve." Here it may remain indefinitely, until prepared for infiltration with paraffin. The addition of five percent glycerine aids in keeping the tissue soft although, with delicate organisms it is reported to cause some shrinkage.

Dehydration may be somewhat hastened when carried out under vacuum although the advantages are not great.

Clearing. The "Cellosolve" is removed from the tissue with Chloroform or xylol, preferably the former because its greater volatility makes it easier to displace.

This process may also be carried out under vacuum.

Infiltration with paraffin (paraffin-beeswax-rubber, Hance, '33.)

The tissue, after removal from chloroform, is placed in melted paraffin in a jar immersed in a water bath and connected to a filter pump. The vacuum thus produced causes the chloroform to leave the tissue in a stream of bubbles. The chloroform is replaced by the paraffin.

The water bath maintains a temperature of between 55 and 60 degrees Centigrade.

When the bubbles cease to come off from the tissue, infiltration is complete.

Time required for infiltration in vacuo varies from 15 to 120 minutes.

Paraffin so treated has a much better texture for cutting—presumably because all volatile materials have been removed.

The original rubber-beeswax-paraffin mixture according to the formula published by Hance in Science, Vol. 77, 1933, still remains superior to any other mixture so far developed.

Sectioning. Paraffin imbedded tissues section to better advantage after standing over night. It is assumed that this is due to the establishment of an equilibrium in the paraffin structure.

Stanley Wall Board knife blades have proven excellent for the sectioning of paraffin blocks. They are relatively thick and consequently stiff. In use they must be set at a considerable angle instead of nearly perpendicular as with the regular microtome knife. They take and hold a fine edge.

Mounting Sections. Albuminized water (about one ounce distilled water plus two or three drops of Mayer's albumen) to which is added one drop of "Tergitol #7" causes the sections to spread to much better advantage—an action again due to the reduction of surface tension phenomena caused by the detergent.

Staining the Slides.

Paraffin removed with xylol.

Through "Cellosolve" to water.

Stain.

Dehydrate in two changes of "Cellosolve."

Counterstain with Eosin in "Cellosolve" if desired.

Oil of Thyme three parts plus Oil of Cloves one part.

Xylol or benzol.

Mounting Cover Glass. The cover glass may be cemented in place with a benzol or xylol solution of isobutyl methacrylate. This dries hard and water white inside of ten minutes.

Isobutyl methacrylate may be used as a cover by itself. A thin film of this plastic may be flowed over the tissue and it will dry within a few minutes to form a very satisfactory protective covering. This material retails for about one dollar per pound in dry form. The Gilmore Drug Co., Pittsburgh, Pa. stocks it.

EXPERIENCES WITH A MARINE AQUARIUM

T. D. Howe

Duquesne University

A marine aquarium, purchased from Turtox, was set up in a north window about December 15th. The original assortment consisted of sea lettuce, starfish, sea anemones, snails, clams, a sea cucumber, sea urchins, and a hermit crab. The last two animals soon died; but the others are still in flourishing condition. We open the window when the room is warm to cool the aquarium. At times we run a current of air through the water; however, there is usually enough light for the sea lettuce to give off bubbles of gas. The starfish and sea anemones are fed pieces of clam. These are bought in the market and placed in the aquarium; about every ten days one is killed and pieces are fed to the animals, since the clams are too large for the starfish to eat themselves. Some of the snails and small clams have been killed by the starfish.

About the end of January small gelatinous masses were noted on the glass wall near one of the sea anemones. By the first of February one had developed tentacles and was seen to be a young sea anemones. The new individuals arose from fragments of the base of the larger animals.
six on the glass and at least ten on the sea lettuce near the other sea anemones. It has not been possible to determine whether they have arisen by budding or sexually.

Small plants of the sea lettuce have been visible on the glass for about two weeks, and are steadily increasing in size.

These animals are all cold-water forms and keeping them alive has been easier because of the cold winter. It remains to be seen whether they will survive during spring and summer.

The animals died off about the first of June with the coming of warm weather. The sea lettuce is overgrown with brown algae which suddenly grew very rapidly and apparently choked out the sea anemones.

THE UTERINE SEDATIVE ACTION OF AUTHENTIC VIBURNUM. X.

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A number of drugs have been found to stimulate the uterus whether isolated or in place, but drugs which have a dependable depressant or sedative action are extremely rare. For this reason the pharmacodynamic action of such drugs deserves thorough study.

The reports by Barratt in 1850 and by Phares in 1866 that Viburnum is a uterine sedative led to the publication of a number of clinical papers, and to a limited number of pharmacological reports, the first apparently being that by Sheeman in 1897. It was found that Viburnum has a uterine sedative action, is non-toxic, and causes a sedation of involuntary muscle, which is associated with a decrease in blood pressure.

A series of conflicting reports appeared between 1910 and 1920. Some workers confirmed the sedative action, while others insisted that commercial preparations were inert. A gap develops in the scientific literature after 1920. Dr. Heber W. Youngken and the author became interested in this question of activity and started cooperative investigations in 1928, which have been amplified and are still under way.

Youngken found various types of Viburnums being substituted for *Viburnum Prunifolium* and *Viburnum Opulus* N F and investigations in my laboratory showed that there were marked variations in potency of different samples of the same species, as well as great differences in activity between the different species of Viburnum.

A cooperative chemical, botanical, pharmacognostical, pharmacological, and clinical investigation was undertaken on the Viburnums. The material is being collected as it grows, from Maine down to South Carolina and Tennessee and also in the central west. Samples of various parts of the plant are being collected at various stages of growth and their pharmacognostic characteristics determined. Commercial shipments are sampled to determine the authenticity of the material. Authentic Viburnum, as identified by Youngken is used in these investigations. Powers has established the presence of a water soluble resin, various acids and a substance giving the reactions of an alkaloid.

Pharmacological studies have shown that authentic *Viburnum Prunifolium*, whether root bark or stem bark (root bark is now official) have definite uterine sedative activity. However, many of the substitutes and adulterants for Viburnum are inert. The recommendation has been made to the Revision Committee of The National Formulary that both root and stem bark of authentic *Viburnum Prunifolium* should be recognized in the next Revision.

CONCLUSION

Authentic *Viburnum Prunifolium*, root and stem bark contain ingredients which have a uterine sedative action. The adulterants present in some commercial shipments are usually inert.

ON THE RELATIONSHIP BETWEEN K, α, (H^+), AND pH.

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This paper presents a novel relationship between the ionization constant K, the degree of ionization α, the hydrogen ion concentration (H^+), and the pH of a solution.

Ostwalds Dilution Law, applied e. g. to the ionic equilibrium for acetic acid, states that the product of the hydrogen ion concentration and the acetate ion concentration divided by the concentration of the unionized acetic acid is a substantially definite value, known as the ionization constant.

This is usually expressed as follows:

$$\frac{(H^+)\ (CH_3COO^-)}{(CH_3COOH)} = K \qquad (1)$$

It is evident that:

$$(H^+) = (CH_3COO^-) \qquad (2)$$

Since acetic acid is slightly ionized it is ordinarily permissable, and customary for the sake of simplicity, to consider the concentraton of the unionized acetic acid to be the same as the total concentration of the acetic acid, and this concentration is frequently designated c.

Degree of ionization is usually expressed as a decimal fraction, and designated by the Greek letter alpha.

By definition:

$$\alpha = \frac{(H+)}{c} \qquad (3)$$

Or, rearranging,

$$(H^+) = \alpha c \qquad (4)$$

If, therefore, either the degree of ionization or the hydrogen ion concentration is known for a given concentration, it is possible to calculate the numerical value of the ionization constant K.

Thus, assuming that the degree of ionization for normal acetic acid = 4.2 x 10^{-3}, equation (1) reads:

$$\frac{(4.2 \times 10^{-3})\ (4.2 \times 10^{-3})}{1} = 1.8 \times 10^{-5} = K$$

Once K is known it is possible, again by using equation (1), to calculate the hydrogen ion concentration, and from this, by using equation (3), to calculate the degree of ionization for any concentration.

Thus, for 0.5 normal acetic acid, equation (1) will read:

$$\frac{X^2}{0.5} = 1.8 \times 10^{-5} = K$$

$$x^2 = 9 \times 10^{-6}$$

$$(H^+) = x = 3 \times 10^{-3}$$

Or perhaps more simply, since from equation (1):

$$(H^+) = \sqrt{K \times c} \qquad (5)$$

$$(H^+) = \sqrt{1.8 \times 10^{-5} \times 0.5} = 3 \times 10^{-3}$$

Substituting this value in equation (3):

$$\text{alpha} = \frac{3 \times 10^{-3}}{0.5} = 6 \times 10^{-3}$$

It is evident that equations (1), (2), and (4) can be combined to read:

$$\frac{\alpha c \times \alpha c}{c} = K \qquad (6)$$

$$\text{or } \alpha^2 c = K \qquad (7)$$

This gives the familiar physical chemistry text-book equation:

$$\alpha = \sqrt{\frac{K}{c}} \qquad (8)$$

We arrive, at long last, at the title of this paper. Recently two of my students, Messrs R. Forman and S. Walter, discovered empirically that $\alpha = K \div (H^+)$

This equation can be shown to be sound by rewriting equation (6) as follows:

$$\frac{\alpha c}{c} \times \alpha c = K \qquad (6A)$$

But obviously:

$$\frac{\alpha c}{c} = \alpha \qquad (7)$$

And, according to (4), $\alpha \cdot c = (H^+)$

Therefore $\alpha \times (H^+) = K$ (8)

or:

$$\alpha = \frac{K}{(H^+)}. \qquad (9)$$

or:

$$(H^+) = \frac{K}{\alpha} \qquad (10)$$

Equations (8), (9), and (10) are, of course, equivalent.

