PROCEEDINGS

OF THE

PENNSYLVANIA ACADEMY OF SCIENCE

VOLUME XI

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HARRISBURG, PENNSYLVANIA
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OFFICERS

1937–38

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PENNSYLVANIA ACADEMY OF SCIENCE

MINUTES OF THE 1936 SUMMER MEETING

August 14 and 15
Somerset, Pennsylvania

Members of the Academy and friends gathered at Somerset in the afternoon of August 14 and formed two groups. One group traveled to the virgin hemlock forest near Bucktown on U. S. Route 30, while the other group studied the rock formations and the gorge of Casselman River.

In the evening, after dinner at the Ferner Hotel, the following program was enjoyed by about 30 persons;

The physiographic significance of Negro Mountain. R. W. Stone, Pennsylvania Geological Survey.

The forest, its trees, trails and tourists. V. M. Bearer, District Forester, Ligonier.

The flora of Negro Mountain. President Paul R. Stewart, Waynesburg College.

Some notable plants of south-central Pennsylvania. Dr. Edgar T. Wherry, University of Pennsylvania.

Snakes in Somerset County. M. Graham Netting, Carnegie Museum.

A business meeting followed in which a grant of $125.00 for research from the American Association for the Advancement of Science was awarded to Raymond J. Greb and his wife Magnhild Torvik-Greb of the Research Laboratories of the Pittsburgh Skin and Cancer Foundation for research on Further Studies on the Unstable Gene in Habrobracon.

The library committee was instructed to distribute the Proceedings which the editor reported about ready for mailing.

Dr. Bradford Willard, press secretary, reported sending notices to the local newspapers telling them of the various activities of the Academy.

Dr. Karl F. Oerlein, representing the Junior Academy, reported that he was getting out a pamphlet concerning the activities of the Junior Academy which will be sent to all high schools in the State.

A motion sponsored by M. Graham Netting that the Academy urge that the stand of virgin hemlock at Bucktown in Somerset County be made a State Forest Preserve, was adopted.

A conservation committee composed of: M. Graham Netting, Chairman, Edgar T. Wherry, D. S. Hartline, J. Kenneth Terres, and E. M. Gress was appointed by the president Dr. T. D. Cope. Dr. Netting

volunteered to send copies of a resolution to members of the legislature and other persons of influence urging that the virgin hemlock forest be made a State Forest Preserve.

The following persons were elected to active membership:

Elsie D. Canan, 836 Napoleon St., Johnstown.
Charles W. Demoise, 1401 Ashland St., Greensburg.
Clarence D. Dieter, W. and J. College, Washington.
Howard M. Fry, 509 State St., Lancaster.
Joseph E. Harned, Oakland, Maryland.
Chester L. McTavish, 400 Beech Ave., Altoona.
Mildred C. J. Pfeiffer, 3050 N. 5th. St., Philadelphia.
Nathan H. Phillips, 409 Rochelle St., Pittsburgh 10.
Hilda G. Ruch, Flicksville.
H. C. Wimmer, 5221 4th St., Altoona.

On August 15 a field trip was taken to Negro Mountain and vicinity. After observing the plant life and the geology of this, the highest point in the State of Pennsylvania, the group assembled at a near-by C. C. C. camp. Here we received a royal reception from Capt. Galen Harris and staff and had a chance to observe camp life. A delicious and novel dinner, prepared by the C. C. C. boys themselves, was served.

MINUTES OF THE THIRTEENTH ANNUAL MEETING

FRANKLIN AND MARSHALL COLLEGE, LANCASTER, MARCH 26 AND 27, 1937

At a meeting of the executive committee held in the Hotel Brunswick Thursday evening, March 25, President T. D. Cope presiding and with 17 persons present, the following actions were taken:

The minutes of the summer meeting at Somerset were read and approved.

Dr. Geo. H. Ashley reported the receipt of a letter from the University of Athens in Greece, requesting the sending of a delegate from the Pennsylvania Academy of Science to the exercises relative to the centenary of the founding of the University. The secretary was instructed to prepare and send a letter of felicitation to the University of Athens signed by the President of the Academy.

S. H. Derickson, chairman of the auditing committee, reported that William O. Hickok, IV, a member of the committee, was unable to serve. Norman H. Stewart was appointed by President Cope to serve on the committee in his place.

H. W. Thurston, treasurer of the Academy, reported a balance in the treasury. His report was submitted to the auditing committee. The

treasurer was authorized to confer with Jaques Cattell of the Science Press Printing Company to investigate the advisability of using a lower rate of postage in mailing bills to the Academy members.

The editor, R. W. Stone, reported that it was previously decided that only papers presented by the author or a substitute should be printed in the Proceedings. Further, that contributed papers are limited to five printed pages unless the author is willing to pay for the extra pages printed. It was agreed that the editor be made a permanent member of the program committee in order that these facts be kept before the membership.

Karl F. Oerlein, representing the Junior Academy, raised the question as to what might be done to get the members of the Junior Academy better acquainted with the members of the Senior Academy. A discussion with suggestions followed and it was decided that Dr. Oerlein take the suggestions offered to the advisory committee of the Junior Academy to get action on what might be done to benefit the Junior members. One of the suggestions given was that a time and place be arranged for in future programs for demonstrations where members of both groups can mingle with mutual advantage.

R. W. Stone reported for the library committee that about 90 sets of the first 5 volumes of the Proceedings are still for sale at $1.00 per set.

It was decided that the program committee for next year carry out the wishes of the executive committee to schedule a symposium dealing with "Methods of Science Teaching" which was called for in the 1936 minutes.

Concerning the places for future meetings of the Academy the next regular meeting in 1938 is scheduled at Bucknell University, Lewisburg. It was suggested that the summer meeting in August 1937 be scheduled for the Wellsboro, Coudersport and Leonard Harrison Park section of the State and that the regular meeting in 1939 be scheduled for the southwestern section of the State, if possible at Washington and Jefferson College.

Upon recommendation by President Cope it was agreed to include in the present setup of the letter head the years 1937–1938.

The secretary of the Academy was asked to be the official representative of the Academy at the Indiana meetings of the American Association for the Advancement of Science.

Applications for the American Association grant of $100.00 were received from Kenneth Dearolf and Charles E. Mohr.

A communication recommending that Dr. Donald Cadzow of the Pennsylvania Historical Commission be obtained as a speaker at some

future evening session of the Academy was received and held for future consideration.

Requests from the Indiana and Missouri Academies of Science to exchange copies of their publications with the Pennsylvania Academy were referred to the library committee for consideration and power to act as they see fit.

A request from the Conservation Committee of the Missouri Academy of Science that the similar committee of the Pennsylvania Academy collaborate with them was referred to M. Graham Netting, chairman of our Conservation Committee.

Thirty persons applied for membership in the Academy. The secretary was instructed to cast a ballot for each applicant. The ballot was cast and the following persons were duly elected to membership:

G. M. Appleby, 2203 Chestnut St., Harrisburg.
Horace B. Baker, Zoology Dept., Univ. of Penna., Philadelphia.
Roger M. Baker, Bureau Plant Industry, Harrisburg.
Arthur W. Bechtel, 339 S. 4th St., Reading.
W. Edward Chamberlain, 3401 N. Broad St., Philadelphia.
A. B. Champlain, Dept. of Agriculture, Harrisburg.
Harry M. Emerick, Shanksville.
Samuel O. Grimm, Annville.
Mildred M. Hicks-Bruun, 423 Riverview Road, Swarthmore.
Charles E. Knopf, 6129 N. Franklin St., Philadelphia.
Kimber C. Kuster, State Teachers College, Bloomsburg.
Harry K. Lane, Hershey.
Alice A. Lentz, 209 Enola Road, Enola.
Albert B. Mickalitis, 346 S. Maple St., Mt. Carmel.
Harold E. Miller, 2342 Union St., Allentown.
Mrs. Rodney D. Moiser, 116 Millview St., Uniontown.
Helen Jean Mowry, 220 North St., Harrisburg.
Mary C. Mowry, R. 1, Camp Hill.
Stuart Mudd, Dept. of Bacteriology, Univ. of Penna., Philadelphia.
James C. Munch, 40 N. Maple Ave., Lansdowne.
Yale Nathanson, 4611 Spruce St., Philadelphia.
Earl H. Newcomer, Dept. of Botany, State College.
Howard H. Nye, 1551 Elm St., Lebanon.
Henry Olson, 20 Elmira St., Mansfield.
Edward C. Otwell, 507 S. Walnut St., West Chester.
A. Williams Postel, N. E. cor. 49th and Regent Sts., Philadelphia.
George S. Shortess, Elizabethtown.
E. C. Williamson, R. D., Hatfield.
J. Donald Witmer, 2017 Bellevue Road, Harrisburg.
Harold Yoder, Senior High School, Altoona.

The library committee was authorized to use their judgment as to the disposition of past correspondence now deposited in the office of R. W. Stone at Harrisburg.

The meeting was adjourned to reconvene in a final business session at 9 o'clock Saturday morning, March 27.

At the regular session of the Academy March 26, of 36 papers on the program, 30 papers were presented. The Pennsylvania Conference of Physics Teachers presented 13 papers. The Junior Academy of Science presented 21 papers.

Papers read before the Academy on Friday but not presented for publication were as follows:

Body and Eye Color Mosaics in *Habrobracon*.
ANNA R. WHITING, University of Pennsylvania.
The Status of Beginning Science Teachers.
WILLIAM N. MARTIN, Wyomissing High School.
The Present Status for the Certification of Science Teachers for the Secondary Schools of Pennsylvania.
JOHN C. JOHNSON, West Chester State Teachers College.
Development of Stomal Group in Net- and Parallel-Veined Leaves.
ANNA MARY ERDMAN, Hershey.
A Homemade Microtome.
ROBERT T. HANCE, University of Pittsburgh.
Notes on Histologic Technique.
NORMAN H. STEWART, Bucknell University.

A joint dinner of the Pennsylvania Academy of Science, the Pennsylvania Conference of Physics Teachers and the Lancaster Branch of the American Association for the Advancement of Science was held in the Hotel Brunswick, with 128 persons present.

Dr. F. R. Moulton, Permanent Secretary-elect of the American Association for the Advancement of Science, delivered the annual evening lecture on the subject of "Science."

The Junior Academy of Science held a dinner in the Franklin and Marshall Academy Building with 104 persons present.

Seven invited papers were presented on Saturday forenoon, March 27.

INVITED PAPERS

1. The Birds of Lake Ontelaunee, Berks County. EARL L. POOLE, Reading Public Museum.
2. The Status of the Upland Plover in Pennsylvania. HERBERT H. BECK, Franklin and Marshall College.
3. Reminiscences of Professor William S. Franklin. R. L. CHARLES, Franklin and Marshall College.
4. Effects of Pressure and Temperature on the Germination of Seeds. R. B. DOW and RAFAEL RIVERA, Pennsylvania State College.
5. Measuring Gravity at Sea. MAURICE EWING, Lehigh University.
6. The Origin and Occurrence of Earthquakes. H. LANDSBERG, Pennsylvania State College.

7. Some Biological Effects of Sounds of High Intensity. L. A. CHAMBERS, Johnson Foundation for Medical Physics, University of Pennsylvania.

Two motions presented by John C. Johnson relative to the certification of teachers of science in Pennsylvania were adopted during the Friday forenoon session. The motions are:

"It is the belief of the Pennsylvania Academy of Science that the supply of science teachers is now adequate in the State of Pennsylvania to meet the demands and that we urge the immediate adoption and application of the recommendations of last year." (To take effect by Sept. 1, 1937.)

"That this, or another, committee be continued or appointed to keep in touch with the State Department of Public Instruction, to consult with them as seems desired, or necessary, and to report back to the Academy each succeeding year until our goal is reached."

During the final business session called at 9 o'clock Saturday morning, March 27, the following items of business were transacted:

Dr. Bradford Willard, press secretary, reported writing 40 letters to various newspapers, Science and the Pennsylvania School Journal, publicizing the activities of the Academy.

The Treasurer's Report:

FINANCIAL STATEMENT

APRIL 1, 1936 to MARCH 17, 1937

Receipts:		
Balance on hand as of April 1, 1936	$361.50	
Dues	633.57	
Junior Academy	31.00	
Misc. sales, extra pages printing, etc.	48.04	$1074.11
Disbursements:		
Printing Vol. 9	$251.32	
Printing Vol. 10	514.27	$ 765.59
Printing and account for Sec'y	$ 41.56	
Misc. expenses, postage, Dr. Gress and Stone	9.29	
Treasurer's account, postage, etc.	75.00	
Bills of Junior Academy	28.41	
Checks returned	2.00	
Balance on hand March 17, 1937	152.26	$ 308.52
		$1074.11

(Signed) H. W. THURSTON, JR.,
Treasurer

The Auditing Committee have examined the accounts of the Treasurer, H. W. Thurston, Jr., and find them correct as given in his report for the year 1936–1937.

(Signed) S. H. DERICKSON
N. H. STEWART
GEO. N. C. HENSCHEN
Auditing Committee.

The committee on conservation was requested by vote to continue in office.

E. M. Gress reporting for the library committee said that the State Library will be a repository for exchange publications. Upon motion the Library Committee was asked to continue in office.

The Committee on Institutional Memberships submitted the following report:

1. That Educational Institutions rating above the High School level be invited to affiliate with the Pennsylvania Academy of Science.

2. That Libraries, both public and private, including libraries of Educational Institutions from the High School level upward, be invited to become subscribing members at the rate of $1.00 per year.

3. That manufacturers or dealers in scientific materials which are of interest to the membership of the Academy be offered cooperative membership at the rate of $5.00, $10.00, $20.00 or $40.00 per year, entitling them to a specified space in the Proceedings, and on the annual program and in the exhibition hall at our annual meetings.

4. That two types of membership be available to Educational Institutions. First, at the same rate as individual membership that shall entitle the president or some official of the institution designated by him to exercise the rights and privileges extended to members, at membership rates, $2.00 per year. Second. Sustaining membership, at a rate of $10.00 or more per year which shall entitle them to be listed in the Proceedings as Sustaining Members and after a total of $100.00 has been paid, as Patrons of Science of the Pennsylvania Academy of Science. (That this type of membership be offered to individuals as well as to Institutions.)

5. That Endowed Perpetual Membership be offered to Libraries upon the payment of $25.00; to Institutions upon the payment of $50.00; and to manufacturers upon the payment of $100.00 or more.

(Signed) H. W. THURSTON, JR.
CHARLES P. OLIVIER
S. H. DERICKSON

After a brief discussion the above report was adopted.

President T. D. Cope reported on the disposition of the previous grants for research of the American Association for the Advancement of Science, and asked for applications for the present available award of $100.00 for 1937–1938. E. M. Gress suggested that certain problems concerning our own State might be financed by this grant and some one assigned to the problems. The assignment of the award for research was referred to the executive committee to dispose of as they see fit.

A motion to have the summer meeting in the Coudersport region was approved.

The recommendation that the Secretary represent the Academy at the Indiana meeting of the American Association was approved.

The committee on resolutions presented the following report:

Resolved, that the Pennsylvania Academy of Science express its appreciation to Prof. H. M. Fry and to all the others who in any way assisted in making arrangements for this meeting.

Resolved, that the Academy commend Dr. Schaeffer, the Administration Officers, and the Trustees of Franklin and Marshall College for the invitation to meet here and for the generous hospitality extended to all of us.

Resolved, that the Academy especially thank Dr. F. R. Moulton, Permanent Secretary-elect of the American Association for the Advancement of Science, for his inspiring and enlightening address.

Resolved, that the Academy express its appreciation to the press, to the President, to the other officers (especially to editor Stone for his painstaking efforts in connection with our Proceedings) and to all members and friends who assisted in the conduct of this meeting. Particularly do we thank the program committee together with Mr. Jaques Cattell and the Science Press for their important part in the preparation and distribution of the program. We appreciate the improved style and form of our printed programs and hope future programs will be published in a similar manner.

Resolved, that the Academy express its thanks to the Pennsylvania Conference of College Physics Teachers, to the Junior Academy of Science and to the Lancaster Branch of the A.A.A.S. for their cooperation in making this one of the most successful meetings in the history of the Pennsylvania Academy of Science.

Resolved, that it is the belief of the Pennsylvania Academy of Science that the supply of Science teachers is now adequate in the State of Pennsylvania to meet the demands and that we urge the immediate adoption and application of the recommendations of last year. We request the Secretary to write to the Department of Public Instruction urging the adoption of these recommendations relative to the certification of all Science teachers in this State.

Resolved, that the Academy express its regret in losing the following members by death during the past year:

George G. Chambers
Malvina Grieves
D. Roberts Harper, 3rd
Ruter W. Springer

We request the Secretary of the Academy to send a copy of this resolution extending our sympathy to the respective surviving families of these four deceased members.

Respectfully submitted,

(Signed) Walter S. Lapp
Donald M. Fraser
Pressley L. Crummy

The report of the resolutions committee was accepted and adopted.

Bradford Willard reported that the International Congress of Geologists will be held in Moscow in July. B. L. Miller, Bradford Willard, and Ralph Miller were designated as delegates representing the Academy at this conference.

Homer C. Will chairman of the nominating committee presented the following nominations for officers of the Academy for the year 1937–1938:

President—George H. Ashley.
Vice President—Jaques Cattell.
Secretary—V. Earl Light.
Assistant Secretary—Charles E. Mohr.
Treasurer—H. W. Thurston, Jr.
Editor—R. W. Stone.
Press Secretary—Bradford Willard.

(Signed) Homer C. Will
M. W. Eddy
Clarence A. Horn

There were no other nominations. The report was accepted as presented and the secretary was instructed to cast a ballot for the nominees. The ballot was cast and the officers were declared elected.

V. Earl Light,
Secretary.

GOVERNMENT AID PROJECTS IN BIOLOGY

By Homer C. Will and Pressley L. Crummy
Juniata College, Huntingdon, Pa.

During the last four years the various departments in the colleges and universities of the United States have been striving to find projects which are suitable for students who have been granted government aid. Many of these students have lacked previous training in the kind of work to which they have been assigned and others have been upperclassmen with majors in those departments. Finding suitable projects for such a heterogeneous group has been a heavy task. Furthermore, it was necessary to exercise care in the selection of projects in order that the work done be such as is not ordinarily included in the program of the school. In general, however, those of us who have been faced with this proposition can feel a justifiable pride in our results.

It is our purpose in this brief report to call attention to some of the results already obtained and to indicate some of the projects now under way, as well as a few that are proposed for future use, in the Biology Department at Juniata College, with the hope that they will prove helpful to our colleagues. It has been our constant aim to assign students to projects which would be educationally beneficial to them as well as to add to the

equipment of the department. It seems to us that this principle is an attempt to make the most of the aid granted by the federal government.