Equation (9) can be rearranged to read:

$$\frac{1}{(H^+)} = \frac{\alpha}{K} \qquad (11)$$

Since pH is defined as log $\frac{1}{(H)}$, it follows that

$$pH = \log \frac{\alpha}{K} = \log \alpha - \log K \qquad (12)$$

Any one of equations 8-12 can therefore be used to compute or to define K, α, (H^+), or pH. It is hardly to be expected that they will replace the established equations and definitions. It is believed, however, that for the semi-mathematical mind, they may afford additional insight into the significance of and relationship between these values.

ANIMAL ACTIVITY AT DUSK

STANTON C. CRAWFORD

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Earlier records[1] of animal activity in the crepuscular zone reported by this writer were made at inland points, in deep jungle, or in hilly country. Reference of the time of activity of animals to the moment of sunset was somewhat unsatisfactory because of the difference between actual and apparent moments. The observer could refer to his watch, but the animals lacked such an instrument. The present records were made on open land which lies virtually at sea level, where the apparent sunset approximates the actual. Neither upstanding hills nor trees of the rain forest obscure the available light, as in the earlier instances.

With the approach of evening, typical daytime species become inactive one by one. The nocturnal species appear in sequence throughout the period of dusk, rather than together, in final darkness. Many species seem to be attuned to certain ranges of light intensity. The nocturnal forms gradually replace the diurnal ones until a new population is abroad. In successive intervals the dominance of different species is apparent.

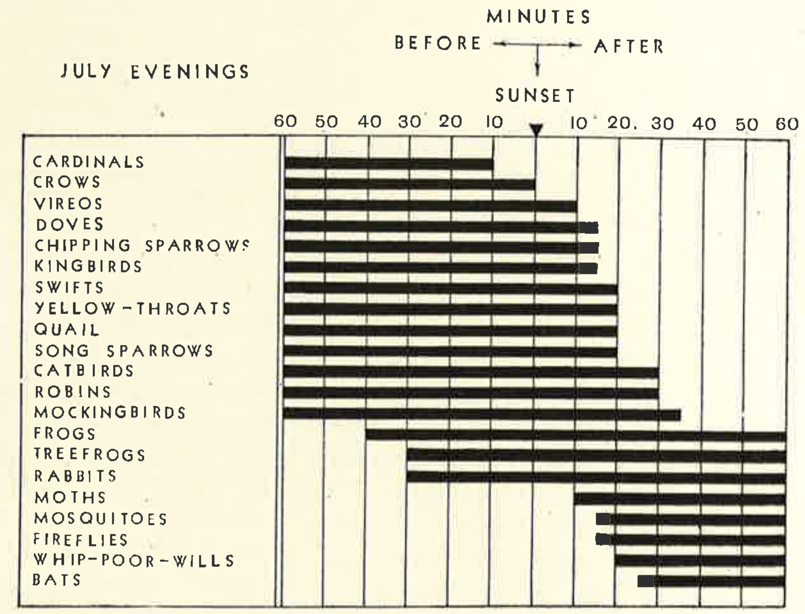
Observations were made at Bethany Beach, Delaware, in the summers of 1938 and 1939. Records cover occasional evenings of June, July, August and September. The chart is based on ten records for July. About 200 yards from the ocean shore, a small clearing is surrounded by thickets. The more conspicuous members of the plant association are sumac, wild cherry, groundsel-tree, water oak, bayberry, willow, grapevine, blackberry, trumpet creeper, Virginia creeper, poison ivy, honeysuckle, mallow, cat-tail, and at short distances, pine.

Notes were made on sheets drawn in checkerboard fashion, with animal species written in the left column and time intervals across the top. Five-minute intervals were employed. Activity of an animal was recorded if it was seen or heard. Meteorological data were recorded. From these records, animal forms have been listed

[1] Crawford, S. C., Twilight and Dawn in Guiana. Nat. Hist., Vol. XXXII, No. 2, 1932.

Crawford, S. C., A Survey of Nocturnal Vertebrates in the Kartabo Region of British Guiana. Animal Ecol., Vol. 2, No. 2, 1933.

Crawford, S. C., Crepuscular Life Viewed from a City Lot. Proc. Penna. Acad. Sc., Vol. VIII, 1934.



in the sequences in which they begin or cease activity with reference to the moment of sunset. Prominent examples are charted in the diagram. Many more observations would be required before the activity of the less conspicuous species could be charted.

The diagram simplifies the records for the sake of clarity. The composite record for each form named is represented by a horizontal line, beginning or terminating at a moment with reference to sunset in a manner which is remarkably constant for that species. Of course, the degree of activity of an animal varies from interval to interval as each evening progresses.

Such a record disregards minor nightly variations in light intensity due to weather conditions. Intensity of available light depends on factors such as clouds, haze, smoke and rain, as well as on the time with reference to sunset. The activity of various animals, especially of amphibians and insects, is profoundly affected by changes in humidity. Further, the activity of insectivorous birds depends on the abundance of insects, a most variable factor. There are normal seasonal changes and successions in the populations to be observed. Also there are differences in the times of usual activity among even closely related species of moths, fireflies, and other insects and of some vertebrates.

In spite of all these qualifying factors, there is remarkable consistency in the performance of each species from evening to evening. Many physiological and ecological factors are involved. This study is not meant to solve them but to call fresh attention to them. Life of the crepuscular zone deserves more study than it has had. The opportunity for research in this field is open in some form to almost every student.

PRELIMINARY SURVEY OF THE LARVAL TREMATODE PARASITES OF EASTERN UNITED STATES

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The Larval Trematode Parasites have been the subject of much research in several parts of the United States, notably in the Mid-west, the Great Lakes region and on the Pacific Coast. In some lakes of the latter region the infection of snails, in which the larval stages are principally found, has been found to be above fifty percent. Not since Leidy's last work in 1890 has much work been done on these parasites in this area. The snails thus far examined in this Eastern section show a much smaller percentage of infection, although the number of different species is probably as great. Thus far only the redia, cercaria and encysted stages have been found. The exact species names of these larval forms of Eastern United States can be given only with certainty when their complex life cycles have been worked out and the adult stages identified. (Measurements and drawings will be included in the completed survey).

THE BEHAVIOR OF PARAMECIUM CAUDATUM IN SOLID AGAR MEDIUM

FRANK FORTUNATO

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It occurred to me that solid instead of liquid media might conceivably be employed to afford a more controllable substance in which paramecia could be better observed.

The same technique, sterilization methods, etc., employed in bacteriology were made use of in this experiment. Accordingly, agar mixtures of varying densities were prepared. It was found that a 1 per cent agar mixture in distilled water could be satisfactorily used.

The procedure is as follows: Sterilize ten 70mm x 10mm Petri dishes in a dry oven at 180° C. for approximately one hour. Prepare about 200 c. c. of a 0.75 per cent to 1.0 percent mixture of Agar, U. S. P., in distilled water and dissolve by autoclaving for 10 minutes at 15 lbs. pressure.

Into each of the Petri dishes inoculate as aseptically as possible, by means of a sterile pipette, 1 c. c. of liquid medium containing between 5 and 10 organisms. When the flask containing the agar mixturei s sufficiently cool to permit pouring without injuring the organisms, raise the petri dish cover high enough to permit the entrance of the neck of the flask and pour into each of the dishes enough agar mixture to fill it about 4|5 full. Replace the cover at once. Carefully disperse the organisms before the agar mixture solidifies. When solidification takes place seal the cover and the dish with DuPont cellulose tape.

A microscope magnifying about fifty diameters was employed throughout the period of observation which lasted for about sixty days. During this time the following general observations were made:

1. If properly sealed, moisture and food in the medium (from contaminating organisms) may be retained for long periods of time.

2. Movement of the paramecia is somewhat sluggish and necessarily restricted.

3. Division is definitely retarded. Only one division occurred during the length of the period of observation. (60 days).

The possibilities of a solid medium of this sort have not been sufficiently explored to warrant any prediction concerning its general use. More experimentation is necessary; and it is hoped that this brief paper may stimulate interest in this type of work.

SOME APPLICATIONS OF COLLOID SCIENCE IN THE CERAMIC INDUSTRY

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Department of Ceramics, School of Mineral Industries, The Pennsylvania State College

The trend in most industries, in recent years, to put much greater emphasis on the use of scientific methods and scientific knowledge in bringing about closer control of their manufacturing processes, as a result of which it is possible to improve products and to develop new ones, probably has not been exemplified better in any business than in the ceramics industry.

In the manufacture of dinnerware, all varieties of glass, paving and face brick, electrical porcelain, floor and wall tile, porcelain enamel, abrasives, refractories of all kinds (for glass making, metallurgical processes, firebox linings, linings of cement and lime kilns, etc.), whether they be ceramic products for the home or for use by other industries, the applications of physics, chemistry, physical chemistry, mineralogy, and other sciences have become so numerous and so important that students who are preparing to become ceramic technologists must have a different kind of education than formerly. Throughout the recent periods of slack business there has been a steady demand for qualified ceramic scientists, or technologists, for positions involving research, control, development, or production.

CLAY AS A COLLOID

The applications of colloid theory and practice are important in all parts of the industry. A substance is said to be in the colloidal state when its ultimate particles lie in the size range between, as an upper limit, particles that can just be seen under the microscope, and, as a lower limit, particles that are in molecular dispersion (solution). The conventional limits are 0.1 micron and 1 millimicron, although colloidal behavior is found to some degree in particles as large as one or two microns. The predominant properties involved in colloidal systems are (1) a continuous phase, or dispersion medium; (2) a finely divided (discontinuous) disperse phase; (3) large total area of disperse phase exposed, magnifying surface effects and reactions; (4) charge relations, whereby the colloidal particles behave somewhat like true ions, and, for example, move toward an electrode when a direct current is passed through their aqueous

suspension; (5) Brownian movement, a random migration which results from the fact that the colloidal particles are nearly as small as the molecules of the suspending medium, and are kicked about by them, which explains the very slow settling of colloidal suspensions.

Clays, as a group, probably constitute the raw material used to the greatest extent in ceramics. It is interesting to note that although there are many kinds of clay, they are used almost invariably for their plastic properties, which in turn depend on their colloidal character, or they are used for their colloidal properties as such. That is to say, clays are composed largely of particles in the size range of colloids, and as a result, wherever they are employed for their physical properties, their proper use involves a knowledge of their colloidal behavior. Considerable attention, therefore, is given to the teaching of colloid chemistry and physics in the ceramics curriculum.