List of Projects in Biology

Making wall charts from standard text-book figures
Preparation of insect life-history exhibits
Making mimeographed outline drawings of laboratory forms
Preparation of skeletal material for laboratory study
Preparation of demonstration dissections
Sealing of delicate organisms in glass tubes for study purposes
Cleaning and repairing old skeletal material
Sorting and cleaning microscope slides
Cataloging lantern slides
Clearing and staining embryological material for demonstration
Culturing Protozoa for class use

Some of the projects in the foregoing list will need further comment as to procedure involved, expense to the department, interest shown by the students, and kind of work produced. We have endeavored, in so far as it was possible, to make assignments that were of interest to or at least within the abilities of the student concerned. A particular case will serve to illustrate this working principle. A student became interested in the preparation of skeletal material while he was studying the endoskeleton in the comparative vertebrate anatomy course and asked for further information. He was furnished with references to the literature dealing with this subject but for various reasons was not particularly encouraged to try his hand at preparing a skeleton. Later, however, when opportunity presented itself he quickly took advantage of it and attempted to prepare the skull of a cat. This attempt proved to be quite satisfactory. Since we were in need of disarticulated cat skeletons at that time a government aid project was proposed. We soon learned that this student was already receiving government aid but was assigned to ordinary labor work on the campus. There was, of course, no difficulty in having him transferred to our department where we put him to work preparing skeletons for class use. Being especially interested in this project he put forth his best effort and produced some fine results. While working on this assignment he tried out several modifications of the routine procedure and finally adopted one which suited his purpose best. In another year we were able to assign other students to assist this one in his osteological work. From time to time it was convenient to put these people to work cleaning and repairing the old skeletons already in our stock. In this way the skeletal material of the department was brought into more satisfactory condition and at a remarkably low cost to the school. A result of far greater significance, was the first-hand information obtained by the students doing the work.

Another project which warrants special attention in this report is that in which wall charts were prepared from standard text-book figures. It is a common experience among teachers that certain text and reference book figures would be more useful if available in the form of large wall charts. Many of these charts are to be had through commercial supply houses but frequently they are listed at prohibitive prices. It is, however, a relatively simple matter for any one who is adept at drawing to enlarge such selected figures to the required size and transfer them to linen cloth. The enlarged figures can then be traced in India ink and the cloth tacked to wooden strips. If preferable, the cloth can be tacked to spring rollers at one end and wooden strips at the other. Several such charts can then be mounted in a wall case prepared for them. Some of these home-made charts received favorable attention while on exhibition at the Pittsburgh meetings of the American Association for the Advancement of Science in 1934. Of still greater importance is the fact that they have proved by their usefulness to be valuable additions to the equipment of the department. Such equipment is just as valuable as and in many respects more valuable than any that could be purchased at the high prices demanded for the commercial product.

During the study of the Prechordates in a comparative anatomy course the whale-tongue form, or *Balanoglossus,* is usually studied superficially as the representative of the subphylum Hemichordata. When the students are permitted to handle these delicate forms they are soon broken and consequently must be replaced frequently. By placing these or any other similar forms in narrow glass tubes which can then be filled with formalin and sealed at both ends, it is possible to use the same specimens for several years. This method of preparation permits the students to examine the specimens as carefully as when handling them but at the same time protects them from damage. The mechanical manipulations involved in preparing such mounts are not especially difficult and any student can be instructed to do this work. Care must be used to see that the liquid preservative does not touch the hot glass while sealing the end. Such a project permits a considerable saving over a period of years, in view of the high original cost of these organisms.

The study of the life histories of insects is made very much easier by observing demonstration preparations in which the various stages of the cycle are shown. Such preparations can readily be made by any one who has even a limited degree of ability in making manual manipulations, if he is carefully supervised. On the other hand, a student who has an elementary knowledge of entomology and a natural ability to make things can, after having been given brief general instructions, obtain his own

materials and prepare insect life-history demonstrations of fine quality. One of the most successful of the projects carried on with government aid was the preparation of such life history mounts. The various stages in the life cycle were collected and mounted in standard exhibition cases. These exhibits are used for demonstration purposes and for exhibition in the department. They prove to be quite worthwhile. This type of project is a good example of the thing at which we have continually aimed, in that it gives an even greater benefit to the person preparing the exhibit than it does to those who study the finished product.

One of the proposed activities on our program is the preparation of demonstration dissections of the commonly used laboratory forms. Later, perhaps, some of the less common forms may be handled in a similar manner. In order that these carefully made dissections will not be damaged, they will be mounted on glass plates and placed in museum jars of the proper size. These jars are then to be sealed in a semi-permanent manner with Murrayite cement. An interesting experiment has already been performed by a student working on a National Youth Administration grant in preparation for this proposed project. The experiment was an attempt to discover whether or not an ordinary quick-drying colored enamel could be used to color the blood vessels of dissected specimens which were to be immersed in formalin in museum jars. The results show that it is entirely possible to brush such an enamel onto the parts to be colored, if the specimen is permitted to dry out to a certain extent. Such painted tissues have been immersed in formalin for several months and at the end of that time still showed the original brilliant color.

It has been the experience of the writers that student-made drawings of the laboratory forms are the most valuable study aids available. However, the study of certain forms is considerably clarified by supplementing the students' own work with mimeographed outline drawings. These outline drawings have been prepared by government aid students who were skilled at making good scientific drawings. In some cases the original drawings of students have been used and in others standard diagrams have been taken from text-books. In any case the figures are readily enlarged to the most suitable size with the aid of a pantograph. The enlarged figure is then placed beneath the waxed sheet of a mimeograph stencil and with the aid of a strong light and a stylus it is traced upon this sheet. Any notations or directions that may be desired can be typed on the stencil. The results obtained by the use of such outline drawings have been very satisfactory. In no case have they been used to replace the drawings of the student but rather as a supplementary instrument of instruction. After the students have completed their own drawings and

submitted them to the instructor, the mimeographed figures are passed out to be labeled and in some cases are used as the vehicles for brief quizzes. This project is probably of less educational benefit to the person employed on it than are some of the others but, nevertheless, it has proven desirable.

In view of the ease with which certain of the protozoans are cultured in the laboratory and the first-hand information to be obtained by culturing these forms, such a project appeared feasible. During the past year or two, one of our government aid students has been successfully supplying all the Paramoecia needed in the department. He has experimented with different locations in the laboratory in an attempt to find which was the most suitable for the maintenance of his cultures. As a result of these experiments he has been successful in keeping live cultures of Paramoecia going, even through the summer months, without a great deal of care. In fact the care of his protozoan cultures now requires such a small amount of time that he is free to work on other projects. Unfortunately, the results with Amoeba and Euglena have not been so successful. No very serious attempt has been made to obtain or keep up pure cultures. The purpose has been primarily that of having protozoa available on demand and the results in that respect have thus far been satisfactory. The convenience and the financial saving associated with this project have been very gratifying to us.

While trivial and injudicious expenditures may have occurred in some of the projects in the schools of our country, we feel that federal aid has accomplished a useful purpose in our laboratories at Huntingdon. On that account our department has always been willing and anxious to find projects for any students who may have been assigned to us. On occasion, we have even requested the transfer of certain students to our department. The biological field is certainly a broad one from which many worth-while projects may be selected. While the particular activities discussed above do not involve anything strikingly original, we hope that they will serve to introduce some ideas which may help to improve laboratory teaching. We know that, in our own case, government aid has enabled us to build up our teaching equipment at a relatively small expense to the department.

THE OSTEOLOGY OF A TERATOLOGICAL GOOSE

MARCUS H. GREEN
Merner-Pfeiffer Hall of Science, Albright College

The purpose of this paper is to give a general description of the girdles and axial skeleton of a newly-hatched, teratological goose. The specimen consists of a single head and two bodies, an anomaly known as duplicatus posterior. The poorly-preserved soft parts precluded any possibility of their investigation.

The pectoral region and all of the body craniad of it appears to be normal from an external view. Just behind the single pair of wings, the body divides into two parts, each bearing a pair of legs and a pelvic girdle. This superficial observation led to the conclusion that the duplicity existed only behind the pectoral region. Subsequent examination of the bones proved this to be untrue.

An examination of the skeleton disclosed that the duplicity really began just caudad of the sella turcica on the floor of the skull. Two bars of ossifying tissue around the notochords extend laterad and caudad from the sella turcica with a broad plate lying between them which is probably the basitemporal plate. The bars continue caudad as parallel series of ossifying centers to the level of the cranial ends of the ilia where they turn laterad from each other.

Each of these two columns possesses paired rows of neutral plates. The neutral plates which extend toward each other from their respective columns unite and form a shallow trough. In this trough lies what little can be distinguished of the spinal cord.

At the level where the columns bifurcate, a hump is formed on the dorsal surface of the goose. This hump indicates the place where the neural plates of each respective column unite dorsally to form a complete vertebral canal. The vertebral canals are normal from here into the tails.

Hereafter the term "outer" will mean that portion of the animal which is lateral to a line drawn caudad from the head between the two trunks of the body and the term "inner" will refer to those structures lying in the triangular space between the two divisions of the body.

The first seven pairs of outer ribs have two distinct heads. The first pair of inner ribs has two heads, not dorsal and ventral as in the other ribs but lying in the same horizontal plane and arising from two consecutive vertebrae. The first of these heads arises from the vertebra which gives rise on its opposite side to the fourth outer rib. The first and second pairs of inner ribs are very short. The remaining five pairs of inner ribs are very long and extend, crowded together, far back along

Figure I. Dorsal Aspect of Skeleton

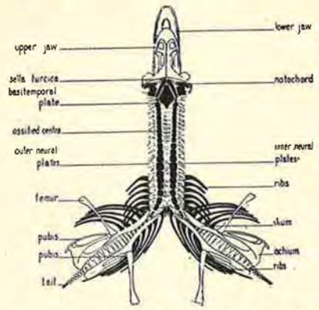
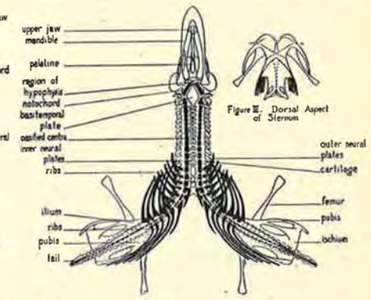


Figure II. Ventral Aspect of Skeleton



the inner sides of the pelvic girdles. None of the inner ribs have articulations with anything but the vertebral columns. The second to the seventh pairs of ribs lying on the outer sides articulate with the sternum.

The pectoral girdle and sternum are normal. The pelvic girdle is apparently normal in each division of the body except for the inner pubes which are reduced to vestiges.

The roofing-over bones of the skull are completely absent except for the frontals. The brain and cord are therefore uncovered with bone except where the cord dives into the vertebral canals at the level of the cranial ends of the ilia.

Partial twinning in which two parallel trunks develop might be brought about by some depression of the apical activity. The first two blastomeres could become partially segregated and thereby produce a partial duplicity. In this case, the structures of the two trunks contingent to each other might have their full development inhibited such as is shown by the shorter ribs and neural arches on the inner sides of the specimen.

Many monstrosities are concerned with twinning. The condition encountered in the discussed animal is known as duplicatus posterior. Duplicatus anterior is an anomaly in which the monstrosity has two heads and a single body. Sometimes only two faces are present and this is known as diprosopus. Another anomaly known as epignathus consists of a rudimentary but fully-formed fetus hanging from the mouth of its twin known as the autosite. The most curious example of twinning is the condition in which one of the twins actually develops within the body of the other. The author heard of an instance in which an elderly man was operated upon for some abdominal growth which was shown to be his twin brother.

THE STEREIDS IN THE PETIOLES OF *NYMPHEA ADVENA*

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The literature produces little information of the morphology or function of the stereids in the petioles of *Nymphea*. A few text-books show some poorly illustrated views of them. In view of this paucity, the authors propose to describe briefly the anatomy of the stereids in *Nymphea*.

The rigid, unattached stereids were first observed in the debris of protozoan cultures. Their firm, long arms excited our curiosity. They gave no evidence of motion and appeared to be the vacated shells of some protozoan. It was suggested that they might be some crystal growth; but the general pattern of their forms and ranges of sizes resembled those of living organisms. An examination of the literature on algae and protozoa did not yield a clue of identity. Our difficulty in identifying the stereids as discrete fragments of a larger organism bore much similarity to losing sight of the forest by studying only the trees.

An inventory of the materials placed in the cultures and an examination of each material revealed a great number of these structures in the petioles of Spatter-docks (*Nymphea advena*).

In order better to locate the positions of the stereids with respect to neighboring cells, transverse sections of the petioles were cut and then stained with Delafield's haemotoxylin.

The internal structure of the petiole resembles, in cross-section, that of a young, monocotyledonous stem. There is a hard layer of epidermal cells around the outside, and a layer of sclerenchyma tissue just beneath it. The inner anatomy consists of a large portion of fundamental tissue composed of parenchyma cells. Scattered throughout this are numerous vascular-bundles. The bundles are strengthened by a layer of sclerenchyma tissue around the xylem and phloem.

The stereids are located at intervals along the axes formed by the articulation of three sheets of the reticulated, fundamental tissue. These axes lie parallel to the longitudinal axis of the petiole. Their spine-like arms extend out into the tube-like interstices which surround the articulations. The typical stereid is larger than the neighboring cells and possesses from four to nine spinelike arms ranging from 12 to 36 microns in length. Both the body of the cell and the arms appear to be hollow. Other stereids differ little in form from their adjoining cells except by their larger size.

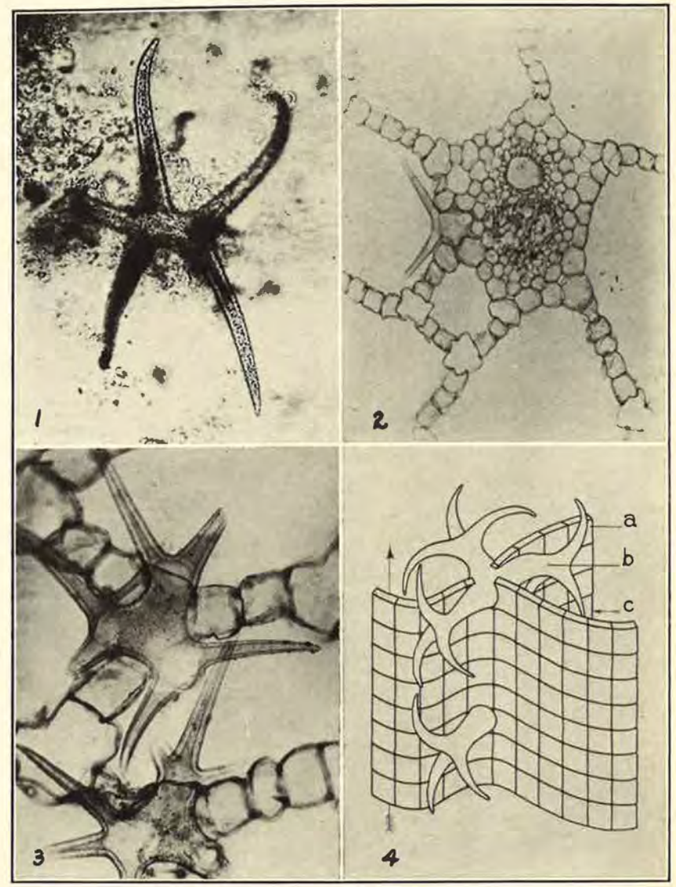

FIG. 1. Single stereid. Magnification × 855.
FIG. 2. Stereid located at a vascular bundle.
FIG. 3. Stereids located at the articulations of the reticulum.
FIG. 4. Diagram showing (a) cells of the reticulum, (b) arms of a stereid, (c) interstices of the reticulum. Arrow shows upward direction of longitudinal axis.

The position of the stereids renders them subject to pressure from several angles. The water around the petioles exerts a pressure which is transmitted to all parts of their inner anatomy, especially the articulations of the reticulum. A cell with strong walls is necessary here and the stereid apparently helps to meet this need.

If the water pressure should become great enough to cause a petiole to collapse, the arms of the stereids would preserve the presence of the interstices by holding out the fundamental tissues of the reticulum. The blunt ends of the arms would not easily pierce the cellulose walls of the fundamental tissue cells.

The stereids resist hydrolysis to an amazing degree. Boiling in either an acidic or alkaline aqueous solution from four to six hours has little or no effect upon them. This characteristic serves them well in their watery environment.

From these observations it is concluded that the stereids, with the sclerenchyma in the vascular bundles, constitutes the inner skeletal units of the petiole of *Nymphea*.

Skeletal units of somewhat similar shape are found in the animal kingdom. An interesting similarity is found by comparing the geometric pattern of the spicules of sponges with that of these stereids. Is it possible that nature, in shaping skeletal units, used the same last for some plants and animals?

THE RESPIRATORY METABOLISM IN THE LARVAE OF THE TOBACCO HORNWORM (*PHLEGETHONTIUS SEXTA*)

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INTRODUCTION

The present study deals with the determination of body weights and the respiratory metabolism during the entire larval stage of the tobacco hornworm *Phlegethontius sexta*).

The larvae of the tobacco hornworm can be identified very easily, even during the second and third day after hatching, by means of the characteristic dorsal posterior-pointed horn from the last segment. Molting occurs definitely at four different periods during the larval stage. Weight and metabolism changes were noted during the molts. The length of the larval stage is 28 to 29 days. Pupation begins at the close of this period. This transition can easily be noted, by discontinued feeding, loss of weight,

increased activity of the larvae until burrowed safely 3 to 4 inches in the soil, when this activity ceases, and the shrinkage of the body within the larval skin. Ludwig ('31) in Japanese beetle considers these changes to be due to histolysis of the tissues. Fink ('25) demonstrated in the potato beetle that this histolysis is accompanied with a lowering of the rate of CO_2 production. Sayle ('28) noted decrease in CO_2 output at the close of the nymph stage in the dragon fly. Bodine ('21, '23) and Bodine and Orr ('25) also showed that the CO_2 output in various species of grasshoppers decreased and that after several days of pupation the output of CO_2 increased. Krogh ('14, '16) noted decrease of CO_2 output at the close of the larval stage and the first several days of the pupal stage of the flour beetle.

MATERIAL AND METHODS

The larvae are hatched from eggs laid singly on the under side of the tobacco leaf, beginning in June and continuing to the end of August. The duration of the larval period is 28 to 29 days. The larvae were collected 2 and 3 days after hatching, when they weighed 0.01–0.02 grams. They were taken to the laboratory, where they were fed on fresh tobacco leaves in large glass laboratory jars. Fresh leaves were supplied every day. The larvae were weighed every day on a laboratory balance. The days on which molts occurred were also noted. A microrespirometer of the closed type (Benedict) for the simultaneous determination of CO_2 output and O_2 intake was used (Horn, '34). Determinations were made daily during the larval stage. The metabolism during the molts and the last day of larval life were noted particularly. All determinations were made at 28°–29° C. Seventy-five animals were used in this study. Weight and respiratory determinations were made daily.

OBSERVATIONS

Every larva was weighed daily during its entire larval life, beginning with the second day when it weighed 0.02 gram. The increase in weight during the first 20 days was only 1.3 grams. Beginning with the 21st day and continuing until the 28th day, the larvae increased in weight from 1.3 to 10.6 grams. This increase was 7 times as much in the last 8 days as during the first 20 days. During the last day of larval life the animals decreased in weight 1.6 grams (Fig. 1). At the end of this day, the larvae pupated by burrowing into the ground.

The first molt occurred during the second day and recovered during the third and fourth days. The second molt occurred on the fifth day and recovered during the sixth day. The third molt occurred on the

tenth day and recovered on the eleventh day. The fourth and last molt occurred on the seventeenth day and recovered on the nineteenth day. Figure 1 shows that during each molt there is a decrease in weight and during the recovery there is a marked increase in weight. However, the fourth molt requires 2 days, but on the second day after recovery, there is a tremendous increase in the rate of growth. During these molts the animal ceases eating, and becomes very inactive. The larval skin begins to split in the medial dorsal anterior region. By rapid intermittent muscular movements, the larval skin is slipped posteriorly and finally is stripped off the body. The larvae immediately begin to feed. The first 3 molts require from 24–36 hours to complete. The fourth molt requires 48–52 hours to complete.

Two days after the larvae were hatched and weighed 0.02 grams, respiratory quotients were determined. CO_2/O_2 = respiratory quotient. The respiratory quotient on the first determination was 0.68. The second day, when the larvae recovered from molting, the respiratory quotient increased and on the third day after the first molt it was 1.1. It decreased to 0.7 with the second molt between the fifth and sixth days and again increased during the recovery from molting, so that 2 days later it was 1.1. The same changes occurred on the third and fourth molts on the tenth and on the sixteenth and seventeenth days respectively, although the respiratory quotients did not reach the same high levels as in the first 2 molts (Fig. 2).

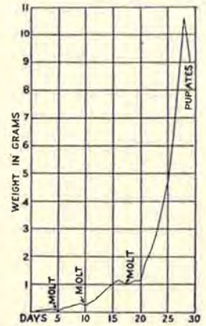

FIG. 1. Rate of growth determined by weight.

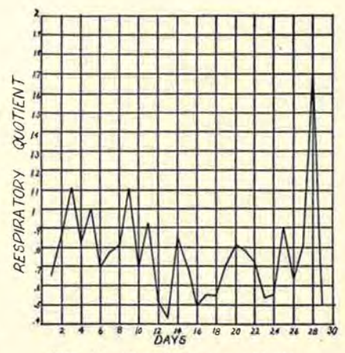

FIG. 2. Respiratory quotients.

The most astonishing feature of the respiratory quotient was observed during the last several days of larval life. On the 28th day the respiratory quotient suddenly reached a new high level of 1.7 and decreased to 0.5 the next day, when pupation occurred.

The CO_2 output and O_2 intake was very high per body gram weight at the beginning of the larval life. This gas exchange decreased rapidly after the first several days, then less rapidly. On the last day of larval life, the CO_2 output and O_2 intake became practically zero (Fig. 3).

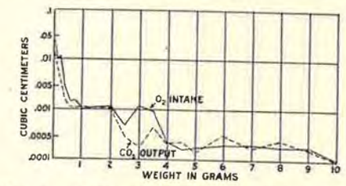

FIG. 3. Rates of CO_2 output and O_2 intake.

DISCUSSION AND SUMMATION

It is very interesting to note that decreases in weight and respiratory quotients occur during the four molts. It is indeed interesting and perplexing that this decrease should be followed within several hours after feeding occurs by immediate increase in weight, and the unorthodox increase of respiratory quotients above 1.

Again the tremendous increase in weight occurred on the next to the last day of larval life accompanied by the unheard of increase in respiratory quotients and was followed by the unusual decrease of both weight and respiratory quotients on the last day of larval life.

These phenomena are rather perplexing and uncertain as to the chemical changes which are taking place in the tissues during molting and during the next to the last day of larval life, just before the time when histolysis is to take place. These changes were observed many times.

BIBLIOGRAPHY

1. Bodine, J. H. 1921. Factors influencing the water content and the rate of metabolism of certain Orthoptera: Jour. Exp. Zool., vol. 32, pp. 137–164.
2. Bodine, J. H. 1923. Hibernation in Orthoptera: Jour. Exp. Zool., vol. 37, pp. 457–488.
3. Bodine, J. H. & Orr, R. R. 1925. Respiratory metabolism: Biol. Bull., vol. 48, pp. 1–14.
4. Fink, D. E. 1925. Metabolism during embryonic and metamorphic development of insects: Jour. Gen. Physiol., vol. 7, pp. 527–543.
5. Horn, C. A. 1934. A microrespirometer: Proc. Penna. Acad. of Science, vol. 8, pp. 16–19.
6. Krogh, A. 1914. On the rate of development and CO production of chrysalids of *Tenebio molitor* at different temperatures: Zeitschr. f. Allg. Physiol., vol. 16, pp. 178–190.

7. Krogh, A. 1916. The respiratory exchange of animals and man: London and New York.
8. Ludwig, Daniel. 1931. Studies on the metamorphosis of the Japanese beetle (*Papillia japonica* Newman): Jour. Exp. Zool., vol. 60, no. 3, pp. 309–323.
9. Sayle, Mary Honora. 1928. The metabolism of insects: Quat. Rev. Biol., vol. 3, no. 4, pp. 542–553.

DEVONIAN NOMENCLATURE IN PENNSYLVANIA[1]

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Pennsylvania Topographic and Geologic Survey

Introduction

Like organic evolution, stratigraphic nomenclature usually proceeds chronologically from the simple to the complex. At first a bare, unadorned, general term may serve to designate the rocks of an entire era. Finally, a single group or formation may be differentiated into ten or a dozen smaller units. Such multifarious ramifications are sometimes carried beyond the limit of usefulness. From such a tendency I myself have not always been totally immune. No doubt finer divisions may be recognized, but usually they are of restricted distribution. This habit of applying a new geographic name to every tag-rag-and-bobtail of a two-by-four unit is to be deprecated. If such units must be mentioned, and no doubt they have their value under excruciatingly precise circumstances governed by highly refined stratigraphic methods of differentiation, then let them be designated as numerical or alphabetical differentiates of a larger, geographic nominal.

To this process of resolving the geologic column into its integral parts, I venture to apply the expression *stratigraphic analysis*. From the earliest to the latest, stratigraphic analyses of the Devonian system in Pennsylvania offer an interesting series.

Stratigraphic Analyses of the Devonian of Pennsylvania

Beginnings

"The year 1809 must ever be notable in the history of American geology, since it brought forth Maclure's Observations on the Geology of the United States, with a colored geological map of the region east of the Mississippi."[2]

Under "Class II, Transitional rocks" and "Class III, Floetz or Secondary rocks" Maclure grouped all of the Paleozoic, some of the pre-

[1] Published with the permission of the State Geologist of Pennsylvania.

[2] Merrill, G. P.: Contributions to the history of American Geology; U. S. Nat. Mus., 1904, p. 217.

Cambrian and probably the Triassic. To these classes he assigned divisions designated by vague mineralogic terms; but under number 1, Class III he noted the *Old Red Sandstone*. Maclure may not always have distinguished the Old Red from the Triassic, not to mention red Paleozoic formations, both older and younger than the Devonian, common in Pennsylvania. But, as his map included our State, this appears to be the first hint of recognition by name within its borders of any portion of the Devonian system.

From Maclure's day until 1836, practically no data on strata now assigned to the Devonian were published. Richard C. Taylor, through his confusion of the relative ages of coals in the Anthracite, Broad Top and Bituminous fields, missed his opportunity of winning geologic immortality. Had he appreciated that the Devonian beds in each of these areas were similar, his misapprehensions would have vanished. Lesley[3] tells us of manuscript maps and other gleanings left by Taylor. Presumably, they followed their maker into oblivion and cannot be consulted today. Their resurrection would be interesting because they evidently supplied a partial basis for the remarkable work of the early years of the First State Survey. Taylor, the outstanding coal authority of his day, firmly believed in Devonian coal in Perry County. This tenet he must have supported with fortitude, for even the skeptical Lesley was so captivated by it that he seems to have accepted the concept even as late as the founding of the Second Survey in 1874. Taylor's beautifully executed sections of 1835 show relations of the "Transitional Measures" and "Secondary Rocks" to the Carboniferous of Central Pennsylvania.[4] Below the coal on the Allegheny Front, he recognized the Old Red Sandstone (probably confused with the Mauch Chunk) and then drew two still older formations, presumably shale, below it, but above a blue band, probably the Helderberg limestone. But, at Half Falls Mountain below Liverpool on the Susquehanna, his totally different interpretation of a nearly identical section includes a coal bed below the Old Red in what is evidenty the Marcellus black shale!

First and Second State Surveys

The centennial of the establishment of the First Geological Survey of Pennsylvania was celebrated in 1936. Henry D. Rogers, first State Geol-

[3] Lesley, J. P.: Historical sketch of geologic exploration in Pennsylvania and other states: Pa. Second Geol. Surv., vol. A, 1876, p. 43.

[4] Taylor, R. C.: On the relative position of the transitional and secondary coal formations in Pennsylvania, and description of some transition coal or bituminous anthracite, and iron ore beds near Broad Top Mountain, in Bedford County, and of a coal vein in Perry County, Pennsylvania, with sections: Geol. Soc. Penna., Tr., vol. I, part II, 1835, pp. 177–192.

ogist, published, late in 1836, the result of his initial year's field work.[5] This remarkably informative leaflet contains the initial attempt to analyze our Devonian sequence. The trial was made prior to the popularizing of geographic names as means of designating geologic units, a fashion to which Rogers never took kindly. His Devonian sequence, of course not designated as Devonian as that name had yet to be proposed, runs:

ROGERS, 1836[6]

9. Brownish red and buff colored slates and sandstones [Dk].
8. Olive Slate Stratum [Dch, Dp, Dh, Dm, Don].
7. Fossiliferous Sandstone [Do].
6. Argillaceous blue limestone [Dhb and youngest Silurian].

Two years later[7] Rogers had considerably advanced his understanding of the Paleozoic sequence; and in some cases he *almost* gave geographic names in the cumbersome phrases with which he designated units according to their geographic distribution:

ROGERS, 1838

IX. Red sandstone and shale of the southeastern slope and base of the Allegheny Mountain [Dk].
VIII. Olive coloured slate of the valley between the Kittatinny and Second Mountains [Dch, Dp, Dh, Dm]. A stratum of blue fossiliferous limestone near the bottom [Don].
VII. Sandstone of the first ridge north of the Kittatinny Mountain [Do].
VI. Blue limestone along the northern base of the Kittatinny Mountain, etc. [Dhb plus].

In this, Rogers's first revised classification, Roman numerals were prefixed to the major units, a designation which has echoed through a century of official utterances. Rogers's final classification,[8] was adumbrated by premonitory, but non-official rumblings which emanated during times of official quiescence. It fully erupted in 1858. His extraordinary system of "transcendental nomenclature" expressed the Devonian formation thus:

[5] Rogers, H. D.: First Annual Report of the State Geologist, 1836.

[6] Bracketed terms indicate approximate modern equivalents, thus: Dk = Catskill, Dch = Chemung, Dp = Portage, Dptr = Trimmers Rock, Dpb = Brallier, Dph = Harrell, Dpbk = Burket, "Dg" = "Genesee," Dt = Tully, Dh = Hamilton (*senso stricto*), Dhm = Moscow, Dhl = Ludlowville, Dhs = Skaneateles, Dhmb = Montebello, Dhmt = Mahantango, Dm = Marcellus, Don = Onondaga, De = Esopus, Do = Oriskany, Dor = Ridgely, Dos = Shriver, Dhb = Helderberg, Dns = New Scotland, Dcy = Coeymans, Dky = Keyser.

[7] Rogers, H. D.: Second Annual Report of geologic exploration of the State of Pennsylvania, 1838.

[8] Rogers, H. D.: Geology of Pennsylvania, 1858.

ROGERS, 1858

"The meaning doesn't matter
If it's only idle chatter
Of a transcendental kind."

IX.	Ponent series	
	Ponent red sandstone	[Dk]
VIII.	Vergent series	
	Vergent shales	[Dch, Dp]
	Vergent flags	[Dptr]
	Cadent series	
	Cadent upper black slate	[Dpbk plus]
	Cadent shales	[Dh or Dhmt]
	Cadent lower black slate	[Dm]
	Post-meridian series	
	Post-meridian limestone	[Don]
	Post-meridian grits	[De]
VII.	Meridian series	
	Meridian sandstone	[Do]
	Meridian slate	[Do and, or Dhb in part]
VI.	Pre-meridian series	
	Pre-meridian limestone	[Dhb, probably plus some Do shale and uppermost Silurian]

Sixteen barren years separate the obsequies of the First Survey from the nativity of the Second. Under J. Peter Lesley, the staff of the newer organization produced several dissimilar Devonian classifications. The best of them and the only ones to prevail through actual contributions are I. C. White's. White studied many regions of the State. As his work progressed, he freely modified his earlier stratigraphic analyses, sometimes for the better, again for the worse. A composite summary of his work follows:[9]

WHITE, 1881–1885

IX. Catskill formation or series [Dk]
Includes sundry divisions most of them developed in northeastern Pennsylvania where his succession runs:

Mt. Pleasant red shale
Elk Mountain shales and sandstones
Cherry Ridge conglomerate, sandstone, limestone and red shale
Honesdale sandstones: upper white, middle red, lower gray
Montrose red shale
Paupack sandstone and shales
New Milford upper, middle and lower sandstones and basal red and olive shales

[9] This table is based upon I. C. White's Second Survey reports, volumes G5, G6, G7 and T3.

	Starrucca shale and sandstone Delaware River flags, including Lackawaxen conglomerate	
VIII–IX.	Transition beds	[Dch-Dk or Dp-Dk]
VIIIf.	Chemung formation	[True Dch or sandy Dp where Dch actually absent]
e.	Portage formation	[Dpb and other shales; Dt doubtful probably only Dh coral zones]
	Hamilton series	["Dg," Dpbk]
d.	Genesee slates	[Dhm?}
c.	Hamilton shales	[Dhm?} Dhmt, approximately]
	Hamilton sandstones	[Dhm?}
b.	Marcellus shale	[Dm]
a.	Selinsgrove lower limestone Upper Helderberg and Corniferous limestones	[Don]
	Selinsgrove shale or Caudigalli grit	[De]
VII.	Oriskany formation	[Do]
	Stormville (Oriskany) shales	[Do and Dhb in part]
VI.	Lower Helderberg	[Dhb]
	Stormville shales (in part)	[Dns in part]
	Stormville conglomerate	[Dcy]
	Stormville limestone and bastard limestone	[Dcy, in part, Dky]

Note: White also used Lewistown limestone as more or less synonymous with Lower Helderberg.

In discussing northwestern Pennsylvania, White [10] wrote:

"The Pocono and Catskill formations, Nos. X and IX, of Middle and Eastern Pennsylvania, are apparently represented by *Shenango, Meadville, Sharpsville, Orangeville, Corry* and *Cussewago beds* (in descending order), and perhaps also by the *Venango Oil Sand Group.*"

He reported also "the Chemung formation," "the Girard shale beds," and "the Portage formation." That White's age determinations are incorrect may be inferred from recent controversial revisions of the sequence in northwestern Pennsylvania, but his conception of the general succession stands today nearly intact. It should be reiterated that one of the most glaring deficiencies of the Second Survey and the cause of many of its miscorrelations was the absence from its staff of a competent paleontologist. It is not my purpose to attempt to show how these earlier views have been altered, perhaps even improved. There is still too little orientation among those floundering in the nomenclatorial maelstrom. Rather, must we await the ebbing of the tide of controversy before a reasonably unbiased conclusion can be announced by any one, particularly the most interested parties.

[10] White, I. C.: The geology of Erie and Crawford counties: Pa. Second Geol. Surv., vol. Q4, 1881, p. 43, etc.

For completion of our characterization of the Second Survey's work, I draw *ad libitum* from Lesley's final disposition of the Devonian:[11]

LESLEY, 1892

IX.	Catskill formation	[Dk]
VIIIg.	Chemung formation	[Dch, in part, and later]
f-g.	Girard shale	[Post-Dch]
f.	Portage formation (Oneonta sandstone)	[Dp in part (Dptr)]
e.	Genesee black slate	[Dpbk]
d.	Tully limestone	[Dt?, upper & middle Dh?]
c.	Hamilton sandstones and shales	[Dh or Dhmt and Dhmb]
b.	Marcellus black shale	[Dm]
a.	Upper Helderberg, Onondaga and Corniferous limestones	[Don]
VII.	Caudigalli (and Schoharie) grits	[De]
	Oriskany sandstone and shale	[Do and probably some Dhb]
VI.	Lower Helderberg shales and limestone	[Dhb, some Do and uppermost Silurian shale]

Twentieth Century Contributions

During the intervals between the Second, Third and Fourth (present) State Surveys, in non-official accounts contemporaneous with the last two, and in the publications of those two organizations themselves, much has been said, some additions made, to the understanding of the Devonian sequence in the State. To cite all the bulletins, folios, private or non-official brochures, maps and other accounts which have developed our present concept of Devonian stratigraphic analysis in Pennsylvania would mean printing a too imposingly voluminous bibliography for the present limited medium of expression. Correctly to list such contributions, we should be obliged to include many out-of-state accounts, particularly from New York, New Jersey, Maryland and Ohio. Rather than attempt this in so brief an essay, a summary table has been constructed based upon manifold writings whose authors number among their coterie such names as Charles Butts, K. E. Caster, S. H. Cathcart, G. H. Chadwick, J. M. Clarke, G. A. Cooper, C. H. Fettke, E. M. Kindle, C. S. Prosser, J. B. Reeside, Charles Schuchert, C. K. Swartz, F. M. Swartz, W. A. Verwiebe, Stewart Weller, Bradford Willard and S. H. Williams. None of the tabulations which follow are necessarily final. All are subject to change and correction, expressing merely the *present status* of Devonian stratigraphic analysis in Pennsylvania:

[11] Lesley, J. P.: A summary description of the geology of Pennsylvania: Pa. Second Geol. Surv., Summary Final Report, vol. 2, 1892.

GENERALIZED SUCCESSION FOR THE MARINE UPPER DEVONIAN OF NORTHWESTERN PENNSYLVANIA (AND SOUTHWESTERN NEW YORK)

Conewango group
- Riceville formation
  - Oswayo member
  - Roystone member
- Venango formation
  - Woodcock member } Cattaraugus red beds to east
  - Saegerstown member } Cattaraugus red beds to east
  - Salamanca member } Cattaraugus red beds to east
  - Panama conglomerate

Conneaut group
- Chadakoin formation (I. C. White's "Chemung")
- Girard formation (I. C. White's "Girard shale")
  - Cuba sandstone

Canadaway group (in part I. C. White's "Portage flags")
- Northeast shale
- Shumla shale
- Leona sandstone
- Gowanda beds
- Dunkirk black shale

Chemung group
- Wellsburg formation
- Cayuta formation

Note: In this and the next table certain lithologic terms have been retained where the precise taxonomic value of the unit is still debatable.