Many industrially important ceramic processes involve the production of suspensions of clay in water, with or without the addition of other pulverized material. The processes are controlled by causing the clay to respond to added chemicals which will tend to flocculate or deflocculate the clay, as the circumstances may require.

Deflocculation: Dilute clay suspensions (two grams in 100 cc. water, for example) are said to be deflocculated, dispersed, or peptized if the particles of clay are present chiefly as separate, single units; Brownian movement is easily detected under the microscope with darkfield illumination; the rate of settling of particles from suspension is low, and the suspension is said to be stable. The charge on the particles is believed to be above the critical potential.

Flocculation: Dilute clay suspensions are said to be coagulated, or flocculated, if the particles tend to agglomerate into curds, or flocs. Because of the large size of the flocs, the rate of settling is rapid and the suspension is said to be unstable. The charge on the particles probably is less than the critical potential.

In concentrated suspensions (50 grams in 100 cc. water, for example) the changes from flocculation to deflocculation (similar to the gel-sol transformation) usually are accompanied by large changes in viscosity. If a very stiff mud in the flocculated condition be deflocculated, a thin, easily pourable slip will be formed.

Cause of Viscosity Changes

To illustrate the profound changes in fluidity possible when a thick clay-water mixture is flocculated or deflocculated, the following determinations were made on a mixture of clays in commercial use. Selected, more colloidal, clays would have shown even greater differences.

(a) Water content to make the mixture pour easily, in water alone, 155%.

(b) Water content to make it equally fluid, when deflocculated with NaOH, 45%.

(c) Water content to give it the same fluidity when flocculated with HC1, 210%.

(d) Water content to make the mixture moldable, as received, 40%.

(e) Water content for same consistency, deflocculated, 29%.

(f) Flocculated, 50%.

In other words, it is possible to pour easily a deflocculated slip containing less than the amount of water than is in a flocculated clay in the condition for modeling.

A remarkable fact is the small amount of reagent capable of causing these effects. For example, one milliequivalent of NaOH reduces the viscosity of 100 grams of certain clays, suspended in water, from about 13,000 times that of water to 100 times, and 2 m. e. probably is enough to bring it down to 8 times water. The deflocculation is reversible; a reagent capable of causing deflocculation will restore the high viscosity, or even make the slip stiffer.

The viscosity of a suspension in which the amounts of solid and water are fixed is very largely a function of the relative volume of each. The volumetric interference of the suspended particles will be increased by any process which will apparently reduce the available suspending and lubricating liquid. Flocculation and deflocculation of thick clay suspensions, which are on the border line between having too little water for easy flow, and having just enough, seem to be dependent on where the water is, and what it is doing. If part of the water is trapped within the flocs of a flocculated suspension it is practically useless as suspending medium, and the viscosity will be high. However, if the clusters are dispersed by the deflocculating action of an added reagent such as NaOH, this water is released, joins the untrapped water, and by changing the apparent ratio of liquid to solid, increases the pourability.

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SPECIFIC HEAT MEASUREMENTS FOR THE LABORATORY

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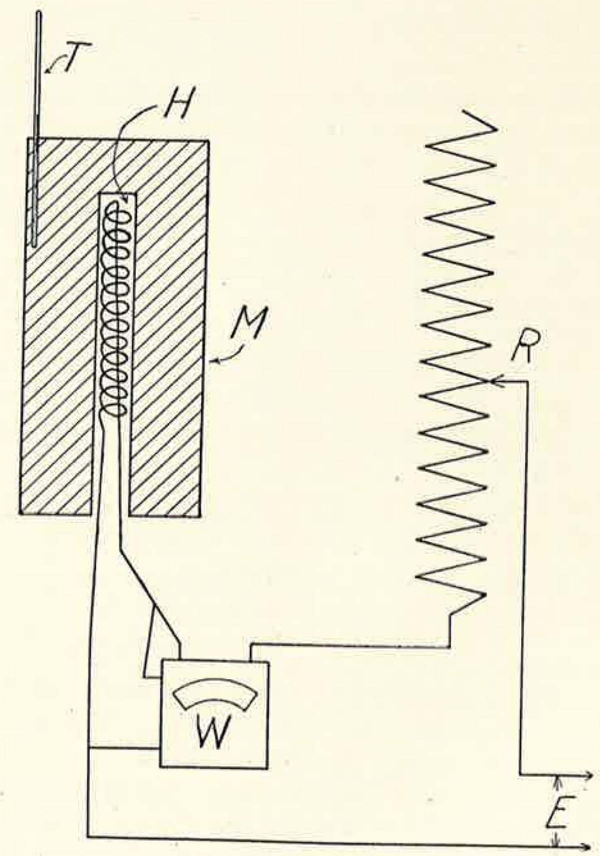
Dickinson College

A laboratory experiment, from the standpoint of the beginner, should be a verification of some law or principle, theoretically developed in the classroom. Too often, however, the verification is somewhat doubtful because of large variable errors due to poor technique, apparatus, etc. There is, to be sure, a certain amount of difficulty to be encountered in the process of carrying out any routine laboratory experiment, but the group of experiments in calorimetry as a whole seem to cause the most trouble.

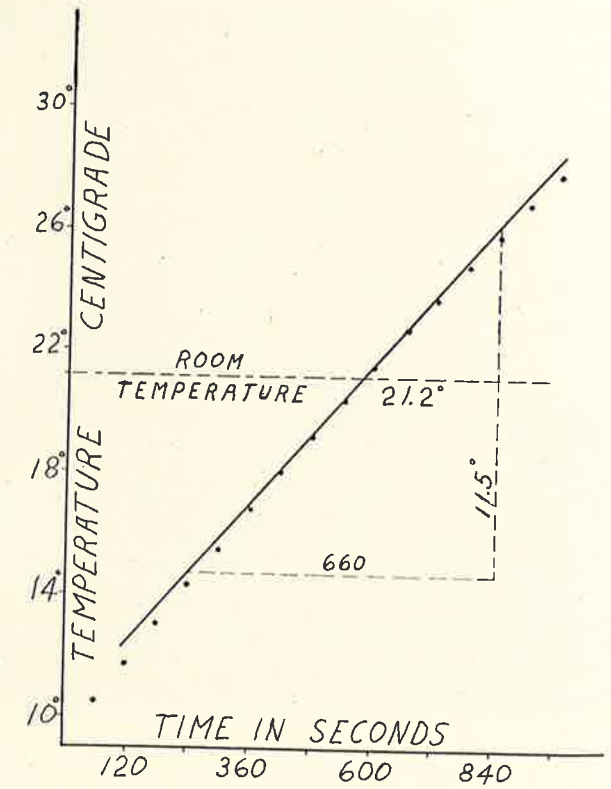
The general laboratory method for determining the specific heat of metal by the process of "mixing" a known mass of hot metal with a known mass of cold water is very simple in theory, but has, as is well known, several practical difficulties. These errors in the method of mixtures were largely responsible for the present electrical method for the determination of specific heats which avoids these uncertainties, and at the same time, furnishes an excellent verification of the electrical equivalent of heat.

A diagram of the apparatus used is shown in figure 1. A small electric heating element, H, is placed in the center of a cylinder, M, of the metal whose specific heat is to be determined. A small hole is drilled near the circumference of the cylinder for the thermometer, T. A rheostat, R, controls the current, and a wattmeter, W,



registers the power used by the heating element. A stop watch is used to record the time. A second thermometer is used to indicate the room temperature during the experiment.

The procedure for a given specific heat determination is as follows. The cylindrical sample of the metal is first cooled about 15 degrees Centigrade below room temperature. It is then placed on the heating element drawing a constant, known amount of power. At the same time, the watch is started and the initial temperature of the metal recorded. The temperature is observed at regular time intervals (60 seconds is very convenient) until there have been at least five readings above that of room temperature. The room temperature should be recorded every time the temperature of the metal is observed since it can vary several degrees during the period of the experiment.



From the observations made, a temperature-time curve is plotted, as in figure 2, temperature readings taken as ordinates, and time intervals as abscissae. It is to be noted that the curve is not a straight line. It would have been a straight line, however, (except for a slight deviation due to the variation of specific heat with temperature) had there been no exchange of heat between the metal cylinder and the surrounding atmosphere. The ideal temperature-time curve is found by drawing a tangent to the curve at the point where the room temperature line cuts the experimental temperature-time curve.

It will be noted that below room temperature, the experimental curve has a greater slope than that of the ideal curve because heat is being absorbed by the metal from the surrounding air. Above room temperature, the slope of the experimental curve is less than that of the ideal temperature-time curve because heat is

being given up by the metal to the atmosphere. Thus, only at room temperature is the time rate of heat absorption by the metal free from errors due to heat exchanges.

The temperature variation and the corresponding time interval are found by taking the coordinates of two conveniently separated points on the tangent to the temperature-time curve, and not on the experimental curve itself. This avoids one source of error mentioned above, namely, that due to the exchange of heat between the metal and the surrounding atmosphere.

The energy developed by the heating element is given by:

$$H_1 = .24\ W\ T$$

where H_1 is the heat in calories developed by the heat element, W is the power in watts drawn by the heater, and T is the time in seconds. The energy absorbed by the apparatus is given by:

$$H_2 = M\ S\ (t_1\text{-}t_2) + C\ (t_1\text{-}t_2)$$

where H_2 is the heat absorbed, M is the mass of the metal in grams, S is the specific heat of the metal to be determined, C is the com-

bined heat capacity of the heating element and the thermometer, and $(t_1\text{-}t_2)$ is the temperature change in degrees Centigrade. Since the heat developed is equal to the heat absorbed, $H_1 = H_2$, and we have:

$$M\ S\ (t_1\text{-}t_2) + C\ (t_1\text{-}t_2) = .24\ W\ T$$

Solving this for the specific heat, S, we have:

$$S = \frac{.24\ W\ T - C\ (t_1\text{-}t_2)}{M\ (t_1\text{-}t_2)}$$

The sample used for the temperature-time curve shown in figure 2 was a piece of cold rolled steel having a mass of 2200 grams. The power used by the heating element was 20 watts. The combined heat capacity of the heater and thermometer was 15. From the curve, using a time interval of 660 seconds and the corresponding temperature change of 11.5 degrees Centigrade, the specific heat of the steel was found to be 0.118 which agrees with the generally accepted values.