GENERALIZED SEQUENCE FOR THE (LARGELY) NON-MARINE UPPER DEVONIAN OF NORTHEASTERN PENNSYLVANIA

	Marine correlates
Catskill facies group	
Mount Pleasant red shale	
Elk Mountain sandstone	Upper Conewango
Cherry Ridge red beds	Lower Conewango and Conneaut
Dyberry glomerate	
Pimple Hill conglomerate	
Honesdale sandstone	Upper Canadaway
Damascus red shale	Middle Canadaway
Shohola formation, Paupack sandstone, Barryville member = New Milford formation, Luthers Mill member, Lanesboro member, Kingsley member	Lower Canadaway and Chemung
Delaware River flags	Upper Portage
Analomink red shale	Upper Portage
Portage group (marine)	
Trimmers Rock sandstone	

GENERALIZED DEVONIAN SEQUENCE FOR PENNSYLVANIA EXCLUSIVE OF NORTHEASTERN AND NORTHWESTERN REGIONS GIVEN ABOVE

Upper Devonian

Catskill continental facies

Age ranges, depending upon locality, from Portage or Hamilton through to the end of the Devonian. Various subdivisions as Oswayo (?) sandstone, Honesdale sandstone and Pimple Hill conglomerate are known. Intercalated marine members include Kings Mill sandstone and Delville beds in Perry County.

Chemung group
- Wellsburg formation
- Cayuta formation

Local sandstones and conglomerates including the "Allegrippus" are recognized.

Portage group
- Fort Littleton formation
  - Brallier member (west), Trimmers Rock member (east)
  - Losh Run member
  - Harrell member
- Rush formation
  - Burket member
  - Tully member

Middle Devonian

Hamilton group

Hamilton is here used in its broader sense to embrace the beds between the Tully and the base of the Marcellus. This is a reversion to ancestral-type and a retrenchment from my recent use of Hamilton as synonymous with Middle Devonian (*i.e.*, to include Marcellus and Onondaga).

- Moscow formation
  - Windom member
- Ludlowville formation
  - Deep Run member
  - Centerfield coral zone
- Skaneateles formation
  - Colgate member (?)
  - Berwyn member
  - Delphi member
  - Rockville member
  - Mottville member

= Mahantango formation of central Penna. In Bedford Co. splits into:
- Frame member
- Cheneysville member
- Gander Run member

= Montebello sandstone facies of Perry County

- Marcellus formation

(Central)	(Eastern)
Mahanoy member	"Cardiff" member or facies
Mexico member	Chittenango member or facies
Turkey Ridge member	Union Springs member or facies
Shamokin member	

- Onondaga formation

(Central)	(Eastern)
Non-cherty limestone member[12]	Cherty limestone member

[12] The advisability of assigning geographic names to the members of the Onondaga is still questionable. *Cf.* Willard, B., The Onondaga formation in Pennsylvania: Jour. of Geol., vol. 44, 1936, pp. 578–603.

Limy shale member	Esopus shale
Oriskany group	
Ridgely formation	
Shriver formation	
Helderberg group	
New Scotland formation	
Coeymans formation	
Keyser formation[13]	Decker limestone in east

Summary

I have presented salient facts on the growth of Devonian stratigraphic analysis in Pennsylvania. In the vague beginnings the system, unrecognized, was grouped with others, Paleozoic and older. Rogers first differentiated its integral parts into a usable succession of lithologically distinct units even before his English contemporaries had named the Devonian. Before he completed his work, he had defined lithologically practically all our major Devonian units. But for I. C. White, the Second Survey might have passed into history without modifying the status left by Rogers. It was White who really standardized our terminology and correlated our Devonian with the established types of eastern North America. The twentieth century has seen an intumescence of terms punctuating increased details of stratigraphic and paleontologic studies. The systematic use of fossils has rectified many of the mistakes in correlation and age determination which the non-paleontologic Second Survey left its geologic posterity. Today the complex Devonian nomenclature cannot be illustrated in a single section or region of this State. In the northeast is found typically a succession of Upper Devonian continental units. The northwestern part of the State shows us their contemporaneous marine facies. But it goes no lower. The great expanse of folded strata in the Susquehanna and Juniata valleys of central Pennsylvania furnishes the most complete sections. These must, nevertheless, be supplemented by reference to eastern and southcentral regions. The work is not complete. Who shall say where our stratigraphic analyses may lead us; where they may finally halt?

[13] Prof. Frank M. Swartz writes, January 18, 1937, that he entertains some doubt as to the final assignment of the Keyser to the Devonian.

THE AMPHIBIANS AND REPTILES OF BEDFORD COUNTY, PENNSYLVANIA

By Thomas H. Knepp
Everett High School

One of the most successful biology projects in the Everett High School has been the collecting of specimens of local fauna and flora. We have had particularly good fortune in securing herpetological specimens. These specimens were collected by students, interested citizens, and me. Many have been determined by M. Graham Netting, Curator of Herpetology in the Carnegie Museum, Pittsburgh.

Of particular interest to one hunting herpetological specimens is an area in East Providence Township, Bedford County, known as Silas Felton's Dam. Here creek, pond, swamp, open field, moist woodland, and dry area collecting is possible. Many of our best specimens were found here.

A list of the specimens in the Everett High School museum is given below:

Salamanders

Triturus viridescens viridescens Rafinesque, Red-spotted Newt
Ambystoma jeffersonianum (Green), Jefferson's Salamander
Ambystoma maculatum (Shaw), Spotted Salamander
Ambystoma opacum (Gravenhorst), Marbled Salamander
Gyrinophilus porphyriticus porphyriticus (Green), Purple Salamander
Pseudotriton ruber ruber (Sonnini), Common Red Salamander
Eurycea longicauda (Green), Long-tailed Salamander
Plethodon glutinosus (Green), Slimy Salamander
Desmognathus fuscus fuscus (Rafinesque), Dusky Salamander

Frogs

Bufo americanus americanus Holbrook, American Toad
Hyla crucifer Wied, Spring-peeper
Hyla versicolor versicolor Le Conte, Common Tree Frog
Rana catesbeiana Shaw, Bull Frog
Rana clamitans Latreille, Green Frog
Rana palustris Le Conte, Pickerel Frog
Rana sylvatica Le Conte, Wood Frog

Reptiles

Chelydra serpentina (L.), Snapping Turtle
Clemmys insculpta (Le Conte), Wood Turtle
Terrapene carolina (L.), Box Turtle
Chrysemys belli marginata Agassiz, Western Painted Turtle
Sceloporous undulatus undulatus (Latreille), Fence Lizard
Carphophis amoena (Say), Worm Snake

Diadophis punctatus edwardsii, RING-NECK SNAKE
Liopeltis vernalis (Harlan), GRASS SNAKE, SMOOTH GREEN SNAKE
Coluber constrictor constrictor L., BLACK RACER
Elaphe obsoleta obsoleta (Say), PILOT BLACK SNAKE
Lampropeltis triangulum triangulum (Lacepede), HOUSE SNAKE
Natrix sipedon sipedon (L.), BANDED WATER SNAKE
Storeria dekayi (Holbrook), DEKAY'S SNAKE
Storeria occipito-maculata (Storer), RED-BELLIED SNAKE
Thamnophis sirtalis sirtalis (L.), COMMON GARTER SNAKE
Crotalus horridus horridus L., BANDED RATTLESNAKE
Agkistrodon mokasen mokasen Beauvois, COPPERHEAD
Heterodon contortrix (L.), HOG-NOSED SNAKE
(No specimen, but a report of a snake given me leads me to include the species.)

REFERENCE

Netting, M. Graham. 1936. Handlist of the Amphibians and Reptiles of Pennsylvania: Herpetological Leaflet, No. 1.

REMINISCENCES OF DR. S. S. HALDEMAN

BY GEORGE N. C. HENSCHEN
Harrisburg

Samuel Staman Haldeman was born at the family homestead in Locust Grove (now Billmyer), Lancaster County, Pa., August 12, 1812. In his boyhood he developed a great fondness for collecting natural history specimens, and encouraged by his father, he arranged a museum for keeping them in the loft of his father's carriage house. At the age of 14 he was sent to Harrisburg to study with a retired physician, Dr. John Keagy, "who," he said afterward, "was a great teacher." Young Haldeman, and Andrew G. Curtin, resided with Dr. Keagy, and often discussion took the place of study of book material. Two years later he entered Dickinson College, and was an eager student under Professor Henry D. Rogers. After remaining there two years, he attended a course of lectures at the University of Pennsylvania, for a further study of Natural Science. Later he assisted his father in the sawmill and lumber business. Then he joined his brothers in the manufacture of iron, and wrote a paper for Silliman's Journal on the Construction of Furnaces to Smelt Iron with Anthracite.

In 1836 he was appointed assistant geologist under Rogers in the New Jersey State Geological Survey, and the next year became assistant to Rogers in the First Geological Survey of Pennsylvania. Here his territory for study was the Cumberland and Lebanon Valley from the Delaware River to the Maryland line.

You can easily understand why one who has been working in geology would devote himself to a thorough study of molluscs, for they are the best preserved clues or indices to the geological age of the strata in which they occur. Omitting the Latin and the French of the classification, note how he describes the Genus Physa, that in our pools moves on the under side of the surface of the water, like a fly walking on the ceiling. "From the lightness of the shells, they possess in an eminent degree the power to move along in an inverted position, with the foot applied to the surface of the water, thus affording the observer an opportunity to examine the oral organs when put into operation by the animal. . . . Cuvier and Ferussac were wrong in naming this family Pulmonifera and Pulmonalia; and I believe we are indebted to Lamarck, for having been the first to indicate the respiratory organs as true branchiae in structure, but adapted to aerial respiration." Louis Agassiz said of his descriptions, "that man Haldeman has an idea behind every word he utters." In Agassiz's Bibliographia Zoologiae, published in London in 1864, he lists 72 articles of Haldeman's. Today we do not hear more of Haldeman because he worked in the formative stage of the development of science, and much of his work has been the source material for later studies by others.

In the Survey of New York Ebenezer Emmons was in charge of the study of the eastern part of the State. He elaborated the Taconic systems to explain the geologic structure there. Rogers and others did not agree with Emmons' conclusion, and at the Boston meeting of the American Association of Geologists and Naturalists, the controversy was left to a committee of which Prof. Haldeman was chairman, to clear up the difficulty. Later the committee concluded that the Taconic Hills are Cambrian, with infaulted Ordovician strata.

In conversation with his cousin, Dr. Haldeman once said, "I think ten years is long enough for one to be doing intense work in one line of study."

Professor Haldeman's greatest distinction is in Philology. When the University of Pennsylvania established a chair of comparative languages, he was named to it. Professor Francis A. March of Lafayette College said of him: "He was in early life and by his mental constitution a scientist, but he took hold of the facts of speech in that spirit."

He published a Monograph of Freshwater Univalve Molluscs of the United States, in one volume; and 122 articles on the following subjects: Conchology, 10; entomology, 25; arachnidae, 3; crustacea, 5; annelides and worms, 6; geology, 7; philology, 33; archeology, 7; miscellaneous, 29.

He was a member of 28 Learned Societies.

Professor Haldeman died of heart disease at Chickies, Lancaster County, September 10, 1880, and his wife with four children survived him.

NOTES ON CAVE VERTEBRATES

By Charles E. Mohr

Cave animals are most abundant in the cave regions of Kentucky, Indiana, and Missouri, but are common also in caves in West Virginia, Virginia, and Tennessee. In most of these states studies have been made either on cave fauna in general, or upon the habits of specific forms. In these regions extensive cavernous areas support a variety of life which the smaller, unconnected Pennsylvania caves apparently do not possess.

A single blind fish has been reported from Pennsylvania, a blind catfish sent to Cope and described by him in 1864. Jacob Stauffer, Secretary of the Linnean Society of Lancaster, collected several fish, about which Cope writes:[1] "This fish, of which specimens have been taken in the Conestoga creek, a tributary of the Susquehanna, is simply a blind representative of the ordinary type of Silurids. . . . It is occasionally caught by fishermen, and is supposed to issue from a subterranean stream, said to traverse the Silurian limestone in that part of Lancaster county, and discharge into the Conestoga." Cope named it *Gronias nigrilabris*. It averaged about ten inches in length. An interesting condition in the specimens examined by Cope was the greater deterioration of one eye over the other, though neither eye contained anything representing a lens. Cope concludes: ". . . observation on the species in a state of nature may furnish interesting results."

The blind catfish has never been taken again although, according to Dr. H. Justin Roddy of Franklin and Marshall College, the spot where the fish were taken is known to be along the limestone cliffs which border Conestoga Creek between Wabank and Slackwater, just below Gable's Woods where several tiny dry caves are located. Roddy suggests that the catfish should be found in the main stream at night.

No other blind fish have been reported, although several Pennsylvania caves have streams of sufficient size to support fish. The largest streams flow through Penn's Cave and Alexander Caverns.[2] Both streams flow directly from the caves as surface streams. Neither, however, has been seriously studied for aquatic fauna. Sizeable streams exist in Hipple Cave and a few others; Reffton, Morgan, Schofer, Needy, and the Johnson caves have bodies of water of some size and permanence, but lack of stream flow may be a limiting factor as far as fish are concerned. Several of these caves, however, support an abundant aquatic fauna.

[1] Cope, E. D. On a blind Silurid from Pennsylvania: Proc. Acad. Nat. Sci. 1864, pp. 231–2.

[2] For location and description of caves, see Stone, R. W., Pennsylvania Caves: Penna. Top. and Geol. Survey Bull. G 3, 143 pp., 1932.

Blind salamanders, in the Americas, are restricted to caves in the Ozark Mountains, in Missouri, and to a few wells and caves in Texas. No blind cave vertebrates, other than fish and salamanders are known.

Practically all the vertebrate animals use the caves for shelter only. This is the case with mammals, including skunks, raccoons, weasels, gray foxes, deer mice, and woodchucks. In many sections of the State traps set in caves have caught these animals.

Bats use the caves during hibernation. They also make certain mysterious visits to caves during summer nights, possibly to get water. Not all bats hibernate in caves, however, the Lasurine bats, including the Silver-haired, Hoary, and Red bats, never entering caves.

Birds, such as phoebes, sometimes nest just inside the entrance of caves, as at Stover Cave, and I have seen a screech owl occupying a roost in Marvel Cave, Missouri, and have found a pellet in Johnson Cave, Mifflin County, Pa.

Reptiles die if they fall into caves and cannot escape. I have seen the skeletons of snakes in Narehood Cave, Montour County, and have found box turtle shells in several caves, particularly in Dietrich Cave, Berks County.

Kenneth N. Dearolf has visited most of the caves with me during the last two years. While engaged primarily in study of the invertebrate fauna, he assisted me greatly in this study of the vertebrates.

The following notes pertain to animals actually seen by the writer during visits to caves, chiefly in Pennsylvania, but also in a number of other states:

Eurycea longicauda: Cave or Long-tailed Salamander

In October, 1931, I found eight large Cave Salamanders in the mine shaft just northeast of Blandon, Berks County. All were taken on the walls or in crevices within a small area, about 100 feet inside the entrance. I returned them a few days later but did not see any again until October 17, 1935, when I came upon four large individuals crawling in very shallow running water. Large ovarian eggs could be seen through the body wall of one of the females. A male was seen hurrying along the floor of the mine in very shallow water, seemingly "sniffing" in search of something. It disregarded the light. Repeated visits to the mine at other times have failed to turn up any of these salamanders.

Two related species in this genus are cave forms, *Eurycea lucifuga*, which has been recorded from West Virginia, Tennessee, Kentucky, Indiana, Missouri, and Arkansas, and *Eurycea melanopleura*, limited chiefly to the Ozark Mountain region.

On exhibition in the U. S. National Museum is a specimen of *Eurycea lucifuga*. The label bears the number 68,359 and the information that it was collected from a "cave in Meadville," Crawford County, Pa., by George P. Merrill, in 1892. The location of this cave is not known to the writer.

Plethodon glutinosus: SLIMY SALAMANDER

Outside of caves Slimy Salamanders are found most frequently on rocky, forested hillsides. It is in caves in such localities that they are most likely to be found. In northwestern Georgia I visited a small cave, on August 28, 1935, where 35 Slimy Salamanders were climbing about the walls, but in Pennsylvania caves I have seen only solitary individuals. In Rupert Cave, Mifflin County, a huge specimen escaped me by diving into a crevice, January 23, 1937. Single individuals have been seen just inside the entrances of Schofer and Dragon caves, in Berks County.

The only egg masses credited to this species have been found[3] in caves in the Ozark Mountains: Sheridan Cave, near Mountain Home, and Indian Cave, near Bella Vista, Arkansas, on August 17, and September 3, 1928.

Plethodon cinereus: RED-BACKED SALAMANDER

The presence of the Red-backed Salamander in caves is probably accidental although I found the closely related *Plethodon dorsalis* guarding its eggs in Mammoth Onyx Cave, Kentucky, on June 27, 1932. I have found the Red-backed Salamander in only two caves, Dragon and Schofer caves, Berks County.

Gyrinophilus porphyriticus: PURPLE SALAMANDER

I saw several large larva and adult Purple Salamanders in both Johnson caves, on the edge of McVeytown, Mifflin County, during the winter of 1936–37. There is a strong possibility that these particular individuals are true cave inhabitants, since there are permanent bodies of water thickly inhabited with invertebrate aquatic life. I have collected Purple Salamanders far within Timber Ridge Cave, near Mouth of Seneca, Pendleton County, West Virginia, as well as in caves in Burke's Garden, Virginia.

Rana pipiens: LEOPARD FROG

Leopard Frogs have been found in early fall in several mine shafts, in considerable numbers in the mine near Blandon, Berks County, and also in Morgan Cave, Berks County.

Neotoma pennsylvanica: ALLEGHENY CAVE RAT

The Allegheny Cave Rat, the eastern representative of the western pack or trade rat, is limited for the most part to the rock slides of the Allegheny Mountains, and while it doubtless lives in some of the more remote caves, I have seen it in Cold Cave, near Pequea, Lancaster County, and at the Pinnacle Cave, in Berks County. In the former of these caves, neither of which is in limestone, forty members of a museum field party observed one of the cave rats as it sat unconcernedly on its nest, in August, 1935. I have approached within a few feet of one of these animals in Cornwall Cave, West Virginia.

[3] Noble, G. K., and B. C. Marshall, The breeding habits of two salamanders: American Museum Novitates, No. 347, p. 6, 1929.

Myotis keenii septentrionalis: TROUESSART'S BAT

As reported earlier,[4] Trouessart's Bats have been captured in considerable numbers during summer in Berks County by placing netting at the entrance of Schofer Cave and catching the bats as they attempted to find their way into the cave. In fall I have seen small numbers of these bats in mine shafts, particularly Blandon, but also in Morgan and Redington caves, and I have found them during winter in Stover, Boyer, and Dulany caves. They apparently enter the caves again in spring for a short period. Their winter range is unknown.

Myotis lucifugus lucifugus: LITTLE BROWN BAT

Found in approximately half of the Pennsylvania caves during the winter, Little Brown Bats occur in colonies in only three: in Woodward there are about 125; in Dulany, 250 (February 27, 1937); and in Aitkin Cave, 5000. In few other caves are there more than a dozen.

Myotis sodalis: SOCIAL OR SOOTY BAT

The largest colony of Social Bats hibernates in Penn's Cave and has been estimated to number 2000 individuals. Strangely enough, other species of bats seem to avoid this cave, since repeated visits have failed to show more than a half dozen individuals of other species. Colonies of perhaps 500 Social Bats have been seen in Aitkin and Hipple caves, and during one of several visits, about 100 were seen in Sharer Cave, about three miles west of Penn's Cave. Few were seen on other visits. From one to half a dozen specimens have been seen in Woodward, Stover, Historic Indian, New Paris, and Dulany caves. They seem to frequent caves with water[5] though none were seen during a single boat trip through Alexander Caverns.

Myotis subulatus leibii: LEAST BROWN BAT

Intensive search has somewhat extended the central Pennsylvania range[6] of this interesting species, two individuals having been found in Johnson Cave, McVeytown, Mifflin County, but frequent visits to this whole area strongly indicate a center of population close to Stover, Woodward, and Aitkin caves, with only occasional individuals being found a few miles farther away.

During the past five winters, 173 Least Brown Bats have been found. Of these 24 were collected, the rest marked and released. About 10 per cent have been recovered. The Least Brown Bats have been found in ten Pennsylvania caves. One of these, Dulany, lies in the southwestern corner of the State, a second, Little Aitkin, has been closed by a fall of rock. The bats found to date in the ten caves total:

Stover Cave, 86; Aitkin, 45; Little Aitkin, 16; Woodward, 15; Maitland, 3; Rossman, 2; Milroy, 2; Dulany, 1; and Sharer, 1. (Each of these caves has been visited at least three times, some of them many more times.)

Notes on the habits and range of this species were given in a previous paper.[7]

[4] Mohr, Charles E., Pennsylvania bats of the genus Myotis: Proc. Pa. Acad. Sci. VII, p. 39, 1933.

[5] Mohr, Charles E., *Ibid.*, p. 40.

[6] Mohr, Charles E., Notes on the least brown bat *Myotis subulatus leibii*. Proc. Pa. Acad. Sci. X, p. 63, 1936.

[7] Mohr, Charles E., *Ibid.*, pp. 62–65.

Pipistrellus subflavus subflavus: GEORGIAN or PIGMY BAT

The small, solitary Pigmy Bat can be found hibernating in practically every cave in the East. It has been recorded in about 90 per cent of the Pennsylvania caves. Six to twelve is the usual number seen but up to 30 individuals have been observed in Furnace Hill mine, near Friedensburg, Berks County. The dark, northern form, *P. s. obscurus,* is apparently quite rare in this region. I have twice taken specimens of it from Woodward Cave. Other Pigmy Bats from several caves appear to be intergradations between the two forms.

Eptesicus fuscus fuscus: BIG BROWN BAT

The Big Brown Bat is the largest cave species and enters the caves late, sometimes not until December. Its hardiness is further evidenced by its hanging in exposed positions near the entrances of caves. Rarely is a cave visited in mid-winter without a few of these bats being seen. As many as 50 have been counted in one of the rooms in Woodward Cave, and nearly as many have been observed in Maitland Cave, Mifflin County.

NOTES ON CAVE INVERTEBRATES

BY KENNETH DEAROLF

71 Park Road, Wyomissing Hills, West Lawn, Pennsylvania

Intermittently for the last two years I have visited sixty caves in Pennsylvania, Virginia, West Virginia, Georgia, Tennessee and Kentucky. The following account deals in a general way with cave collecting technique, the species collected and the physical conditions under which they are found, together with some remarks on their activities and food habits.

The physical conditions encountered in caves, such as cramped quarters, darkness, the ever present mud, and the small size and delicate nature of most of the specimens, necessitated devising a collecting technique specifically for cave forms. It is best to wear a light attached to a hat, leaving both hands free. Two sizes of vials are carried in vest pockets, including two vials half filled with alcohol. An aspirator is extremely convenient for capturing many soft-bodied elusive forms which otherwise would be difficult to secure in numbers. Forceps and air and water thermometers complete the equipment.

By far the best method of collecting cave invertebrates is by trapping. A large vial containing a saturated solution of picric acid is buried up to the rim in the cave clay. In it is suspended a smaller vial containing bait. For bait I have used a mixture of limburger cheese and rotten meat. Trapping in this manner secures a greater number of specimens which are only infrequently collected while visiting a cave. If the trap and bait vials are filled outside, a minimum of material must be carried into the cave.

An article by Charles E. Mohr in the Pennsylvania Topographic and Geologic Survey Bulletin G3, Pennsylvania Caves, lists thirty species of cave fauna. Reports of the cave fauna of Kentucky, Tennessee, Virginia, West Virginia and Indiana have been published.

The inhabitants of caves may be divided roughly into two classes, the dwellers of twilight, just inside the entrance, and those of darkness, deep within the cave. Twilight dwellers consist of hibernating mosquitoes, syrphid flies, fungus gnats, moths and winter crane flies. These are found in winter. Cave grasshoppers, springtails, spiders, carabid beetles and thysanura are twilight dwellers also, and may be either permanent or only visitors. The inhabitants of the dark portions of caves are mostly permanent residents. The white eyeless springtails, thysanura, isopods, amphipods, planaria and millipeds are undoubtedly permanent residents, together with some flies, spiders, mites and beetles which are not white and eyeless, due perhaps to having shorter cave ancestry. Of course twilight species are sometimes found in the dark regions of a cave, but they are strays.

FLIES

The most common invertebrates found in caves are flies. Fifteen species were collected in 25 of 30 caves visited in Pennsylvania. Most of the flies are confined to the twilight zone just inside the entrance, where they hibernate through the winter. Species of fungus gnats are most common in the twilight area where they hibernate along with females of the mosquitoes *Culex pipiens* Linnaeus and *Anopheles punctipennes* (Say). Other flies wintering in the twilight area include the flower fly *Eristalis tenax* Linnaeus, species of Helomyzid flies and the winter crane fly, *Trichocera sp.*

The flies that do inhabit the dark portions of caves include members of the families Phoridae, Sciaridae, Helomyzidae and Chironomidae. Members of these families breed in decaying organic material in moist places on the cave floor. Since larvae, pupae and adults have been found, it would seem to indicate that their entire life is spent in the cave. They have, however, no modifications to fit them for a life in darkness. Flies encountered in caves may be easily captured with the aspirator or by simply placing a small empty vial over them.

GRASSHOPPERS

Members of two genera of Orthoptera inhabit caves. *Hadenoecus subterraneous* (Scudder) found in the Kentucky caves is the only true cave dwelling grasshopper. It is found far back in the dark recesses of caves, where it breeds and spends its entire life living on the scant organic mate-

rial present. The other member of this genus, *H. puteanus* Scudder, is found commonly in the caves of Pennsylvania but only in the twilight zone, as it is not a true cave inhabitant.

Species of the second genus, *Ceuthophilus,* are entirely twilight dwellers. *C. gracilipes gracilipes* (Haldeman) was present in 13 of 30 caves visited in Pennsylvania. Members of this genus are not true cave inhabitants, but are also found outside where they are a seclusive species, seeking dark damp retreats, such as the crevices under rocks, logs and humus and in cellars. Their presence in caves is incidental to their preference for a dark, damp habitat. When disturbed they quickly leap some distance away but may easily be captured with the fingers. However, it is next to impossible to keep intact their long legs and extremely long slender antennae. Sometimes in moist places on the wall they are found covered with droplets of condensed moisture, showing a period of inactivity. Kept in captivity these long-horned grasshoppers ate paper, peanut butter and each other. They have well-developed eyes and are not modified for cave life.

Beetles

Of the insect order Coleoptera three families are represented in caves, Carabidae, Staphylinidae and Silphidae. The carabids may be dismissed by saying that members of this family found in Pennsylvania caves are all outside forms which are present in caves by accident only. No blind cavernicolous carabids have yet been found in any Pennsylvania cave. Of the staphylinids three species have been found in 8 of 30 Pennsylvania caves. Two species are of the genus *Quedius.* They are found under boards, decaying organic material and fungus. These forms are also observed above ground, but those recovered deep within caves undoubtedly spend their lives there. They are not modified for cave life. Silphid beetles of three species occur in 9 of 30 Pennsylvania caves. Two species are of the genus *Choleva.* They are found in moist clay, under boards, beneath decaying organic matter and in traps. They also are not modified for cave life.

Moths

Three species of moths have been found in 3 of 30 Pennsylvania caves. All of them are Noctuids and hibernate in the twilight zone. The most common is *Scoliopteryx libatrix* Linnaeus. This moth has been reported from caves in Tennessee and Indiana, and is a common Noctuid in the United States and Europe. In Pennsylvania it has been collected in Morgan, Refton and Barton caves. The second species, *Hypenna humuli* Harris, was taken in Barton Cave. It has been reported previously only

by A. M. Reese, from Upper Bear Hole, West Virginia. A third species, *Plathypena scabra* Fabricius, has been taken by Mohr in Barton and Refton caves.

Spiders

Three species taken in 22 of 30 Pennsylvania caves makes spiders second in abundance of cave invertebrates. Some, like the common *Meta menardi* (Latreille) spin their webs in the twilight zone. The presence of twilight-dwelling spiders is, as with cave grasshoppers, only incidental to their liking for a cool shady habitat. Other spiders dwell deep in the cave's darkness and are taken from wet decaying wood. These dwellers in darkness probably spend their entire lives there feeding upon springtails, mites and flies and their larvae. Ives of Tennessee found that the cave spider *Nesticus pallidus* Emerton, breeds to a certain extent all the year through, but large counts over a long period indicate that a slight increase in breeding occurs in April and October, which corresponds with the general breeding season of spiders outside of caves. This means then, that these spiders have not inhabited caves long enough to lose entirely their seasonal breeding habits. Besides the two species mentioned, *Troglophyphantes incertus* (Emerton) is also found in the caves of Pennsylvania.

Springtails

Third in abundance of cave invertebrates are the springtails. Four species were taken in 20 of 30 Pennsylvania caves. These minute insects occur wherever moisture and decaying organic material are found. From the surface of cave pools they can be caught in a small vial and from decaying wood can be secured best with the aspirator. Some are white and blind, showing adaptation to cave life, while others are dark colored, outside forms. The white forms are undoubtedly confined solely to cave existence.

Crustaceans

Of crustaceans there are five species in 6 of 30 Pennsylvania caves. Two species are isopods and three are amphipods. Isopods are found in shallow pools of water in total darkness. Two isopods, *Asellus richardsonae* Hay and an unidentified Asellid, were found on decaying wood. *A. richardsonae* has been recorded before only from caves in Tennessee. In Pennsylvania it has been found in both Upper and Lower Johnson caves, Mifflin Co. Accompanying isopods are amphipods of three species, *Gammarus sp., Sympleonia clatoni* Creaser and *S. sp.* Amphipods are carnivorous and feed in captivity upon dead isopods. They have been

taken in Veiled Lady, Upper Johnson, Barton, Dulany, Refton and Penn's caves. Both isopods and amphipods are white and blind due to having lived many generations in complete darkness.

Flatworms

Two species of flatworms were observed. *Phagocata gracilis* (Haldeman) is an outside form which seemed to have colonized in Veiled Lady Cave, Center County, having been found there between November 1936 and April 1937, and probably first washed in during the spring of 1936 by flood waters which sometimes completely fill the cave. It was living in several small pools at the end. Recently water again flooded this cave and no trace of the flatworms is now seen. The other species is a white eyeless planarian discovered by Mr. John Price of Lancaster, in Brownstone cave. It is named *Speophila pricei* Hymen after Mr. Price. It has since been discovered by Mohr in Upper Johnson Cave where it inhabits decaying wood in pools of water a few inches deep.

Physical Conditions

The physical conditions in caves which make life possible are the yearly constant temperature, entrance of organic material, presence of moisture and places of concealment. The temperature variation throughout the year depends upon factors such as, the presence of two openings, presence of water and the size and depth of the cave. Some caves have a seasonal difference of ten degrees while others have a difference of only one degree. The air temperature for ten caves average 7.8° C. The range was from 3.3° to 12.8° C. These are temperatures for the mild winter of 1937. Moisture is essential; dry dusty caves are devoid of life. Organic material occurs in caves in numerous forms. It may be logs, branches, twigs, leaves, boards, paper, cardboard, animal dropings, dead bats or other animals, candle drippings and water-washed debris. Places of concealment may be under rocks, under organic material or in cracks and crevices, and beneath ledges. Since constant temperature and places of concealment are common to all caves, wet or dry, the presence of moisture and organic material are the two essentials for life to exist in a cave.

Food

A clue to the food habits of cave invertebrates may be found by observing all the forms living together in a small sociological unit. An ideal condition is a long, wet, badly decayed log, half in and half out of water. Rolling over the log reveals springtails, beetles with their larvae, flies and their larvae, spiders, mites and perhaps a round worm or earthworm.

Here is a division of scavengers and predators. Springtails, silphid beetles and their larvae, flies with their larvae and worms are the scavengers, eating fungus and the decaying plant and animal material of the log. Staphylinid beetles with their larvae, spiders and mites are the predators, preying upon the scavengers as well as upon each other. In the water the same is true. Isopods feed upon the decaying wood of the log, amphipods feed upon dead isopods and perhaps the planarian on both. Organic material, scavengers and predators constitute an independent sociological unit in caves.

Cave invertebrates are modified in four ways. The animal becomes smaller. Meager diet probably explains this. It becomes eyeless and develops longer sensory appendages, a compensative development for the lack or the uselessness of eyes. The absence of color is due merely to the absence of light and is a physical phenomenon rather than an adaptive development.

As much of my material is still acquiring names in the hands of specialists, I am not prepared to offer a comparison of Pennsylvania cave fauna with that of other States. The present work shows promise of uncovering new cave species as well as increasing the range of many subterranean forms.

Note: For the identification of material my gracious thanks is due the following specialists: Amphipods and Isopods, Clarence R. Shoemaker and James O. Maloney, respectively, of the United States National Museum; Orthoptera, Mr. Morgan Hebard, of the Philadelphia Academy of Sciences; Planaria, Dr. Libbie H. Hyman, of the American Museum of Natural History; Spiders, Prof. Sherman C. Bishop of the University of Rochester.

A METHOD FOR DETERMINING THE EFFECT OF TIME AND TEMPERATURE ON THE DISTRIBUTION OF GLYCERIN IN A VERTICAL COLUMN OF WATER

By W. A. Parlin
Department of Physics, Dickinson College

The variation of the refractive index with concentration and a sectional tube made of flat glass plates are used to determine the diffusion of glycerin in a vertical column of water. The distribution is given for various temperatures and intervals of time.

The present work was undertaken, not because of any particular importance attached to the diffusion of glycerin in water, but to test a possible method for determining the diffusion of heavy solids and liquids into solvents having different indices of refraction. Since it is possible, by

means of the various types of refractometers, to measure the refractive index of a liquid to the fourth decimal place, the variation in the refractive index is frequently used to indicate the purity or the concentration of a substance whose refractive index is sufficiently different from that of the solvent.

Since glycerin and water have quite different refractive indices, and furthermore, since they are infinitely soluble in each other, they were chosen for a test of the method. An Abbe refractometer with a constant temperature bath was used to determine the refractive indices, the observations being taken at a temperature of 30° C., with a maximum variation of less than one-tenth of a degree. The refractive indices of known dilutions of glycerin with water were made and a calibration curve drawn, showing the relation between the refractive index and the percentage concentration of the glycerin as shown by figure 1.

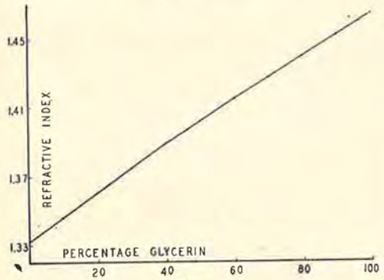


FIG. 1

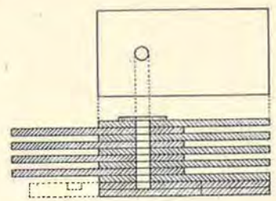


FIG. 2

FIG. 1. Relation between refractive index and concentration of glycerin. FIG. 2. Construction of sectional tube.

To determine the distribution of glycerin at different levels in a vertical column of water, a sectional tube was constructed of flat glass plates 6 cm. wide, 12 cm. long, and 0.49 cm. thick. A hole was drilled through each plate at a point midway between each side and 3 cm. from one end. A cross-sectional view of the vertical tube is shown in figure 2. The tube consists of ten plates or sections placed on top of one another in such a way that alternate plates extend to the right and left. While in the position indicated by the dotted lines, the bottom section is filled with glycerin, and the other nine sections are filled with distilled water. The bottom section is then moved into line with the other sections and the tube left in a vertical position for a definite time at a constant temperature. After the specified time has elapsed the plates are slipped parallel to each other, thus confining the liquid in ten separate cells. The refractive index of

the liquid in each cell is then determined and, by means of the calibration curve of figure 1, the percentage of glycerin corresponding to the refractive index of the liquid in each cell is obtained, thus giving the percentage distribution of glycerin in the tube after the specified time has elapsed. Curves showing the distribution of glycerin for different periods of time at constant temperature (30.2° C. with variation of 0.1 degree) are given in figure 3.

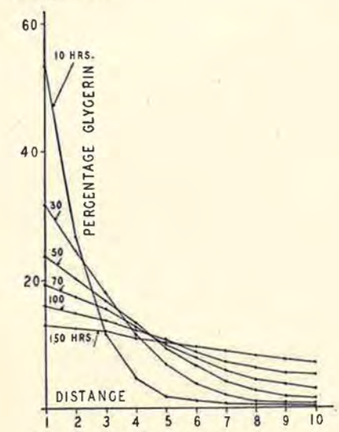


FIG. 3

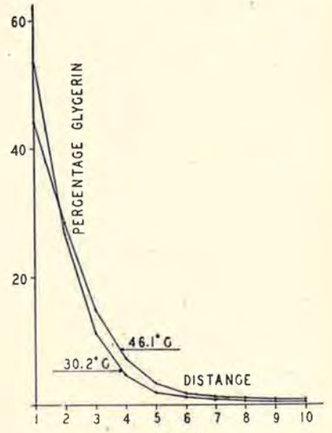


FIG. 4

FIG. 3. Distribution of glycerin in tube at given time intervals. FIG. 4. Effect of temperature on the distribution of glycerin in the tube.

In order to check against possible leaks between the plates, the percentages of glycerin in the ten cells were added. In all cases the sum was found to be 100% plus or minus 0.1%.

The effect of temperature on the distribution of glycerin in the tube is shown in figure 4. The temperatures for the tests were 30.2, 38.1, and 46.1, with a maximum variation of not more than 0.1 degree, the time in each case being ten hours.

In the near future, it is planned to use the present method to determine the diffusion of some heavy organic liquids and solids into vertical columns of various solvents.

HABROBRACON AS A MEANS FOR TESTING THE EFFECTIVENESS OF PHYSICAL AGENTS IN CAUSING MUTATIONS

By P. W. Whiting
University of Pennsylvania

Quantitative work on production of mutations is in general dependent upon study of recessive lethals because visible viable mutations are so rare that very large numbers must be counted in order to make differences statistically significant. To detect recessive lethals breeding tests of progeny must be carried out, but these are somewhat laborious even in such a convenient form as *Drosophila.*

Sterility of males is frequently due to lack of sperm or to sperm that are inactivated or defective so that they fail to fertilize the eggs. Muller (1927) suggested that x-radiation of *Drosophila* males may cause another type of sterility due to the production of dominant lethals. The sperm themselves are not inactivated but carry such a lethal effect into the egg that it fails to develop. In *Drosophila* and most other forms these two types of male sterility cannot be statistically separated; the eggs fail to develop in either case.