A photograph of the apparatus in use is shown in figure 3. By using cylinders of the same material having different masses, and by varying the amount of power used by the heating element, a large number of independent sets of observations can be obtained. The metals used in this group of tests were aluminum, brass, and steel.

A STUDY OF TISSUE FROZEN BEFORE FIXATION

WILLIAM E. LLOYD AND ROBERT T. HANCE

Graduate School, Duquesne University

Hance demonstrated in 1917 that the fixation of mammalian tissues in ice cold chrome-osmic-acetic solution preserved the chromosomes in characteristic life-like condition. The cooling of the tissue was thought to check most physiological activity until the killing fluid could penetrate and fix the cellular structures.

The failure of sudden freezing to permanently injure living organisms (goldfish may be frozen solid in liquid air but return to normality when placed in water) suggested that tissues subjected

Hance, R. T. 1917. The fixation of mammalian chromosomes. Jour. Morph., Vol. 12.

Hance, R. T. 1933. A new paraffin embedding mixture. Science, Vol. 77.

to these lower temperatures before immersion in the fixative might be well preserved.

Pieces of the liver, lungs, and alimentary tract from the frog were immersed in liquid nitrogen for thirty seconds and then transferred to a picro-formo-acetic mixture known as B #3. The tissues were kept in this solution which was cooled in ice for twelve hours to allow a gradual thawing and the slow penetration of the B #3. Dehydration in cellosolve and clearing in chloroform followed. In filtration with rubber paraffin was carried out under vacuum which required three and one-half hours.

The first experiments with this technique have yielded tissue that was very well preserved although not conspicuously better than afforded by the usual technique. It is worth noting, however, that the preservation, if not better, was at least very good indicating that the severe cold had produced no abnormalities. This justifies further investigation along these lines and suggest the following modifications in procedure.

The transfer of tissue from liquid air to ice cold fixative involves a rise in temperature of about 200 degrees Centigrade. It has been found possible to make a fixative which, containing little water, will have its freezing point greatly reduced. Tissues transferred from liquid air to such a fixing solution cooled to 30 or 40 degrees below O Centigrade will suffer less shock than occurred in the above experiments. The solution and frozen tissue can be allowed to slowly regain room temperature. The results, we hope, may shed light on the effect of very low temperatures on protoplasm as well as afford improved methods of preservation.

PLASTICS OF POSSIBLE USE IN MICROLOGY

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The term plastics broadly includes materials which possess plasticity, that is, materials which may be deformed by mechanical stress and which maintain that new form. The qualities affecting such deformation and the qualities which plastics attain and maintain are very complex functions of their compositions and handling. A survey of the growing number of resins, both natural and synthetic, of their complement solvents and associated materials, and other organic plastics (such as cellulose and its derivatives) in which we are interested, leads us to marvel at their continuous development and the possibility of their unlimited modification and adaptation.

Such growth of new materials, which is in response particularly to thousands of new Industrial demands, furnishes the Scientist with new tools and the opportunity of adopting and adapting them to his benefit.

The general types of resins suitable for possible use to the Micrologist for support and protective purposes are macro-molecular, polymerizing organic plastics. These may be considered in two classes:

1. The heat-hardening alkyds, phenolic, and urea type resins,
2. The cellulose derivatives-vinyl polymers, cyclized and chlorinated rubbers, acrylic, olefinic and styrene polymers.

It must be remembered that for your purpose thousands of modifications and improvements of these new synthetic resins are possible through the use of mixtures with natural and other resins, of different solvents, and of chemical mechanisms such as wetting agents, etc. The makers of these new products are generally anxious to find new uses for them and they are, therefore, willing to lend their technical facilities to your use.

The Micrologist uses a wide variety of chemicals. His resins are imported from all over the world. His dyes and stains are manufactured by synthesis or obtained by incredible and painstaking care. His materials make or break his specialized technique. He is, therefore, looking for new materials in the hope of technique improvement. How long will the Histologist maintain his standby list of chemicals and technique with the advent of so many new materials?

Take the case of mounting media:

For years Canada Balsam has been the standby. It has been used in mounting whole objects and sections, for microscopic inspection. It is almost a general laboratory cement.

Gum Damar, Euparal, Hydrax and Styrax are others. In their favor are favorable refractive index values, adhesion, and drying characteristics. Against them are poor color, slow drying of low volatility, solvents and certain chemical reactivity.

Already several synthetics have been used successfully as substitutes. eg. Nevillite acycloparaffin of improved color, solvency, and drying and Isobutyl methacrylate, presented as a superior mounting medium by Dr. Hance and myself. This material has excellent optical properties along with others. The acrylic resins are of exceptional interest in the support and preservation of organic tissues.

In considering the Micrologist's methods of imbedding tissue for sectioning, it may be difficult to supplant the use of paraffin. Perhaps it will be easier to supplant cellulose (celloidin) with a synthetic or cellulose derivative of improved properties. The Hercules Powder Company manufacture a number of similar materials such as Ethyl Cellulose, Cellulose acetate and Hercose C & A P. An investigation of these may prove profitable.

As for paraffin, it has been improved by the addition of favorably modifying materials but can we combine the properties of the fixative and preservative with the embedding medium? It may be possible that synthetic waxes, water soluble ones, with antiseptic properties will be used or water soluble, crystal-clear resins with like properties. Glyco Products, New York, make a number of such materials, along with emulsifying agents, wetting agents, etc. Again can we minimize dehydration with a technique utilizing a water soluble paraffin? Or would it be possible to precipitate such a material as vinyl acetate in the tissue and polymerize it to the desired state by different mechanisms? Can we stain and mount in toto in one operation with such a material as isolac which is a thermoplastic dissolving resins with staining properties?

These are but a few questions to the Micrologist and they involve the need of new materials.

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Micrology, Gnyer.
Dr. R. T. Hance, Duquesne University.
L. J. Behan, Paint Research Chemist, St. Joseph Lead Company.

A NEW SPHINX FROM EASTERN UNITED STATES

W. Sweadner, F. H. Chermock and R. L. Chermock

Graduate Schools University of Pittsburgh and Duquesne University

Ceratomia catalpae KANAWAHENSIS new race

In the summer of 1933, two of the authors visited the Kanawah valley in West Virginia in search of *Argynnis diana* which according to W. H. Edwards, a well known lepidopterist, and a native of that region, occurs in the Kanawah valley. During our search for this insect, we noted that the catalpae trees were defoliated, and investigated as to the cause. We noticed around the trees large pellets of excrement which we assumed to be from sphingid larvae. Near Coalburg, our search for the larvae resulted in a few specimens, which we were fortunate enough to rear. Although the larvae appeared to be those of *Ceratomia catalpae*, the adults, upon emergence, did not agree with the little material we had on hand. However, we refrained from reaching any definite decision concerning these specimens until we obtained more examples of both the typical and Kanawah *catalpae*.

During the summer of 1937, two of the authors made an expedition into this region especially for this hawkmoth, and obtained a large number of larvae from Braxton County, West Virginia. These were reared, and a fine series was obtained which still illustrated the same distinctive characters of the specimens from Coalburg. Some specimens from this brood were successfully bred and reared, proving that the moth was at least double brooded.

Recently, we acquired an excellent series of typical *catalpae* from the east (N. J. and Eastern Pa.) and upon comparison with the Kanawah material we found the two forms distinct and easily separated. The late Foster H. Benjamin of the U. S. National Museum, declared this locality the farthest west record to date. After considerable study, we decided that the Kanawah form is distinct and unnamed. Because of its abundance in the Kanawah basin, we have decided to call this race *KANAWAHENSIS*.

This new race can be easily distinguished from the typical *catalpae* by its uniform light gray coloration, in contrast to the uniform brownish color of typical *catalpae*. Further, there is a marked tendency to an obliteration of the markings. In no case, are the dark markings as heavy or well defined as in the New Jersey specimens. The type series is extensive, containing over two hundred specimens, from the late June and August broods. However, the deformed specimens will not be included in the type series.

Holotype, male—Braxton, W. Va., IX-4-1937.
Allotype, female—Braxton, W. Va., IX-4-1937.
Paratypes, nos. 1-200—Braxton, W. Va., and Coalburg, W. Va.

NEW MELANIC MOTHS FROM SOUTHWESTERN PENNSYLVANIA

F. H. CHERMOCK AND R. L. CHERMOCK

Graduate School, Duquesne University

It has been found that numerous European Lepidoptera found around the large industrial cities in England and on the continent have melanic forms occurring in relatively large proportions. The European workers have noticed this and have applied the name "Industrial Melanism" to the phenomenon. This type of melanism appears to be predominant among the *Noctuidae* and *Geometridae,* but does occur in other families of moths. In attempting to explain this peculiar type of melanism, Hasebrook subjected the pupae of various moths to ammonia, pyradine, cyanide, methane, chloroform, and natural gases for a long period of time and obtained partial melanism in the adults. He concluded that these gases may exist in the air around industrial areas and may be an explanation for industrial melanism. Harrison and Garrett fed the larvae of some moths on plants treated with chemicals such as Magnesium sulphate solutions which may occur around industrial areas, and obtained a fair percentage of melanics. Consequently, industrial melanism was attributed to chemicals present in the air around industrial regions and may even give rise to mutations which can be inherited from one generation to another because of the genetic makeup of the moths.

The authors have been collecting for a number of years in southwestern Pennsylvania, which is an industrial area, and have discovered many unnamed moths which seem to illustrate industrial melanism. It is the purpose of this paper therefore, to name and describe some of these.