In the wasp *Habrobracon* males normally develop from unfertilized eggs by haploid parthenogenesis while fertilized eggs give rise to females. Unmated females or females mated with sterile males produce males only and any reduction in number of daughters because of naturally occurring male sterility is compensated by corresponding increase in number of sons. Male sterility due to dominant lethals decreases the females without increasing the males. The eggs which might otherwise develop are killed by fertilization. Males of *Habrobracon* may therefore be subjected to various physical agents and the breeding test completed in the first generation. Whatever agent causes dominant lethals may also in all probability induce transmissible recessive lethals and even visible viable mutations.

Stancati (1932) demonstrated dominant lethals in *Habrobracon* induced by x-radiation of sperm. He based his conclusions on decrease in biparental ratio and decrease in number of offspring per culture vial.

In the experiments reported herewith, total days during egg-laying period while the females are set are taken as the basis of comparison, the averages males per day and females per day being calculated. Table 1 summarizes results of an x-radiation experiment in which wild-type males (stock 25) were treated November 9, 1936, by Dr. Raymond Zirkle, Department of Radiology, University of Pennsylvania Hospital, and were

TABLE 1
Offspring of Females Mated to X-rayed Males

X-ray dosage	Days	Males	Females	Males per day	Females per day
Controls	108	71	286	0.66	2.64
10,000 R.	72	62	5	0.83	0.07
20,000 R.	99	95	0	0.96	0
40,000 R.	117	157	0	1.34	0

then mated to orange-eyed females (stock 11–0). The daughters are almost all absent if sperm are given 10,000 R units and there seems to be at least one dominant lethal in every sperm cell after higher dosages, for no females are produced. Although males per day fail to compensate for this lack of females there is a slight increase as dosages are increased.

To test whether sperm might be inactivated by still higher x-ray dosages another experiment was carried out, February 2, 1937. Mates of males treated with 75,000 R produced 890 males in 515 days, 1.73 per day. This is somewhat higher than males per day from mated controls which produced 388 males and 1024 females in 271 days, 1.43 males and 3.78 females per day. Unmated control females, however, produced 3,191 males in 675 days, 4.73 per day, so that even after treatment with 75,000 R the sperm are not inactivated but are still able to fertilize almost as many eggs as are the untreated sperm. The slight excess of males produced by mates of treated males as compared with mated controls may be due to inclusion of some "step-sons" of "naturally" sterile males, males lacking sperm. Another possibility is that while mature sperm are not inactivated, spermatogenesis may be stopped and sperm supply decreased even though matings were made but a few hours after treatment. This hypothesis will be tested in a later experiment.

Neutrons have also been shown to produce dominant lethals (Whiting, P. W., 1936) being actually much more effective than x-rays. Later experiments should therefore demonstrate increase in rate of visible mutations following neutron treatment.

Ultra-short (1 meter) radio waves appear to be ineffective. Dr. G. M. McKinley, University of Pittsburgh, treated large numbers of males with such heavy doses that they were killed or so disabled that they were unable to mate. Three survivors although much weakened sired in five matings a total of 177 biparentals (13 males and 164 females). Impaternate brothers were only 62. The high biparental ratio indicates that this agent will have no genetic effect.

The experiments here reported have been aided by grants from the Committee on Effects of Radiation on Living Organisms (National Research Council).

LITERATURE CITED

Muller, H. J., 1927. Artificial transmutation of the gene. Science 66: 84–87.

Stancati, M. F., 1932. Production of dominant lethal genetic effects by x-radiation of sperm in Habrobracon. Science 76: 197–198.

Whiting, P. W., 1936. Dominant lethal genetic effects caused by neutrons. Science 84: 68.

NOTABLE PENNSYLVANIA FERNS

By Edgar T. Wherry

University of Pennsylvania

Although the early botanists did not usually designate a type locality for their species, there seems reason to believe that at least ten of our native ferns may be regarded as having been first described from this State. These are:

Asplenium ebenoides R. R. Scott. Described in 1865 from the southwest bank of the Schuylkill River, in Montgomery County.

A. pinnatifidum (Muhl.) Nuttall. This was discovered by Muhlenberg, no doubt in southern Lancaster County, and named by him *A. rhizophyllum* B. *pinnatifidum* in 1813. It was raised to species rank by Nuttall 5 years later.

A. trudelli Wherry. Founded in 1925 on specimens collected at Cully, just below Holtwood, along the Susquehanna River in Lancaster County.

Botrychium obliquum Muhl. ex Willd. Muhlenberg collected this, in all probability in Lancaster County, and sent it to Willdenow, who described it in 1810.

Dryopteris intermedia (Muhl. ex Willd.) Gray. This had the same history as the next-preceding, although it was at first mistakenly described as a *Polypodium,* transfer to the genus *Dryopteris* being made by Gray in 1848.

Lygodium palmatum (Bernh.) Swartz. Another discovery by Muhlenberg; some reference to it is made in his journal, now preserved at the American Philosophical Society in Philadelphia, but just where he obtained it is not clearly stated. He sent it to Willdenow, who announced it as a *Hydroglossum,* but this name was first published as a synonym for *Gisopteris palmata* by Bernhardi in 1801. Five years later Swartz transferred it to his genus *Lygodium.*

Lycopodium obscurum L. John Bartram collected this near Philadelphia and sent it to Europe, where it was figured by Dillenius in 1741. Linnaeus based his species upon this figure. Another Clubmoss with the same early history was misunderstood by Linnaeus, and grouped under

the northern *L. complanatum,* not being recognized as deserving species standing until 1919, when Blanchard named it *L. flabelliforme.*

Polystichum acrostichoides (Michx.) Schott. Michaux observed this fern in "Pennsylvania, Carolina, and Tennessee" and named it *Nephrodium acrostichoides* in 1803. Schott transferred it to *Polystichum* 31 years later.

Selaginella apoda (L.) Fernald. This was probably sent to Europe by Bartram, for when he figured it in 1741, Dillenius gave the range as "Pennsylvania, Virginia, and Carolina." When Linnaeus named it *Lycopodium apodum* in 1753, he listed the same States, but in reverse order. Fernald made the correct combination in 1915.

Woodsia obtusa (Spreng.) Torrey. When Sprengel named this *Polypodium obtusum* in 1804, he attributed it merely to Pennsylvania, but as he is known to have been receiving material from Muhlenberg at the time, the probabilities are that it had been collected by the latter, in Lancaster County. Transfer to the correct genus was made by Torrey in 1840.

Several ferns are noteworthy in that, although in part discovered elsewhere, they reach a range-limit in this State. Here may be enumerated:

1. Circumboreal Plants

Botrychium multifidum (var. *silaifolium*). This enters from the north, being known in Erie and Monroe Counties, and reaching a limit in central Berks County. (One station in Monmouth County, New Jersey, being slightly farther south.)

Botrychium simplex. Known in 10 counties: Berks, Bucks, Crawford, Dauphin, Indiana, Lehigh, Monroe, Northampton, Pike, and Wayne. A station near Finland, Bucks County—lat. 40° 23′ N.—is apparently the southernmost known for the species. Three varieties are represented, but their individual distributions have not been worked out.

Cryptogramma stelleri. In cool ravines from western Lycoming to eastern Wayne counties. Known further south only at one place in Bergen County, N. J.

Polystichum braunii (var. *purshii*). Found in ravines tributary to that of Kitchen Creek in western Luzerne County, and to that of Fishing Creek in eastern Sullivan County; also near Lake Shehawken, Wayne County. The first named is the southern limit for the species, lat. 41° 18′ N.

Equisetum litorale. The taxonomic status of this plant is not clear, but at any rate it reaches its southern limit here, along the Susquehanna River in York and Lancaster Counties, and at Chester in Delaware County.

2. Appalachian Mountain Plants

Lygodium palmatum. The Climbing Fern has a sporadic distribution, but becomes locally abundant in several northeastern mountain counties, reaching a western limit near Lopez, Sullivan County, long. 76° 20′ W.

Asplenium bradleyi. Several stations along the Susquehanna valley in York and Lancaster Counties and one in Carbon County. The latter is a northwestern limiting occurrence, although the species is known at two places each in New Jersey and New York. *A. gravesii,* the hybrid between this and the next, reaches its northeastern limit in Lancaster County.

Asplenium pinnatifidum. Scattered through the more southern counties, Lancaster County being in the lead, with 15 recorded stations. An old specimen from Berks County, if authentic, represents the northeastern limit of the species, reports from New Jersey apparently referring to the next following.

Asplenium trudelli. One station in Fayette, and several each in York and Lancaster counties. This presumable hybrid between *A. pinnatifidum* and *A. montanum* reaches a northern limit in Warren County, N. J.

3. Southern Calcareous Rock Plants

Asplenium resiliens. This Mexican species follows limestone outcrops into Missouri and North Carolina, and has been especially successful in traversing the Shenandoah valley. It recently turned up on a single cliff near Mercersburg, in Franklin County, Penna., lat. 39° 47′ N., apparently the absolute limit of its range.

4. Eastern Bog Plants

Thelypteris simulata. The northwesternmost authentic occurrence of the Bog Fern is that in Bear Meadows, Centre County, long. 77° 45′ W. Reports farther northwest have proved to be based on misidentifications. Little is known as to the limits of the range of this plant in the south, and it may have entered the continent from a former land mass lying off our coast, now buried beneath the sea.

Lycopodium adpressum. Besides being found along the Delaware, this coastal lowland species extends inland to White Oak, in northern Lancaster County.

CASTS OF HALITE CRYSTALS IN THE BEEKMANTOWN LIMESTONE

By Benjamin L. Miller

Casts of halite crystals in ancient sediments not associated with salt deposits have been reported from many localities and from strata of widely different ages. In some strata they are fairly common, as, for example, in the Triassic of the Appalachian region where they have been found in association with the casts of other salts, particularly glauberite. The purpose of this short article is merely to call attention to a new locality for halite casts and to discuss the significance of the occurrence.

The specimens were obtained from the Keller dolomitic limestone quarry at Portland, Pa. They are present in a dark-colored, shaly dolomite about half an inch thick, on the north side of the quarry 10 feet above the quarry floor. In March, 1937, the quarry was idle and the ledge concealed by a considerable depth of water. The bed is close to the base of the Beekmantown formation, according to the author's belief. Due to the fact that there is no sharp differentiation between the Beekmantown and the underlying Allentown in this region, there is a possibility that it belongs in the upper Allentown.

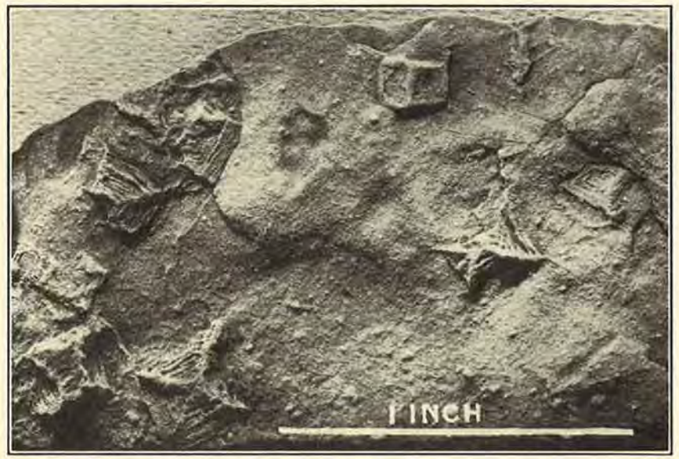
Description of Rock and Casts

Sodium chloride, on crystallizing, forms cubes in which the edges grow faster than the faces, thus resulting in symmetrical four-sided pyramidal hopper-shaped cavities in the center of each face. In later stages these cavities may be filled, producing ordinary cubes. In this case the crystals did not advance beyond the hopper shape before they were covered with calcareous ooze in which there was an admixture of carbonaceous matter. The ooze consolidated sufficiently to hold its shape before percolating waters removed the soluble salt. In the accompanying illustration most of the forms shown are the fillings of the cavities. One shows a cast of the entire salt crystal. Other specimens show only the crystal edges. The casts vary in diameter from three-sixteenths to one-fourth inch along the edges of the hopper-shaped crystals.

The crystals are not oriented. In some cases a face is parallel to the surface of the bed, and these show best the growth lines of the pyramidal cavities which appear as steps. These growth lines have much the appearance of spider webs. More of the casts have only one corner protruding with the three edges appearing as equidimensional radiating ridges (not represented in illustration).

The thin bed of dolomite on which the crystals appear at the surface contains some oolites and small brecciated fragmenst.

The chief interest in these specimens is the light thrown on the physiographic conditions which prevailed in the region at certain periods during Beekmantown time. Sun cracks, which are indicative of shallow water receding sufficiently to expose the calcareous muds to the drying action of the sun, have previously been noted. Likewise, ripple marks, oölites, and intraformational conglomerates also furnish evidence of the same sort, although these phenomena probably are developed at times in localities where the water may be of moderate depth.



Casts of halite crystals, Portland, Pa.

The crystal casts must have been formed in a lagoon where the marine waters evaporated sufficiently to precipitate halite. It may be that in places layers of salt actually were formed but were later entirely removed, leaving no trace of their existence.

The place of origin with reference to Appalachia, the land mass that yielded most of the sediments of the Paleozoic strata, is also of interest. In various parts of the world at the present time, there are marginal salt marshes adjoining seas or salt lakes where evaporation has progressed to the point of salt saturation. In the case of the Portland locality we can scarcely regard it as having been a marginal basin. We do not know how far distant the northwestern shore of Appalachia was at the time but it must have been at least 30 miles and perhaps much more.

With this assumption we may depict the Beekmanstown sea as extremely shallow at certain times and places, and instead of a large uninterrupted inland sea there were probably many detached bodies of shallow water separated by calcareous mud banks both near the shore of Appalachia and many miles removed. In these separate basins, deposition was probably unequal, and individual beds throughout the valley were never continuous. This may account in part for the difficulty encountered in attempting to correlate the strata of the Beekmantown in outcrops only a few miles apart.

The discovery may also furnish some evidence, although not conclusive, of a warm arid climate during part of Beekmantown time since continued excessive evaporation seldom occurs under other conditions.

The presence of these salt crystal casts may have some bearing on the origin of the Paleozoic limestones of the Great Valley. The author has been strongly inclined to minimize the importance of chemical precipitation in their formation and has explained the absence or sparsity of fossil remains as indicating the primary agency of bacteria or other forms of life devoid of hard parts. This find seems to furnish evidence of a purely inorganic origin for at least some of these limestones, since it is not probable that water evaporated to the point of halite precipitation without forming deposits of the less soluble calcium and magnesium carbonates.

The discovery here reported was made on Sept. 9, 1932. The author was accompanied by Ralph L. Miller and Philip B. Myers. It was not reported previously as it had been hoped that other similar occurrences might be found but this hope has not been realized. It will be a source of gratification if other examples of the same sort are found elsewhere in the Paleozoic sediments.

REPLACEMENT OF HARDYSTON QUARTZITE BY JASPER

By Donald M. Fraser
Dept. of Geology, Lehigh University

The origin of the jasper or ferruginous chert found so abundantly in the Highlands of eastern Pennsylvania has become a problem of importance in connection with the mapping of the geology of that area.

Interpretations which have been presented to account for the cherty material agree that replacement is the responsible process but differ in regard to the material which has been replaced. One view holds that the

cherty material is "derived from the replacement of limestone by silica. . . .";[1] another contends that the Hardyston quartzite has been altered and that "The grains of quartz of the sandstone were dissolved, and the material was later precipitated in the cryptocrystalline form."[2] This paper presents evidence in support of the latter view.

When the chert and jasper are mapped as areas of former limestone, discordant structural relations result between the pre-Cambrian and the Paleozoic formations and in some places between two or more of the Paleozoic formations themselves. These discordant relations have been used as one line of evidence in support of the hypothesis of the overthrust origin of the Reading Hills.

If, however, the chert and jasper are mapped in the main as areas of former Hardyston quartzite, most of these structural discordancies are obviated and the overthrust structure of the Reading Hills becomes quite improbable.

The writer believes that silica replacement of the limestones of the area has occurred in many places, often resulting in masses of milky chert and sometimes forming jasper. It is thought, however, that to offer the presence in the field of chert, jasper or ferruginous chert as positive evidence of the presence or former presence of limestone, is not justifiable.

The close association in the field of the jasper and Hardyston quartzite, often in places where it would be unreasonable or difficult to account for the presence of limestone, is suggestive of their close relationship.

That the Hardyston has been altered to jasper or ferruginous chert in many places has been contended by B. L. Miller, who for many years has been guided in part by these materials in tracing the Hardyston in the area. P. B. Myers'[3] study of the Hardyston quartzite in Lehigh and Northampton Counties also showed the close association in the field between the jasper and the quartzite. He found and described arkosic facies of the Hardyston showing silicification in the form of encroachment of small microcrystalline areas of silica into both quartz and feldspar grains in the quartzite.

An especially good example of the formation of jasper and ferruginous chert by the complete replacement or reorganization of Hardyston quartzite was found by Robert D. Butler and the writer $1\frac{3}{4}$ miles north

[1] G. W. Stose and A. I. Jonas, Highlands near Reading, Pennsylvania; the erosion remnant of a great overthrust sheet: Bull. Geol. Soc. Am., vol. 116, May, 1935, p. 772.

[2] B. L. Miller, Topographic and Geologic Atlas of Pennsylvania, Allentown Quadrangle: Pa. Top. and Geol. Survey, A 206, 1925, p. 43.

[3] P. B. Myers, The origin of jaspers in Lehigh and Northampton Counties, Pennsylvania: Proc. Penn. Acad. Sci., vol. VIII, pp. 87–92, 1934.

of Limeport in the southwest part of the Allentown quadrangle. Small indistinct rounded patches on the surface indicate the former sand grain areas and show definitely that here is a piece of Hardyston quartzite which has been jasperized.

The true nature of this alteration is well shown in thin-section. The rounded grains of the material shown in Fig. 1 appear as grains of quartz in the thin-sections (Fig. 2). They are typically rounded sand grains firmly cemented together to form a dense quartzite. The cementing material contains small amounts of sericite and (or) chlorite and iron hydroxide granules. In plane polarized light the material appears to be a normal quartzite (Fig. 2) but when the nicols are crossed the true cherty or jaspery nature of the mass is immediately apparent (Fig. 3). The supposed large rounded quartz grains are made up of hundreds of minute granules of silica, the typical crypto- or microcrystalline silica of a silicified rock.

The minute granular nature cannot be related to crushing because the rounded outlines of the larger grain-areas would have been distorted. The suggestion that the original sand grains may have been chert particles is disproved by the close relationship between the small silica granules of the grain areas and those of the matrix or cementing material. Those of the latter area are somewhat larger in places and this feature together with the greater abundance of iron hydroxide in the cementing material serves to outline the sand grain areas both in plane polarized light and between crossed nicols. The fact that some of the thin-sections show a gradation from material such as is shown in Fig. 3 into ordinary ferruginous chert completely lacking in sand grain structure also indicates a later replacement origin rather than a primary deposition of the rounded grains as chert particles. It is thought therefore that there is little doubt that the origin must be one of complete replacement or at least reorganization of the original siliceous rock by iron-bearing siliceous waters.

In many places in the field large amounts of massive jasper or ferruginous chert associated with the Hardyston, bear no trace of the former sandstone structure of the original formation. These areas illustrate the gross replacement wherein masses of the Hardyston were replaced by colloidal silica which later crystallized. Another type of replacement is that wherein the process occurs on a more minute scale in which original structures are preserved. Here, too, the secondary silica is probably deposited in colloidal form, producing a gel which later crystallizes. It is this latter type of jasper or ferruginous chert described and pictured above which is of special importance in the conclusions listed below.

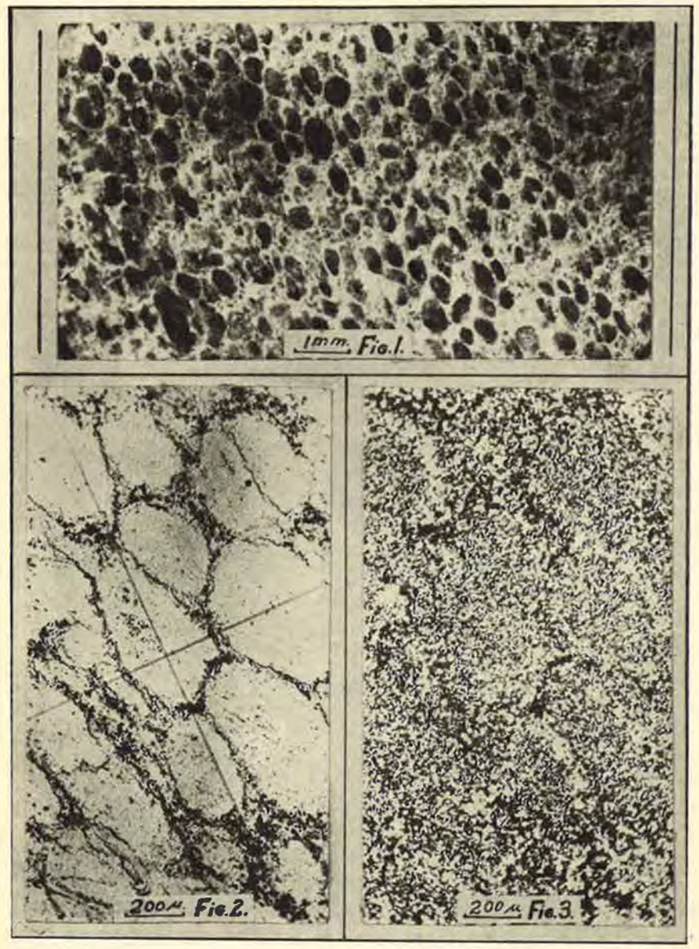


FIG. 1. Hardyston quartzite showing rounded grains which have been replaced by jasper or ferruginous chert.

FIG. 2. Photomicrograph, in plane polarized light, of the material shown in Fig. 1. The opaque material in the matrix is iron hydroxide.

FIG. 3. Photomicrograph of the same field as in Fig. 2, taken between crossed nicols showing that the rounded grains are made up of aggregates of quartz granules of typical cherty or jaspery character.

1. Silica-bearing waters have widely permeated the lower Paleozoic sandstone and limestone of the eastern Pennsylvania Highlands.

2. Chert and jasper have been formed in places by the replacement of limestone by the silica in these waters.

3. Jasper and ferruginous chert have been formed in many places by the replacement of the Hardyston quartzite by these waters.

4. The mapping of areas wherein jasper and ferruginous chert are found might be carried out on the basis of the following suggestions:

a. In known limestone areas the presence of jasper and ferruginous chert may be considered as having been formed by replacement of the limestone.

b. Where the areas of these materials are in structural continuity with the Hardyston, are found together with Hardyston, or are on the higher slopes or tops of pre-Cambrian hills they should be considered as having been formed by replacement of the Hardyston.

The writer wishes to express his appreciation to the National Research Council for a grant which has made possible the thin-sections for this and related problems in progress at the present time.

THE USE OF TOPOGRAPHIC MAPS WITHOUT CULTURE IN TEACHING PHYSIOGRAPHY

LAWRENCE WHITCOMB
Lehigh University

The United States Geological Survey has issued a number of topographic maps which show only the relief and the water. As the culture, the work of man, has been left off these special maps, they are very valuable for class work. Maps which give the names of the State, the cities, rivers, and other well-known geographic features, often provide the student with too much information that is helpful to him in solving problems. It is desirable therefore to use maps that do not have these aids in order to force him to rely upon the topography.

For example, depressions caused by glaciers (kettle holes), underground water (sink holes), and the work of the wind (blow outs), are easily confused by the elementary student. If the map is labeled Florida the work of glaciers is immediately ruled out and the problem of their origin is much simpler. In order to test the true ability of the student it has been common practice in many schools to include a few of these special maps in class work and examinations.

There is another use for these maps in teaching physiography which the writer believes to be of even greater value. If the student can be

taught to place these unnamed maps in their correct Physiographic Province it is good evidence of a true knowledge of the topography of the various parts of the United States and an ability to read maps correctly.

Attempts along this line which did not prove to be particularly successful led to the development of a key to be used with the maps. It has been found that with its aid the average student rapidly acquires the ability to locate the maps in their correct district. After working with the key for a while, confidence is gained and its help is no longer needed by the student.

The advantages to be obtained by this method are numerous. In the first place the student must read the map correctly. Secondly, he soon becomes familiar with the characteristics of the different provinces. Thirdly, the student accepts the map as a challenge and in many cases asks for more maps than are supplied. This last point is of prime importance as it produces the right mental attitude.

It is recognized that the key, which follows, is not fool-proof and that many people would take exception to some of its parts or would make additions. In constructing the key, the main idea was to have it short and clear enough to take care of the more typical maps representing the various provinces. No attempt has been made to produce an unfailing system as it is often an advantage to have the student see that a map has characteristics that are common to two or more areas. Such a situation causes him to try to find some distinctive difference between the two possible areas. When this stage is obtained the results are sure to be good.

After using the key on the simpler and more typical maps the student is ready for the more complicated ones. By this time the method of attack has become firmly fixed and the key is practically never consulted.

The key is as follows:

Key to Determination of Physiographic Provinces of Topographic Maps which Lack Culture

1. What is the scale?
2. What is the contour interval?
3. Is the map uniform (one province), or varied (more than one province)?
4. Is it A, Plains; B, Plateaus; or C, Mountains?

A. Plains.
   1. Elevation.
      a. Under 500 feet, probably Coastal Plain.
      b. 500 to 2000 feet, probably Central Lowlands.
      c. 2000 to 5000 feet, probably Great Plains.
   2. Glaciated or non-glaciated.
      a. If glaciated it is north of Ohio and Missouri rivers.

      x. If direction of glaciation is from west of north to east of south it is probably east of Ohio.
      y. If direction of glaciation is from east of north to west of south it is probably west of New York.
      b. If map does not show glaciation it may be north of Ohio and Missouri Rivers but probably not.
   3. Does the ocean show on map? If so, see special section for shore lines.
   4. Direction of stream flow of major rivers.
      a. East into the Atlantic or east into the Mississippi, or the Gulf.
      b. South into the Gulf of Mexico or Long Island Sound.
      c. West into the Mississippi or Pacific.
   5. Is it a limestone region? If so, and low elevations, probably Florida.
   6. Is it an arid region? If so, probably west of Mississippi River.

B. Plateaus.
   1. Elevation.
      a. Under 1000 feet, probably Interior Low Plateaus.
      b. 1000 to 3000 feet, either Appalachian Plateaus or Ozark Plateaus.
      c. 3000 to 5000 feet, Columbia Plateau.
      d. 5000 to 7000 feet, Colorado Plateau.
   2. Glaciated or non-glaciated. See A. 2.
   3. How great is the relief?
      a. Over 1000 feet probably west of Mississippi River.
   4. Direction of stream flow of major rivers. See A. 4.
   5. Are there entrenched meanders? If so, it may be:
      a. Appalachian Plateaus.
      b. Interior Low Plateaus.
      c. Ozark Plateau.
   6. Is it an arid region?
      a. Very arid, Colorado Plateau.
      b. Intermediate, Columbia Plateau.
      c. Moist, east of Great Plains.
      d. Playa lakes, probably Basin and Range Province.

C. Mountains.
   1. Elevation.
      a. Over 7000 feet, west of Mississippi River.
      b. Under 7000 feet, mature mountains cut in rocks of uniform hardness, probably east of Mississippi in Blue Ridge, New England, or Adirondack Province; may be in western U. S.
   2. Continental glaciation.
      a. See A. 2.
      b. Mountains showing continental glaciation.
         x. New England Province.
            Direction of glaciation nearly north-south. Not many large areas of swamps.
         y. Adirondack Province.
            Direction of glaciation east of north to west of south. More swamps than in New England Province.

3. Mountain glaciation.
   a. Glaciers present. Probably Northern Rockies or Cascades.
   b. Glaciers absent. May be any of western ranges.
4. Folded strata. Hard and soft beds.
   a. Mountains running east of north to west of south, probably Valley and Ridge Province.
   b. Mountains running east and west, probably Ouachita Province.
5. Mountains with large alluvial fans at base in arid country probably Basin and Range or Pacific Border Province.

D. Shore Lines.*
   a. Is shore line low and sandy? If so, probably Coastal Plain.
   b. Low, glacial till, probably New England Province (Cape Cod to Connecticut, or Long Island).
   c. Low glaciated rocky coast. Probably New England Province north of Cape Cod.
   d. Low limestone country. See A. 5. Probably Florida.
   e. Low arid country. See A. 1, a, and A. 6, probably Coastal Plain in Texas.
   f. Low east-west coast line, unglaciated, probably Coastal Plain along Gulf of Mexico. Delta of Mississippi River may cause confusion.
   g. Rocky coast line, small beaches, ocean to west. Pacific Border Province.
   h. Water above seal level. Probably on the Great Lakes.

E. More than one Province shown on map.
   1. Study each section separately.
   2. Find area where two or more provinces meet that will fit the findings under E. 1.

ORISKANY THICKNESSES IN PENNSYLVANIA[1]

By Arthur B. Cleaves

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Introduction

The Oriskany was first recorded in Pennsylvania by H. D. Rogers in 1836,[2] and elaborated by him in his Second Annual Report[3] and subsequent reports. Whereas, in his first report he recognizes only the (Ridgeley) sandstone, in his second he establishes the lower cherts (Shriver) as being associated with the sandstone. Rogers did not designate the Oriskany by any geographic name.

At the present time the Oriskany beds are divided into two distinct formations. The upper sandstone beds are called the Ridgeley formation,

* Direction of shore line and relative position of land and water are often of great help.

[1] Published with the permission of the State Geologist of Pennsylvania.

[2] First Annual Report: State Geologist, Harrsiburg, p. 14, 1836.

[3] Second Annual Report: State Geologist, Harrisburg, pp. 49–51, 1838.

and the lower, siliceous limestones, shales, and cherts, the Shriver formation.

These formational names were originally assigned to similar beds in Maryland by the Maryland Geological Survey.[4] After a study of these beds over the entire area of outcrop in the State of Pennsylvania, the Maryland names are believed to be entirely satisfactory and appropriate in Pennsylvania.

Although the Oriskany has been known in Pennsylvania for over 100 years, the work, partly encompassed in this paper, constitutes the first comprehensive study over the State as a whole.

In the present report the two Oriskany formations, collectively to be called a group, are separated only on lithology. Subsequent work on the paleontologic data secured may make it necessary to transfer some strata from the upper Shriver to the Ridgely.

Ridgeley Formation

The Ridgeley formation consists of a calcareous sandstone and contains conglomerate beds. The fresh rock is bluish-grey and is very tough. Weathering removes the calcareous cement, reducing the rock to loose blocks and sand. The upper contact is frequently marked by the presence of considerable hematite and limonite, which, with the rapidly varying thicknesses is strong evidence of an erosional unconformity. In the central part of the State the Ridgeley yields a quartz sand so pure that it is quarried extensively as glass sand.[5]

Shriver Formation

The Shriver formation consists of blocky, greyish-black impure chert, impure siliceous limestone and interbedded dark grey to black shale. Weathering frequently reduces the material to punky, buff-colored fragments, which in part remain in fairly thick blocks. The purer chert weathers almost white, and is often found in small pieces covering fairly extensive areas. The Shriver also varies in thickness, though not as rapidly as does the Ridgeley.

Thicknesses Along the Allegheny Front

At Hyndman, southeast of the Allegheny Front in Bedford County, the Ridgeley is a hard, tough, calcareous sandstone approximately 89 feet

[4] Swartz, C. K., *et al.*: Maryland Geological Survey—Lower Devonian, pp. 90–96, 1913.

[5] Fettke, C. R., Glass Manufacture and the Glass Sand Industry of Pennsylvania: Topographic and Geologic Survey of Pennsylvania, Rpt. No. 12, 1919.

thick. It weathers to a dirty brown, loose sand, is highly fossiliferous and contains local, thin, conglomeratic beds.

The Shriver formation in the same section is an impure grey to black, siliceous limestone and shale. Black chert beds 1 to 4 inches thick are common in the upper two-thirds of the formation. It is 108 feet thick and is underlain by 20 feet of barren, black, massive, slightly calcareous shale. This underlying shale is commonly found at this level and is assigned to the New Scotland formation of the Helderberg group.[6]

Twelve miles northeast, near Bedford Springs, an incomplete section contains 105 feet of Ridgeley and 40 feet of Shriver. The New Scotland shale member here is 44½ feet thick.

In Blair County, 30 miles north of Bedford Springs, in the vicinity of Hollidaysburg, composite sections indicate an approximate thickness of 110 feet in the Ridgeley. The upper beds have had the calcareous cement removed and do not form the conspicuous ridges so common in other parts of the State. The lower beds are highly calcareous and merge at the base with the Shriver formation, which is arenaceous at the contact. The Shriver is 115 feet thick, typical, very fossiliferous, and overlies 30 feet of the New Scotland shale which has become fissile.

At Mount Eagle, Centre County, 48 miles northeast of Hollidaysburg, the Ridgeley is 50 feet thick, coarse, and dirty. It contains limonite and hematite at the top. The Shriver in the same section is approximately 90 feet thick. A covered interval conceals the possible presence of the New Scotland shale member.

Twenty-seven miles northeast on Pine Creek, near Jersey Shore, Lycoming County, the section is incomplete but approximately 93 feet of Ridgeley are exposed. Both uncemented sandstone and durable, calcareous Ridgeley are exposed on the two limbs of the syncline. There are 81 feet of Shriver in this section, many intervals of which are concealed.

One mile east of Montoursville, Lycoming County, in a complete section there are 65 feet of Ridgeley. It is clean, light colored, and loosely cemented. The Shriver is only partly exposed, but the stratigraphic interval between the Ridgeley and the New Scotland limestone would permit of 113 feet of Shriver provided there is no New Scotland shale member. The presence of this member is suspected but lack of exposures obviate definite proof.

The Shriver sections just mentioned in Centre and Lycoming counties contain considerable limy shale.

The interval of 21 miles between the Pine Creek and Montoursville sections has no Oriskany strata indicated on the State and County geologic maps. Thicknesses, however, at both ends of this interval strongly suggest their occurrence. The reason for non-exposure is accounted for by lateral planation by Bald Eagle Creek and burial in its flood-plain debris.

[6] Swartz, C. K., *et. al., op. cit.*, pp. 87, 89, 175.

Thicknesses in the Juniata-Susquehanna Valleys

The Ridgeley has its greatest thickness variations in the Juniata and Susquehanna valleys. From a maximum of 190 feet at Mapleton, Huntingdon County, it diminishes to zero in Snyder and Montour counties, a distance of only 45 miles. At Mapleton rapid changes in sedimentation produced conglomeratic beds, the stratigraphic positions of which vary in adjacent sections. For the most part the rock is loosely consolidated; however, some of the quarries in the Mapleton district show extremely durable Ridgeley, in which the cementing material today is silica instead of the calcareous cement observed in other areas.

The Shriver near Mapleton is poorly exposed; the best exposure is at the northwest end of the limestone quarry of the Mapleton Limestone Company across from the town of Mapleton, on the north side of the Juniata River. Here, the Shriver is punky, buff-colored rock, highly fossiliferous. It has a thickness of approximately 89 feet. The lower beds are concealed, so it is not known whether the Shriver is here underlain by the New Scotland shale. However, ten miles to the south on Sugar Run there are 5 feet of this shale. Consequently the latter is believed to thin out in this area.

Sections of Ridgeley in Mifflin County show a thinning northeastward. In the McVeytown-Lewistown area the sandstone ranges between 90 and 140 feet thick. The Ridgeley in both Huntingdon and Mifflin counties often holds up ridges although the cement is largely removed in many places.

Shriver strata in Mifflin County are best shown in sections one-half and one mile north of McVeytown where the thickness is 145 feet. The beds consist of siliceous limestone, thin interbeds of shale, and thin chert beds. The latter are most common in the lower 26 feet, where nodular chert beds are also found. In the upper Shriver the limestone becomes arenaceous. Underlying the Shriver there are 13 feet of the fissile New Scotland shale.

In Snyder, Union and Montour counties, 33 to 69 miles eastward, no sandstone is present. The overlying Onondaga limy shale rests directly on the Shriver formation. However, near-by to the south, in parts of Juniata and Northumberland counties, a little Ridgeley sandstone occurs, nowhere over 8 feet thick. Transitional zones of thin calcareous sand-

stones, shales, impure cherts and siliceous limestones are present between the Ridgeley and the Shriver. Such conditions unquestionably indicate marginal facies and changes from deeper to shallow water in the Oriskany sea, or sudden rejuvenation of streams on the adjacent land masses.

At Beaver Springs, Snyder County, there are 106 feet of Shriver, principally a siliceous limestone, although containing many beds of grey and black chert 4 to 14 inches thick. Near the top of the section the chert becomes somewhat arenaceous, weathers to a punky brown rock and is very fossiliferous. At the extreme top, under the Onondaga limy shale, there is an iron-rich zone similar to that which is usually found at the top of the Ridgeley. Underlying the Shriver there are 90 feet of the barren New Scotland shale.

In Montour County, 2½ miles east of Danville, the Oriskany section is again composed entirely of Shriver. Here the beds, 110 feet thick, are primarily black siliceous limestone and shale, with interbedded black chert. The chert is largely contained in the upper 56 feet.

Thicknesses in the Southern and Eastern Areas

In southern Fulton County in a section on the west slope of Dickey's mountain, only four feet of sandstone and conglomerate can definitely be assigned to the Ridgeley. The Shriver part of the same section is not entirely satisfactory because of the absence of fossils. However, 20 feet of loose sand and chert, and 15 feet of massive chert beds are tentatively assigned to the Shriver. These beds are underlain by interbedded clay and chert which contain fossils that might indicate either New Scotland or Becraft; if the latter, that is the only occurrence of Becraft discovered by the writer in Pennsylvania.