Ceratomia undulosa ENGELI new form

In this form, the usual gray color is replaced by black or a deep cinnamon brown. This is true of both wings and both surfaces.

Holotype, male—Finleyville, Pa. VI-15.
Allotype, female—Finleyville, Pa. VI-21-1938.
Paratypes, nos. 1-30—Finleyville, Pa.; Wall, Pa.; Aspinwall, Pa.; and Pittsburgh, Pa.

Many of these specimens were reared, but the majority were taken at lights and flowers. We take great pleasure in naming this fine hawkmoth in honor of our good friend Mr. Henry Engel who has reared this moth.

Euparthenos nubilis UNILINEATA new form

This form is characterised by its melanic primaries and by the presence of a single transverse submarginal line of deep yellow across the secondaries. Below, it is a characteristic melanic.

Holotype, male—Indiana, Pa. V-23-1934.
Paratype no. 1—Pittsburgh, Pa. VIII-13-1934.
Paratype no. 2—Pittsburgh, Pa. June.
Paratype no. 2 has been deposited in the Southern California Academy of Sciences.

Apatela hamamelis GUYASUTA new form

In this form the usual gray is suffused by black scales on the primaries. The genitalia agree with the typical form.

Holotype, male—Pittsburgh, Pa. VI-9-1936.
Allotype, female—Pittsburgh, Pa. VI-9-1936.
Paratypes, nos. 1-42—Pittsburgh, Pa.; Butler County, Pa.; and Aspinwall, Pa.

Apatela impressa LEMMERI new form

This, like the preceding form, has the gray on the primaries replaced by black scales. Again, the genitalia agree with the typical form.

Holotype, male—Pittsburgh, Pa. VII-16-1925.
Allotype, female—Indiana, Pa. V-3-1935.
Paratypes, nos. 1-40—Pittsburgh, Pa.; and Indiana, Pa.

Conistra morrisoni OPACA new form

In this form, the tawny brown color of the primaries is replaced by a grey ochraceous color. The transverse white lines appear much whiter due to the dark color.

Holotype, male—Indiana, Pa. IV-23-1935.

Heterocampa bilineata BOWERI new form

In general appearance, this form has much in common with the other melanics, the primaries are suffused with black, and the light transverse lines stand out very distinctly. The genitalia agree with the typical form.

Holotype, male—Pittsburgh, Pa. V-27-1922.
Allotype, female—Pittsburgh, Pa. VIII-11-1924.
Paratypes, nos. 1-3—Pittsburgh, Pa.

We take great pleasure in naming this form in honor of our friend and fellow collector, Mr. John Bower, N. S., Pittsburgh, Pa.

Heterocampa guttivitta HUGOI new form

In this form, not only are the primaries suffused with black, but in most cases, the secondaries are also suffused with black. The genitalia agree with the typical form.

Holotype, male—Finleyville, Pa. VI-5-1939.

Allotype, female—Pittsburgh, Pa. VI-4-1923.

Paratypes, nos. 1-47—Finleyville, Pa.; and Indiana, Pa.

We take great pleasure in naming this form in honor of our father, Hugo L. Chermock. He has been a very active collector since his youth.

A NEW RACE OF *EUPHYDRYAS PHAETON* DRU.

F. H. Chermock and R. L. Chermock

Graduate School, Duquesne University

In 1927, Dr. Austin H. Clark, recognized two distinct races of *E. phaeton,* the one a northern race and the other a southern race. He considered the northern race as typical and redescribed the southern race from Maryland specimens, calling it *schausi.* The southern race represents typical *phaeton,* therefore *schausi* becomes a synonym of *phaeton* leaving the northern race without a name. Dr. Clark, because of our study and extensive material on hand, has advised us to describe this unnamed northern race.

Euphydryas phaeton BOREALIS new race

Upper side: the ground color of this race is a jet black, almost glossy, in contrast to the dull sooty black of typical *phaeton;* the orange marginal spots of *phaeton* are replaced by large, almost red markings which form a rather wide band intersected only by the black veins. The red spots in the cells of both wings are large and pronounced; white markings similar to *phaeton.*

Lower surface: The red markings on this surface are again large and very pronounced; white markings similar to the typical form.

Male wingspread averages about 42 mm.; female wingspread averages about 47 mm. Generally, this race is smaller than typical *phaeton.*

Holotype male: Lincoln, Maine, VI-30-1935.

Allotype female: Lincoln, Maine, VII-6-1932.

Paratypes nos. 1-100: Hamilton, Ontario; Enfield, Maine; Lincoln, Maine; Portland, Maine; Mer Bleue, Ontario; Lanoroie, Quebec; Georgeville, Quebec; Knowiton, Quebec; Baddeck, N. S.

Holotype is deposited in the Canadian National Museum, paratypes will be deposited in various museums and major collections.

STUDIES IN URINE ANALYSIS

Lawrence Marshall

Graduate School, Duquesne University

Organic pigmentation presents a series of Biological problems extending from the coloring of moths and butterflies to that of human races and on the abnormal side we have the serious melanotic tumors of man and other mammals. Any study of melanin formation and behavior may contribute to our knowledge of what may well be a sort of biological indicator.

During the past year I have made a series of Total Nitrogen Determinations on the urine of normal healthy Negro children living under carefully controlled conditions. The results have been interesting.

The procedure used was the conventional Kjeldahl, involving the digestion of the sample with strong sulfuric acid, releasing the ammonium compound with concentrated alkali solution and carefully measuring the quantity of ammonia released. Standardized acid is used to catch the liberated ammonia. This standardized acid is used against a base of standard strength. The amount of nitrogen from this, of course, is easily calculated. Potassium acid pthalate was used in standardization. The arrangement of the apparatus was such that the ammonia loss was reduced to a negligible minimum. The source of the samples was a children's home in the city of Pittsburgh, where the donors, children between the ages of nine and thirteen, were ascertained to be healthy and blessed with normal appetites (an eccentric appetite would influence the results considerably) and where the prevailing conditions made for excellent control from a standpoint of diet, exercise, sleep and similar factors.

On the basis of twenty cases the average percentages made for a range from 1.51 to 1.07 percents for total nitrogen. It was noted that the darker children revealed a higher percentage than did those children of lighter pigmentation.

Two cases of brown children showed a greater nitrogen content than did the darker children. The fact that pigmentation is not a simple Mendelian factor might introduce some irregularities.

The investigation was limited to children because the total nitrogen in people of this age is known to represent, in most cases, breakdown nitrogen. This is due to the growth factor. (Bodansky)

It is only natural that one would be tempted to draw the conclusion that a definite relationship exists between this nitrogen content and pigmentation. However, because it is not possible at present to settle certain factors for the cause of the relationship, future work must decide whether (1) there is a breakdown of melanin that would increase the total nitrogen or (2) there is an increased appetite in normal behavior of the darker children for protein in compensation for the synthesis of protein in metabolism.

A PLASTIC COVER GLASS

HAROLD C. O'BRIEN AND ROBERT T. HANCE

Graduate School, Duquesne University

Either Canada Balsam or gum Damar, long used media for cementing covers over tissue sections has the objections of taking days to harden sufficiently to permit cleaning and of turning yellow with age.

Nevillite, or Clarite, as recently suggested by the General Biological Company, dries rapidly and is practically without color.

We have recently found that another plastic, isobutyl methacrylate dissolved in benzol or in xylol is a water white solution, dries hard in from five to ten minutes, and results in a mounted preparation that is somewhat more brilliant when viewed under the microscope than are specimens mounted in Clarite. The refractive index of the dried film is given as (1.477), almost exactly that of glass. Due to the slightly lower index of refraction over Balsam (1.535), unstained or faintly stained elements are rendered visible. As is claimed for Euparal, isobutyl methacrylate should become serviceable in the study of spindle fibers and other such delicate cytological elements.

Mention should be made of the possibility of using isobutyl methacrylate as a mounting fluid under 3000 angstrom units in the Ultra-violet spectrum where its high transmission would be advantageous.

Also isobutyl methacrylate may be used to replace the cover glass or possibly the quartz cover.

A stained section on a slide when dipped into a thin solution of this plastic, withdrawn carefully so that the solution draws evenly

from the slide, will be so coated as to protect it with apparently the same adequacy as does the usual cover glass. The coating on the back of the slide may be allowed to remain or can be removed with a cloth moistened with benzol or xylol.

The thinness of this coat will interfere less with the transmission of light than does a cover glass. Immersion oil does not dissolve it and the film can be washed in alcohol and polished with a paper handkerchief. The film will scratch but these scratches can be removed by dipping the slide again into the solution of the plastic.

This film can be written on with ordinary ink. Or a label can be written directly on the glass and then dipped, for protection, into the isobutyl methacrylate. The quick drying characteristics of this new solution may make it useful in filling up deep well mounts. The crystals sell for about a dollar a pound. It was originated by the DuPont Company.

LIST OF MEMBERS OF THE PENNSYLVANIA ACADEMY OF SCIENCE 1940

Walter Ainsworth, 1233 W. Girard Avenue, Philadelphia	1939
Paul F. Albright, 1300 Lancaster Avenue, Reading	1940
Russell B. Alderfer, Soil Conservation Service, Experiment Station, State College	1940
Arthur K. Anderson, State College	1939
Wilbur Charles Anderson, 221 Emerson Avenue, Aspinwall	1939
G. M. Appleby, 22[illegible]3 Chestnut Street, Harrisburg	1937
J. L. T. Appleton, 4001 Spruce Street, Philadelphia	1939
Sister Mary A. Archibald, Rosemont College, Rosemont	1932
George H. Ashley, State Geologist, Harrisburg	1924*
John L. Atlee, 37 E. Orange Street, Lancaster	1931
Arch A. Aucker, 339 Clay Avenue, Scranton	1925
A. Avinoff, Schenley Hotel, Pittsburgh	1928
Hazel E. Baer, 5 Derrick Avenue, Uniontown	1939
Horace Burrington Baker, Zoology Department, University of Pennsylvania, Philadelphia	1937
Rhea Olive Baker, South Philadelphia High School for Girls, Philadelphia	1940
Roger M. Baker, Bureau of Plant Industry, Harrisburg	1937
Ewart M. Baldwin, New Bloomfield	1939
Lena M. Balsinger, 53 Kerr Street, Uniontown	1939
Adam M. Barker, 150 Morewood Avenue, Pittsburgh	1939
Mark B. Barry, Southampton	1939
Lawrence W. Bass, Assistant Director, Mellon Institute, Pittsburgh	1930
Fred F. Bastian, 1410 Walson Street, Williamsport	1939
Edison O. Bates, 201 N. Main Street, Port Allegheny	1936
H. C. Beard, State Teachers College, Kutztown	1938
John C. Bechtel, 6608 Wayne Avenue, Philadelphia	1936
Charles A. Behney, 30 Manor Road, Wynnewood	1928
Frank Bell, R. D. No. 1, Clarksville	1939
R. H. Bell, Bureau of Plant Industry, Harrisburg	1938
Raymond Martin Bell, Washington and Jefferson College, Washington	1938
George W. Bennett, 720 Donnan Avenue, Washington	1938
Kenneth Bergstresser, Beaver College, Jenkintown	1936
Joseph Berman, 500 West Lehigh Avenue, Philadelphia	1938
Leonard K. Beyer, 67 Cole Street, Mansfield	1938
Amos H. Black, 484 Maple Street, Annville	19[illegible]9
Irwin Boeshore, MacFarlane Hall, University of Pennsylvania, Philadelphia	1932
Austin D. Boltz, 270 E. Fayette Street, Uniontown	1939
Paul R. Bowen, Beaver College, Jenkintown	1940
Lelia E Bower, Red Bird Mission, Evangelical Church, Beverly, Kentucky	1926
Ruth V. Brenneman, State Teachers College, Indiana	1940
John Bright, 127 Roup Street, East Liberty, Pittsburgh	1930
Benjamin Brownstein, 517 Fourth Street, Ellwood City	1929
Harold A. Bruce, Geneva College, Beaver Falls	1932
Warren S. Buck, 514 Juniper Street, Quakertown	1934
W. Glenn Burig, Fayette City	1939
F. E. Burpee, Bucknell University, Lewisburg	1932
Charles W. Burr, 1527 Pine Street, Philadelphia	1931
Robert D. Butler, Department of Geology, Lehigh University, Bethlehem	1938
William F. Butler, 626 Longacre Boulevard, Yeadon, Upper Darby P. O.	1940
Donald C. A. Butts, 6 S. 39th Street, Philadelphia	1928
Charles K. Cabeen, Department of Geology, Lafayette College, Easton	1935

* Charter members.

Elsie D. Canan, 836 Napoleon Street, Johnstown	1936
Benjamin F. Cary, 349 Hayden Street, Sayre	1926
A. Eugene Case, 927 Main Street, Towanda	1939
Olga G. Catizone, 2319 Glenarm Avenue, Brookline, Pittsburgh	1939
Jaques Cattell, Science Press Printing Co., Lancaster	1930
W. Edward Chamberlain, 3401 N. Broad Street, Philadelphia	1937
A. B. Champlain, Department of Agriculture, Harrisburg	1937
Rollin L. Charles, 51[illegible] Race Avenue, Lancaster	1927
Franklin H. Chermock, Masonic Apartments, Wilmerding	1940
Ralph L. Chermock, 804 Constance Street, Pittsburgh	1938
Allan Claghorn, 125 Chestnut Avenue, Narberth	1935
Sister Irma Claire, Villa Maria College, Erie	1939
John Clark, Carnegie Museum, Pittsburgh	1940
Edward P. Claus, 2704 Brownsville Road, Pittsburgh	1933
Janet Clayton, 15 Lawrence Avenue, West Orange, N. J.	1939
Arthur B. Cleaves, Pennsylvania Geological Survey, Harrisburg	1933
David L. Cline, 1129 Rosalie Street, Philadelphia	1940
Anna A. Conn, 95 Ben Lomond Street, Uniontown	1933
Francis R. Cope, Jr., Dimock	1931
Hannah L. Cope, 262 W. Main Street, Uniontown	1939
Sophie E. F. Cope, 239 Lenoir Avenue, Wayne	1936
Thomas D. Cope, 239 Lenoir Avenue, Wayne	1931
S. C. Crawford, University of Pittsburgh, Pittsburgh	1924*
John I. Cretzinger, 2331 Brownsville Road, Pittsburgh	1940
Pressley L. Crummy, Juniata College, Huntingdon	1932
Ruth Curtis, 613 Braddock Avenue, Pittsburgh	1939
Roger O. Dain, 501 Broad Street, Nescopeck	1940
L. K. Darbaker, 424 Franklin Avenue, Wilkinsburg	1925
Thomas Darling, Jr., 328 N. Sixteenth Street, Allentown	1939
James G. Davis, 70 Fifth Avenue, New York City	1940
Kenneth N. Dearolf, Public Library Museum, Dayton, Ohio	1935
Palmer De Pue, 4209 Longshore Street, Philadelphia	1940
S. H. Derickson, Lebanon Valley College, Annville	1924*
Roy M. Dibert, DuBois Center, The Pennsylvania State College, DuBois	1934
Parke A. Dickey, Topographic and Geologic Survey, Harrisburg	1939
Clarence D. Dieter, Washington and Jefferson College, Washington	1936
Arnold Dresden, 606 Elm Avenue, Swarthmore	1928
Casper Drueding, Fifth and Master Streets, Philadelphia	1928
J. E. Drummond, West Liberty, West Virginia	1939
Lincoln Dryden, Bryn Mawr College, Bryn Mawr	1935
Marin S. Dunn, 3744 Huey Avenue, Drexel Hill	1934
E. H. Dusham, Department of Zoology, State College	1927
R. Adams Dutcher, Department of Agricultural Biochemistry, State College	1928
L. B. Earhart, 709 Shadeland Avenue, Drexel Hill	1936
Sidney K. Eastwood, Elberon Apartments, 301 S. Winebiddle Avenue, Pittsburgh	1931
Joseph Ebert, 135 S. Eleventh Street, Philadelphia	1929
Frank H. Eby, 109 Fairview Road, Springfield	1939
M. W. Eddy, 249 W. Louther Street, Carlisle	1924*
John K. Edwards, Botanical Laboratory, University of Pennsylvania, Philadelphia	1939
Harry Eissler, Jr., 2905 Frankford Avenue, Philadelphia	1939
E. R. Eller, Carnegie Museum, Pittsburgh	1932
Florence Emerson, 237 Smithfield Street, Canonsburg	1939
O. G. Enstron, Jefferson	1940
Marlin Espenshade, 701 E. Main Street, Middletown	1939
William F. Etchberger, 925 Church Street, Lebanon	1939
Robert M. Evans, R. D. No. 3, Black Horse Pike, Sewell, N. J.	1939
Maurice Ewing, Lehigh University, Bethlehem	1936

Verna Faust, Mercersburg 1938
Robert L. Fee, 27 Grant Street, Uniontown 1939
James B. Finn, Jr., Mount Mercy College, Pittsburgh 1938
George E. Fisher, Susquehanna University, Selinsgrove 1924*
Lloyd W. Fisher, Department of Geology, Bates College, Lewiston, Maine 1929
Louis Fletcher, 5746 Chestnut Street, Philadelphia 1938
Theodora C. S. Fletcher, Dimock 1937
John M. Fogg, Department of Botany, University of Pennsylvania, Philadelphia 1932
Richard M. Foose, Top. and Geol. Survey, Harrisburg 1939
Frank Fortunato, 1537 Beechview Avenue, Pittsburgh 1939
Jane E. Frankston, Orchard Avenue, Woodsdale, Wheeling, W. Va. 1936
Donald M. Fraser, Department of Geology, Lehigh University, Bethlehem 1932
Raymond M. Freed, 636 E. Wadsworth Street, Mt. Airy, Philadelphia 1936
A. Henry Fretz, Lehigh University, Bethlehem 1924*
Howard M. Fry, 509 State Street, Lancaster 1936
Mont R. Gabbert, University of Pittsburgh, Pittsburgh 1932
Sister Mary Wilfrid Gallagher, College Misericordia, Dallas 1934
M. Bernard Gingrich, 1917 Park Street, Harrisburg 1939
D. I. Gleim, Mechanicsburg 1932
Alfred Gordon, 1900 Locust Street, Philadelphia 1932
Robert B. Gordon, State Teachers College, West Chester 1939
Joseph M. Gorman, Pennsylvania Turnpike Commission, Harrisburg 1938
Jean R. Gray, Biology Department, University of Pittsburgh, Pittsburgh 1939
Peter Gray, Biology Department, University of Pittsburgh, Pittsburgh 1939
Marcus H. Green, Albright College, Reading 1931
Thelma J. Greenwood, State Teachers College, West Chester 1932
E. M. Gress, 2000 High Street, Camp Hill 1924*
Ivor Griffith, 'Rhiwlas,' Elkins Park 1931
Samuel O. Grimm, Lebanon Valley College, Annville 1937
William A. Gruse, Mellon Institute, Pittsburgh 1931
Ernest E. Gulban, 114 Wissinger Road, Windber 1940
Mrs. Tracy W. Guthrie, Beaver Road at Newbury Lane, Edgeworth, Sewickley 1925
T. L. Guyton, 2204 Chestnut Street, Harrisburg 1924*
Florentine Hackbusch, Department of Welfare, Harrisburg 1931
Robert T. Hance, 1 Broadmoor Avenue, Pittsburgh 1928
Francis Harper, Swarthmore 1934
William A. Harris, Jr., 995 Broad Street, Station No. 3, Washington 1938
Joseph W. E. Harrisson, 214 S. Twelfth Street, Philadelphia 1939
D. S. Hartline, State Teachers College, Bloomsburg 1924*
Mary Mae Hartsough, The Pittsburgh Press, Pittsburgh 1939
K. C. Heald, Gulf Building, Gulf Company, Pittsburgh 1928
Oscar F. Hedenburg, Mellon Institute, Pittsburgh 1924*
LeRoy N. Heilman, 115 W. Main Street, Annville 1935
Arthur W. Henn, Carnegie Museum, Pittsburgh 1924*
Edward C. Henry, 224 Mineral Industries Building, State College 1940
LeRoy K. Henry, Carnegie Museum, Pittsburgh 1929
G. N. C. Henschen, 2139 N. Second Street, Harrisburg 1924*
E. C. Herber, Dickinson College, Carlisle 1930
Kenneth F. Herrold, Bucknell University, Lewisburg 1938
William O. Hickock, IV, P. O. Box 446, Harrisburg 1932
Edna Higbee, 2845 Broadway Avenue, Smith Hills Station, Pittsburgh 1934
J. Ben Hill, State College 1924*
Harrison S. Hires, 206 S. 24th Street, Philadelphia 1930
John Mendel Hirst, 610 Walnut Avenue, Scottdale 1939

Katharine R. Hirst, Cedar Crest College, Allentown 1928
Edward Hoberman, 72 E. Church Street, Lock Haven 1930
William W. Hockenberry, 107 N. Main Street, Port Allegheny 1939
H. E. Hodgkiss, State College 1929
W. H. Hoffman, 806 Third Street, Juniata, Altoona 1936
Charles B. Hollenbach, 317 Rose Street, Reading 1940
John A. Hollinger, 204 Administration Building, 341 Bellefield Avenue, Pittsburgh 1939
Richard Holstein, West Nottingham Academy, Colora, Maryland 1934
George E. Holtzapple, 203 S. George Street, York 1930
Arthur P. Honess, 210 S. Allen Street, State College 1927
Franklin J. W. Horich, Camp Hill 1924*
Clarence A. Horn, Albright College, Reading 1924*
T. D. Howe, Duquesne University, Pittsburgh 1936
Harry S. Hower, 5709 Solway Street, Pittsburgh 1924*
W. Frederick Huber, 309 Walnut Street, Lebanon 1939
A. Witt Hutchison, Department of Chemistry, State College 1939
Merrill B. Iams, State Teachers College, Indiana 1936
Norman J. Ilkuvitz, 553 Miller Avenue, Clairton 1939
Harry A. Itter, 641 Parsons Street, Easton 1935
Lyle W. R. Jackson, Botanical Laboratory, University of Pennsylvania, Philadelphia 1933
M. W. Jacobs, Jr., Box 910, Harrisburg 1924*
Mrs. O. E. Jennings, 241 Oakland Avenue, Pittsburgh 1930
O. E. Jennings, University of Pittsburgh, Pittsburgh 1924*
W. S. Jennings, 411 N. Broad Street, Lansdale 1938
Ernest E. Johonson, 5850 N. Sixth Street, Philadelphia 1936
John C. Johnson, State Teachers College, West Chester 1929
Louis K. Johnson, Stoystown 1937
John P. Jones, Soil Conservation Service, Center Building, Upper Darby 1931
Hugo Kahl, Carnegie Museum, Pittsburgh 1924*
Mary Kalina, 820 Muhlenberg Street, Reading 1940
T. J. Kean, 1630 N. Sydenham Street, Philadelphia 1932
Paul D. Keener, 1817 Pine St., Philadelphia
Susan Dorothea Keeney, 318 E. Lancaster Pike, Wayne 1940
J. B. Kelly, State College 1924*
Frank D. Kern, 140 W. Fairmount Avenue, State College 1924*
Harry B. Kirk, Bureau of Plant Industry, Harrisburg 1930
M. Ruhl Klepper, 413 S. Allen Street, State College 1939
Marie B. Knauz, 1217 Trevanion Street, Pittsburgh 1931
Thomas H. Knepp, 9 W. Main Street, Everett 1933
Charles E. Knopf, 6129 N. Franklin Street, Philadelphia 1937
H. H. Krauss, Red Hill 1939
E. B. Krumbhaar, Box 4378, Chestnut Hill, Philadelphia 1928
Paul D. Krynine, School of Mineral Industries, State College 1938
Marcella Kunz, R. D. No. 4, Anderson Road, Millvale 1939
Kimber C. Kuster, State Teachers College, Bloomsburg 1937
David Buell Lackman, Room 211, Medical School, University of Pennsylvania, Philadelphia 1938
Helmut Landsberg, Geophysics Laboratory, State College 1937
Paul T. Landis, 214 W. Third Avenue, Derry 1939
Harry K. Lane, Hershey 1937
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Robert Lehman, 7024 Hamilton Avenue, Pittsburgh 1938
Henry Leighton, Department of Geology, University of Pittsburgh, Pittsburgh 1924*

Alvin C. Leithold, Jr., 228 Comly Street, Philadelphia	1939
Forrest L. Lenker, Radnor High School, Wayne	1938
V. Earl Light, R. D. No. 1, Annville	1925
Ray H. Light, Cornwall	1934
Edward Lindsey, Warren	1928
C. C. Lively, Waynesburg College, Waynesburg	1924*
William E. Lloyd, 1134 Macon Avenue, Pittsburgh	1940
Bess Long, High School, Bloomsburg	1940
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Burritt K. L. Lupton, Franklin Avenue, Wyckoff, N. J.	1938
Clyde A. Lynch, Lebanon Valley College, Annville	1934
Henrietta E. MacCosbe, Dubois Undergraduate Center, Pennsylvania State College, Dubois	1938
Pauline Beery Mack, Textile Chemistry Building, State College	1937
E. H. McLaughlin, Philadelphia College of Pharmacy and Science, Philadelphia	1939
Gordon MacMillan, 609 Whitney Avenue, Wilkinsburg	1933
Donald L. MacNeal, 852 S. Main Street, Towanda	1940
John S. Madore, 12 Kensington Circle, Uniontown	1939
John P. Marbarger, 206 Homewood Terrace, Baltimore, Maryland	1938
Robert P. Marsh, 49 Delevan Street, New Brunswick, N. J.	1928
Lawrence Marshall, 112 Industry Street, Beltzhoover, Pittsburgh	1940
Marion I. Martin, 513 E. End Avenue, Wilkinsburg	1939
Thales Martins, Instituto Oswaldo Cruz, Caixa 926, Rio de Janeiro, Brazil	1930
E. H. McClelland, Carnegie Library of Pittsburgh, Pittsburgh	1928
Ralph McCoy, State Teachers College, California	1940
Herbert A. McCullough, 509 Washington Road, Pittsburgh	1938
James B. McDowell, Greensburg High School, Greensburg	1939
H. R. C. McIlvaine, Schuylkill Undergraduate Center, Pennsylvania State College, Pottsville	1934
G. M. McKinley, Biology Department, University of Pittsburgh, Pittsburgh	1939
T. M. McMillion, Geneva College, Beaver Falls	1930
Alfred Medendorp, 5235 Ravenswood Avenue, Chicago, Illinois	1940
Bernard Melkon, Philadelphia College of Pharmacy and Science, Philadelphia	1939
Walter Melnihoff, 33 S. Sycamore Street, Clifton Heights	1939
Walter Mendelson, 639 Church Lane, Germantown, Philadelphia	1940
David Meranze, 7122 Cresheim Road, Philadelphia	1938
Ruth A. Merrel, 198 Academy Street, Wilkes-Barre	1940
Albert B. Mickalitis, 346 S. Maple Street, Mt. Carmel	1937
Plantou Middleton, 8409 Navajo St., Philadelphia	1930
Anthony J. Miklaucic, Box 246, Imperial	1939
Benjamin L. Miller, Lehigh University, Bethlehem	1924*
Elda L. Miller, Route 2, Ruffsdale	1936
Harold E. Miller, 2342 Union Street, Allentown	1937
Morrison A. Miller, 714 W. Princess Street, York	1939
Ralph LeRoy Miller, Department of Geology, Columbia University, New York City	1935
Charles E. Mohr, 2226 Locust Street, Philadelphia	1927
Richard E. Moody, 342 N. Partridge Street, Lebanon	1939
Maurice L. Moore, 305 Cheswold Road, Drexel Hill	1939
Sister M. Sylvia Morgan, Marywood College, Scranton	1928
G. Paul Moser, 455 Market Street, Bloomsburg	1938
Ralph V. Mostoller, Stoystown	1936
Stuart Mudd, Department of Bacteriology, University of Pennsylvania, Philadelphia	1937
Hugh C. Muldoon, Duquesne University, Pittsburgh	1929
James C. Munch, 52 E. Greenwood Ave., Lansdowne	1937

William W. Murray, 218 Hawthorne Street, Canonsburg	1929
Richmond E. Myers, 1018 N. 18th Street, Allentown	1938
W. M. Myers, School of Mineral Industries, State College	1939
Yale Nathanson, 269 S. Nineteenth Street, Philadelphia	1937
M. Graham Netting, Carnegie Museum, Pittsburgh	1924*
Hillard R. Nevin, 751 St. Marks Avenue, Brooklyn, N. Y.	1939
Walter J. Nickerson, 311 S. New Street, West Chester	1936
Henry W. Neiman, 115 E. Market Street, Bethlehem	1930
Wesley Northeimer, 17 Parkway, Coatesville	1938
Howard H. Nye, 1551 Elm Street, Lebanon	1936
Harold C. O'Brien, Division Lane, Beaver	1940
C. Leonard O'Connell, 1451 Boulevard of the Allies, Pittsburgh	1938
Sister Mary C. O'Connor, College Misericordia, Dallas	1935
Karl F. Oerlein, 526 Third Street, California	1931
Marcus C. Old, Ursinus College, Collegeville	1931
Charles P. Olivier, Flower Observatory, Upper Darby	1933
Wayne Frazier O'Neill, 427 Seneca Street, Bethlehem	1940
L. O. Overholts, Department of Botany, State College	1928
C. M. Palmer, Butler University, Indianapolis, Indiana	1924*
Wellington A. Parlin, Dickinson College, Carlisle	1930
Elizabeth Peabody, Wilson College, Chambersburg	1939
Robert Pearson, Mechanics Trust Company Building, Harrisburg	1926
Arthur E. Pew, Jr., Bryn Mawr	1928
Mildred C. J. Pfeiffer, 6830 Old York Road, Oak Lane, Philadelphia	1936
Nathan H. Phillips, 409 Rochelle Street, Pittsburgh	1936
C. J. Pietenpol, Washington and Jefferson College, Washington	1938
Hon. Gifford Pinchot, Milford	1928
Aura Stiers Pollard, 3008 N. Fifth Street, Harrisburg	1940
H. W. Popp, Botany Building, State College	1924*
A. Williams Postel, N. E. Cor. 49th and Regent Streets, Philadelphia	1937
Eli Purnell, 317 Schuylkill Avenue, Tamaqua	1934
H. W. Rankin, 102 W. Hillcrest Street, State College	1939
Mark L. Raymond, Central High School, Scranton	1924*
T. Edwin Redding, Central Y. M. C. A., Harrisburg	1938
Elwyn T. Reese, 2059 Edna Avenue, Scranton	1939
Mae E. Reider, 332 S. Harrison Street, Palmyra	1936
J. W. Crane Remaley, Verona	1939
Jacob Rennard, 442 Ninth Street, Sunbury	1938
Edgar G. Rex, Department of Agriculture, Trenton, N. J.	1924*
David Riesman, University of Pennsylvania, Philadelphia	1930
Norman G. Riggs, R. D. 9, South Hills, Pittsburgh	1932
D. M. Rockwell, Juniata College, Huntingdon	1933
Horace E. Rogers, 120 Parker Street, Carlisle	1939
George Rosengarten, 1105 Edgwood Road, Upper Darby P. O.	1939
Felice A. Rotondaro, 5219 N. Sixteenth Street, Philadelphia	1929
Wilson M. Royer, Jr., 42 N. Wakefield Road, Norristown	1939
Ethel Ruhling, 1820 Loesel Avenue, Erie	1940
Donald Griscom Sands, 2424 Grandview Street, Mt. Penn, Reading	1940
D. C. Sandy, Glenshaw	1938
Harry J. Schaeffer, 7047 Lincoln Drive, Philadelphia	1939
Charles Anthony Schaich, 1301 Walnut Street, Reading	1936
Jacob R. Schramm, Department of Botany, University of Pennsylvania, Philadelphia	1939
Alta E. Schrock, Salisbury	1940
David Martin Seaman, 6321 Howe Street, Pittsburgh	1939
Marchant N. Shaffner, 224 Peffer Street, Harrisburg	1932
Reuben T. Shaw, 834 Real Estate Trust Building, Philadelphia	1935
S. S. Shearer, State Teachers College, Shippensburg	1924*
William G. Shemeley, 7 Haddon Avenue, Camden, N. J.	1932
Andrew Sherockman, Burgettstown	1936

George S. Shortess, Elizabethtown College, Elizabethtown	1937
Alexander Silverman, University of Pittsburgh, Pittsburgh	1925
Leonard Silverman, 1418 Conlyn Street, Philadelphia	1939
Richard J. Simon, 239 S. Fairmount Street, Pittsburgh	1939
Geddes W. Simpson, Agriculture Experiment Station, Orono, Maine	1927
James Sinden, Department of Botany, State College	1931
John R. Skeen, 313 W. Manheim Street, Philadelphia	1929
Carl C. Slaybaugh, Huntingdon Valley	1939
James C. Small, N. E. Cor. 36th and Walnut Streets, Philadelphia	1929
Stanley S. Smith, 14 Lincoln Avenue, Williamsport	1928
Thomas N. Smith, 31 N. Tremont Avenue, Greensburg	1939
Thomas Smyth, State Teachers College, Indiana	1936
George E. Snyder, University of Pittsburgh, Johnstown	1932
Richard Snyder, 730 Mt. Vernon Street, Lansdale	1935
Dwight E. Sollberger, State Teachers College, Indiana	1939
J. Riley Staats, State Teachers College, California	1939
William F. Starkey, Singer Memorial Research Laboratory, The Allegheny General Hospital, Pittsburgh	1935
J. Clyde Stayer, 310 Seventeenth Street, Huntingdon	1933
Walter Steckbeck, University of Pennsylvania, Philadelphia	1932
Frank John Steele, 123 E. Ross Street, Lancaster	1938
Harold M. Steiner, Arendtsville	1938
Norman H. Stewart, Bucknell University, Lewisburg	1924*
Paul R. Stewart, Waynesburg College, Waynesburg	1924*
G. B. Stichter, 6905 Torresdale Avenue, Philadelphia	1924*
John C. Stone, Mt. Union	1939
Paul W. Stone, Argentine	1939
R. W. Stone, Pennsylvania Topographic and Geologic Survey, Harrisburg	1924*
William J. Stoneback, Bethlehem Pike, Colmar	1938
Bradley Stoughton, P. O. Box 567, Bethlehem	1925
Albert Strong, 500 S. York Street, Mechanicsburg	1939
William L. Sulzbacher, 1006 S. Braddock Avenue, Pittsburgh	1938
W. J. Sumpstine, Box 156, Bethany, W. Va.	1939
Mrs. Charles Y. Tanger, 318 N. President Avenue, Lancaster	1935
Roy C. Tasker, Bucknell Junior College, Wilkes-Barre	1938
Ruth Tate, 96 Grant Street, Uniontown	1939
J. S. Taylor, Mathematics Department, University of Pittsburgh, Pittsburgh	1926
Nelson W. Taylor, Department of Ceramics, Pennsylvania State College, State College	1939
Walter Thomas, Old Experiment Station Building, State College	1927
W. Stephen Thomas, American Philosophical Society, 104 S. Fifth Street, Philadelphia	1938
H. W. Thurston, Jr., State College	1924*
I. P. Tolmachaff, Carnegie Museum, Pittsburgh	1928
Carl V. Tower, 32 Sixth Avenue, Collegeville	1931
Willard J. Trezise, 205 W. Miner Street, West Chester	1934
Robert Troxel, Jonestown	1934
Rodney H. True, Botany Laboratory, University of Pennsylvania, Philadelphia	1927
Orville Frank Tuttle, Coryville	1940
E. J. Udine, 223 W. Pomfret Street, Carlisle	1938
George D. Uibel, 136 N. Eleventh Sreet, Reading	1934
Levi J. Ulmer, State Teachers College, Lock Haven	1930
C. T. Van Meter, 1431 Boulevard of the Allies, Pittsburgh	1939
Eugene Vellner, 401 Hellerman Street, Philadelphia	1930
Henry Venable, 833 Heberton Street, Pittsburgh	1930
Peter L. Vissat, Seton Hill College, Greensburg	1940
Elbert Voss, Duquesne University, School of Pharmacy, Pittsburgh	1939

Ernest A. Vuilleumier, 150 Louther Street, Carlisle	1930
Paul R. Wagner, Ursinus College, Collegeville	1934
Amory Hooper Waite, Jr., 55 McKinley Avenue, Trenton, N. J.	1938
Ralph A. Waldron, State Teachers College, Slippery Rock	1933
Paul N. Walker, State Teachers College, California	1939
Robert N. Walker, Wilson College, Chambersburg	1940
George Egbert Wallace, Jr., Carnegie Museum, Pittsburgh	1938
Edward H. Watson, Bryn Mawr College, Bryn Mawr	1935
George W. Walton, 1426 Palm Street, Reading	1924*
H. A. Ward, 1100 N. Third Street, Harrisburg	1924*
E. R. Weidlein, Mellon Institute, Pittsburgh	1925
Max H. Weinberg, 6093 Jenkins Arcade Building, Pittsburgh	1932
Edgar T. Wherry, University of Pennsylvania, Philadelphia	1931
Kenneth S. Whisler, 140 E. Hanover Street, Hanover	1940
Lawrence Whitcomb, Lehigh University, Bethlehem	1931
Anna R. Whiting, University of Pennsylvania, Zoology Department, Philadelphia	1933
P. W. Whiting, University of Pennsylvania, Zoology Department, Philadelphia	1928
Melvin L. Whitmire, 300 E. Fifth Street, Berwick	1940
Frank C. Whitmore, School of Chemistry and Physics, State College	1930
E. E. Wildman, Administration Building, Parkway, Philadelphia	1935
Hans Wilkins, 241 S. Eleventh Street, Reading	1935
Homer C. Will, Juniata College, Huntingdon	1931
Bradford Willard, Department of Geology, Lehigh University, Bethlehem	1931
Clement C. Williams, Lehigh University, Bethlehem	1936
Joseph L Williams, Box 90, Lincoln University	1940
E. C. Williamson, 410 E. Summit Street, Souderton	1937
Walter L. Wilson, 376 First Avenue, Phoenixville	1939
Clifford Winnette, R. D. No. 2, Canonsburg	1939
Golda Wood, 95 Ben Lomond Street, Uniontown	1940
E. Alfred Wolf, Department of Zoology, University of Pittsburgh, Pittsburgh	1928
Leonard N. Wolf, Department of Biology, St. Thomas College, Scranton	1935
Michael M. Wolfe, Widener Building, Philadelphia	1939
Emily T. Wolff, 139 N. Highland Road, Springfield	1938
Harlan N. Worthley, 222 Hartswick Avenue, State College	1930
L. K. Wright, 303 Botany Building, State College	1936
William Albert Earl Wright, State Teachers College, Shippensburg	1939
Charles B. Wurtz, 55 Overbrook Road, Pittsburgh	1938
George Johannus Yevick, 1161 Third Avenue, Berwick	1940
Harold Yoder, Altoona Senior High School, Altoona	1939
George H. Young, Mellon Institute, Pittsburgh	1939
Henry S. Young, 501 South Avenue, Wilkinsburg	1938
Charles H. Zierdt, 1813 N. Thirteenth Street, Philadelphia	1939
George L. Zundel, Botany Building, State College	1929