The nearest complete section northward is at Neelyton, in southeastern Huntingdon County, where the Ridgeley is 57 feet thick and the Shriver 109 feet thick. The rocks in this section are badly weathered, hence far from ideal. The Ridgeley consists of loose sand and sandstone blocks, whereas the Shriver consists of broken down siliceous limestone, sand and chert blocks. The Shriver is underlain by New Scotland chert and limestone.

Thirty-six miles eastward in central Perry County, at Falling Springs, there are 41½ feet of Ridgeley consisting of interbedded sandstone and conglomerate. In this county the Ridgeley is a ridge-builder, and in some sections the conglomerate is exceedingly coarse. The thickness variations are rapid; near New Bloomfield sections show only 20 and 25 feet of sandstone. The Ridgeley in Perry County is almost invariably iron-rich at the upper contact. The Shriver section at Falling Springs is especially

interesting. It is 50 feet thick and consists of chert and interbedded sandstone. Some of the chert beds are 4 to 6 feet thick. Underlying this there are 31 feet of coarse, light, cream-colored sandstone, which has yielded Oriskany fossils. Its stratigraphic position is that of the barren New Scotland shale in other parts of the State. Underlying this sandstone there are 13 feet of chert and greenish-grey clay. This chert and clay contain *Spirifer perlamellosus* and *Spirifer macropleurus,* guide fossils of the New Scotland, hitherto recognized only as a limestone at Half Falls Mountain, on the Juniata River, in eastern Perry County. At the latter locality a sandstone beds 3 feet thick is interbedded in the New Scotland limestone.

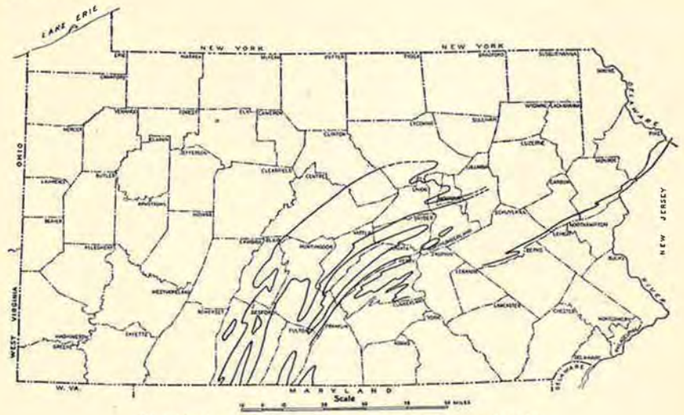
The Oriskany group is probably cut out by an unconformity in southeastern Perry County for it does not reappear along the strike west of Schuylkill County.

The first Ridgeley appears as loose boulders, sand, and gravel in western Schuylkill County. It undoubtedly is thin as indicated by the first sections, 20 feet (not completely exposed) at Andreas in western Carbon County, and 54 feet at Germans, four miles west of Bowmans on the Lehigh River. It thickens rapidly eastward. At Bowmans it attains the startling thickness of 125 feet.

Eight miles east of the Lehigh River a very good Oriskany section may be studied at Little Gap, where the Ridgeley is 120 feet thick and the Shriver approximately 51 feet thick. In the Lehigh River region the Ridgeley is a ridge-forming rock, very conglomeratic and frequently strongly cemented. The Shriver consists chiefly of massive beds of chert. Both formations are sparsely fossiliferous. Below a 10 foot concealed interval under the Shriver there is 25 feet of exceptionally coarse sandstone and conglomerate. This sandstone is tentatively correlated with that appearing below the Shriver at Falling Springs in Perry County.

From Little Gap eastward the Ridgeley thins rapidly until, in eastern Monroe County, at Experiment Mills on Brodhead Creek, it occurs in a zone transitional with the underlying Shriver. In this zone, 43 feet thick, no sandstone bed thicker than 5 feet occurs. The sandy and conglomerate beds are very calcareous. The Shriver consists of 2 and 4 inch beds of black chert and interbedded siliceous limestone. The latter becomes shaly locally and is strongly sheared near the base. Underlying the 36 feet of Shriver are New Scotland fossiliferous limy shales, which are strongly sheared. In this section no sandstone appears between the New Scotland and the Shriver. A mile and a quarter northeast, however, in a section near Shawnee-on-the-Delaware, a very coarse sandstone below the New Scotland limestone is interbedded with the upper beds of the Coeymans

limestone. The zone containing the sandstone is 13 feet thick. Whether this is the same sandstone reported in the other southern sections is open to question. Possibly it is the same which occurs progressively higher in the columnar section as one travels west, or they may be entirely separate sandstones.



Distribution of the Oriskany group in Pennsylvania.

Contacts

Upper Ridgeley contact: The upper contact of the Ridgeley formation is always sharp. Except in the region east of the Lehigh River it is overlain by the Onondaga limy shales. Frequently the top of the Ridgeley contains considerable limonite and hematite, and this fact, added to the great variances in thickness (sometimes its total absence), and the complete faunal break between the Ridgeley and the Onondaga, point to the existence of an unconformity.

East of the Lehigh River the Ridgeley is overlain by the Esopus shales and "grits." This formation thickens from 5 feet at the Lehigh River to 316+ feet in eastern Monroe County. The sparse fauna contained in the Esopus closely allies it to the Onondaga, with which Willard has recently grouped it.[7] The same unconformable relationship exists between the Esopus and Ridgeley as between the Onondaga and Ridgeley.

Ridgeley-Shriver contact: The contact of the Ridgeley with the Shriver is, for the most part, sharp. However, the upper beds of the Shriver are

[7] Willard, B., The Onondaga Formation in Pennsylvania: Jour. Geol., vol. XLIV, p. 584, 1936.

frequently arenaceous, and in some localities, notably in Juniata, Northumberland, and Monroe counties, interbedding of sandstone of Ridgeley type and siliceous limestone, chert, and shale of Shriver type is common.

Shriver-New Scotland contact: Along the Allegheny Front, and in much of the Juniata-Susquehanna Valley region, the Shriver, where clearly exposed, rests on a black, splintery, barren shale. The contact is a transitional one, because thin interbeds of the shale occur in the lower Shriver. In the southern and eastern areas this shale is absent, and the Shriver is commonly separated by a sharp lithologic break from the New Scotland limestone, or as at Falling Springs, Perry County, it may rest on a coarse conglomerate and sandstone, the age of which is Oriskany, probably Shriver.

The barren shale is tentatively placed in the New Scotland,[8] although further studies may make it advisable to place it in the Shriver. The shale wherever observed, rests on the New Scotland limestone and chert beds. The separation from the New Scotland limestone is certainly sharper than from the Shriver.

THE PARASITIC ISOPOD, *LIVONECA OVALIS* (SAY)

By V. Earl Light
Lebanon Valley College

Two specimens of the parasitic isopod, *Livoneca ovalis*, were obtained from the gills of a sunfish found in the water at Round Bay in the Severn River, about six miles north of Annapolis, Maryland.

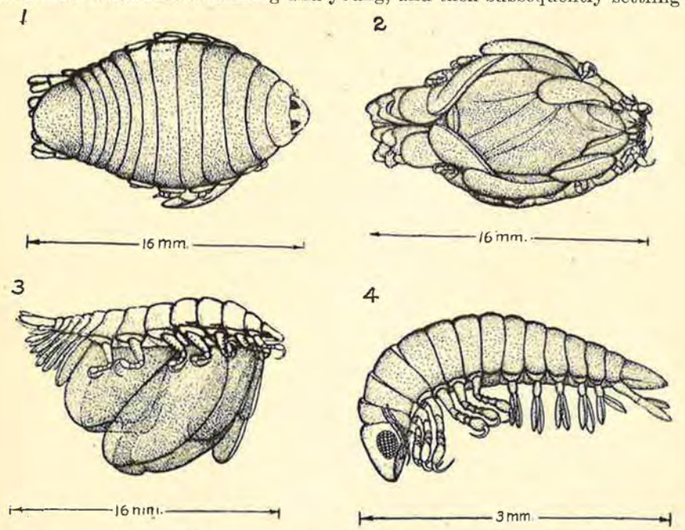
My attention was first attracted to the sunfish because of its peculiar position in the water. The fish had its head close to the surface of the water, with the posterior end down, and seemed to be struggling feebly. The mouth was opening and closing continuously as though the fish was suffocating. Apparently near the point of exhaustion it offered no resistance to being caught. The gills on both sides were easily visible, because the operculums were held away from the body as though propped open by some object. Upon closer examination the specimens previously mentioned were found attached to the gills, one on each side, their inflated bodies serving to prop open the operculums.

I loosened the two isopods from their places of attachment and placed them in water in a pail. A short time afterward, upon looking into the pail, I was amazed to see several hundred small animals swimming about in the water. The two large animals were practically motionless in the water. They were no longer very much inflated, and each one possessed

[8] Swartz, C. K., *op. cit.*, p. 3.

on its ventral surface a cavity, formed from projections of the thoracic region, in which the numerous young were formerly contained.

All the young and the two parents were preserved in ten percent formalin. The number of young was found to be 376. Smith, Woods, Shipley, Warburton and Thompson (1909), as well as Leichmann (1891), state that perhaps all the isopods are hermaphroditic, each individual acting as a male when free-swimming and young, and then subsequently settling



The parasitic isopod, *Livoneca ovalis* (Say). 1. Dorsal view, adult. 2. Ventral view, adult. 3. Lateral view, adult. 4. Lateral view, young.

down and becoming female. This apparently is true of *Livoneca ovalis*. There are marked differences of structure and function between the young and the adults.

In a dorsal view of the parasitic adult (Fig. 1) the body is ovate, about $1\frac{2}{3}$ times longer than wide. The head is partly submerged about as long as wide. The eyes are small, indistinct and situated in the postlateral angles of the head. There are two pairs of small antennae. The thorax consists of seven segments and the abdomen of six segments. The sixth or terminal segment is large and rounded posteriorly.

The ventral view (Fig. 2) shows the large brood pouch formed from the oostegites on the thoracic limbs of the female. On an adult 16 mm. long this pouch is large enough to contain 188 young each 3 mm. long.

A lateral view of the adult (Fig. 3) shows the enormous extension of the oostegites on the thorax to form the brood pouch. This view also shows seven prehensile legs on a side, one on each segment of the thorax, each terminating in a long hook.

Fig. 4 shows one of the 3 mm. free-swimming young with its characteristic curved body. The eyes and antennae are much larger in proportion than in the adult. The thorax consists of seven segments as in the adult, but the abdomen has seven segments compared to six in the adult. The young have six prehensile legs on each side of the thorax, each armed with a long hook. The seventh segment of the thorax has no legs.

These isopods, essentially marine forms, were found on a sunfish which is a fresh-water form and were obtained in brackish, tide water. Parasitic as adults, one of them was in turn the place of attachment for a colony of Bryozoa, *Helobdella stagnalis*.

LITERATURE CITED

Hansen, H. J. 1897. The Isopoda. Bull. Mus. Comp. Zool. at Harvard College, vol. XXXI, no. 5, pp. 95–129.

Leichmann, Georg. 1891. Beiträge zur Naturgeschichte der Isopoden. Bibl. Zool., Heft X.

Pratt, H. S. 1925. Manual of the Common Invertebrate Animals. A. C. McClurg and Co.

Richardson, Harriett. 1905. A Monograph on the Isopods of North America. Bull. U. S. Nat. Mus. No. 54, 727 pages.

Smith, Woods, Shipley, Warburton, Thompson. 1909. Crustacea and Arachnids. 566 pages. The Macmillan Co.

THE INHERITANCE OF PSEUDOHYPERTROPHIC MUSCULAR PARALYSIS

By V. Earl Light
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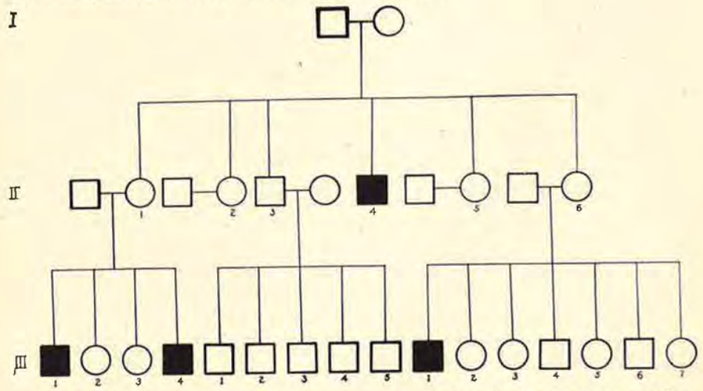
Pseudohypertrophic muscular paralysis is characterized by a false hypertrophy of some muscles, combined with atrophy in others. The individuals in the family under observation and here recorded all showed the paralysis confined chiefly to the lower extremities.

In each individual affected the disease first manifested itself at about five years of age. The patients acquired a peculiar waddling gait, with noticeable difficulty in ascending stairs. The leg muscles became weak, with enlargement and contraction of the calf muscles. The tendon reflexes became diminished or lost in proportion to the degree of atrophy of the muscles involved.

"If placed on his back on the floor, the affected individual first rolls over onto his abdomen, then brings himself to a kneeling position by the aid of his arms, and next into a stooping position with his hands on the floor. He then straightens his legs and brings them toward the vertical by pushing backward with his hands, gradually bringing them closer to his feet. When this is accomplished, he places one hand on the corresponding knee and with the other hand still on the floor, pushes with both until he gains sufficient extension of the hips to enable him to place both hands on his knees, after which it is a simple matter to bring the trunk upright" (Sajous).

As to sex frequency of the disease Whiting (1909) says that males are more frequently affected than females as 5 to 1.



In the family history here recorded, the mother in the first generation was a twin and sickly as a child. The malady is not known to have existed in the family previous to the individuals here shown. In the second generation there were four daughters and two sons. One son, number 4 of the pedigree chart, acquired the disease at about five years of age and died at 14. The second son, number 3, is normal and has 5 sons in the third generation ranging in age from 9 years to ½ year, all of which are normal.

Two daughters in the second generation, numbers 2 and 5, were married but had no children.

The daughter, number 1 in the second generation, had two sons and two daughters. Both daughters are normal. The son, number 1, acquired the disease at about the age of 5 and died at the age of 18. His younger brother, number 4, was under medical observation and at the age of 4 was pronounced healthy and free of the disease, but at the age of 5 the disease became noticeable and now at the age of 14 he is unable to walk, can however move himself about on a wheel chair, but the disease is becoming progressively more pronounced.

The fourth daughter, number 6 of the second generation, has three sons and four daughters. To date her son number 1 at the age of 14 has the disease as marked as his cousin, but his brothers, aged 8 and 5 years respectively, do not show the disease. The sisters also are normal.

In each of the four boys affected with the disease in this family history the malady appeared at about 5 years of age. The disease was steadily progressive and none of the affected individuals thus far reached adult age. Apparently the disease is sex-linked; in this case transmitted by the daughters, unnoticed, to their sons. Thus daughters may become the genetic carriers of the disease while their sons may become the victims of the manifestation of the disease.

LITERATURE CITED

Burris (Can. Med. Assoc. Jour., Jan., 1912).
Cadwalader and Corson-White (Med. Rec., June 7, 1913).
Castor, R. H. (Indian Med. Gaz., April, 1911).
Craig (Dublin Jour. Med. Sci., June, 1912).
Sajous's Analytic Cyclopedia of Practical Medicine. F. A. Davis Co., Phila. 1924.
Whiting, A. (Med. Press and Circular, Jan. 27, 1909).

A NEW SILURIAN CRINOID FROM CENTRAL PENNSYLVANIA

By J. Donald Witmer

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Introduction

The Keefer sandstone is assigned by Swartz[1] to the Rochester formation of the Clinton group of the Niagaran series and is of Middle Silurian age. He characterizes it thus: "Interbedded calcareous sandstone and some greenish arenaceous shale, the sandstone in layers up to 1 foot thick and weathering yellowish to rusty; some beds contain many crinoid rings. A little oölitic hematite in upper six inches. These beds form the Keefer sandstone proper."

At Mount Union the thickness is 34 feet. About 24 feet of Keefer sandstone outcrops along the east bank of Juniata River three miles northwest of Mifflintown on U. S. Highway 22. A careful check of the

[1] Swartz, F. M., Silurian section near Mount Union, Central Pennsylvania: Geol. Soc. Am., Bull., vol. 45, pp. 81–134, 1934.

locality, geologic succession and lithology established the identity of the sandstone. During the summer of 1936 highway construction was in progress here, and the rock was excavated and dumped in a fill about one mile east of the outcrop. The author, while superintending the construction work, found the fossils at the fill. He submitted them to Dr. Bradford Willard of the Pennsylvania Topographic and Geologic Survey at Harrisburg. Dr. Willard subsequently visited the locality to verify the identity of the Keefer and confirmed the author's assignment of the specimens. The rarity of the remains is attested in letters from Prof. Frank M. Swartz of Pennsylvania State College to Dr. Willard. He states (July 29, 1936): "The Keefer sandstone frequently abounds in crinoid rings, but I have never seen calyces," and, again (December 21, 1936): "I have only one crinoid crown from the Silurian of the Appalachian area, . . . The one specimen I have is from the McKenzie at Mount Union."

Because of the rarity of these remains and the fact that nothing comparable to them has probably been recorded, much less described, from the Middle Silurian in Pennsylvania, it was thought imperative to submit the fossils to someone more familiar with Paleozoic crinoids. Miss Winifred Goldring of the New York State Museum most obligingly consented to examine the specimens. In a letter to Dr. Willard dated January 29, 1937, she reported at length the result of her studies. These remarks have been largely applied in preparing the following description. The author takes this opportunity of expressing his gratitude and appreciation to Miss Goldring for her help and interest, and it is particularly emphasized that without her advice, great hesitancy would have been felt about publishing this account.

Description of Species

Order CAMERATA Wachsmuth and Springer
Family Dimerocrinidae Bather
Dimerocrinus Phillips

The Mifflintown specimens belong to the genus *Dimerocrinus* according to the description by Springer.[2] "Calyx rather elongate; IBB 5, post. B truncate; first anal plate in line with RR, followed by 3 in second range; 1Br in several ranges; anus without a tube; arms biserial, simple, 2 or 4 to a ray, directed upward; column round." He further states that *D. decadactylus* Phillips is the genotype. James Hall assigned it to the genus *Thysanocrinus*,[3] a number of species of which Springer subsequently transferred to *Dimerocrinus*. *Glyptaster* is also a synonym.

[2] Springer, Frank, American Silurian crinoids: Smithsonian Institution, 1926, p. 12.
[3] Hall, James, Paleontology of New York, vol. II, 1852.

Dimerocrinus mifflinensis Witmer, *sp. nov.*

Fig. 1

Calyx conical, cup-shaped, asymmetrical, with moderately strong arms, IB probably 5 (only 3 clearly outlined); B 5, small, 4 of them triangular, the 5th (posterior B) truncated; R and IR hexagonal, ornamented by 6 ridges which radiate from the plate centers and bisect the sides; interbrachials not depressed. Arms 20, 4 to a ray, upright, pinnules slender, numerous. Column round. Horizontal section of calyx distinctly pentagonal. Miss Goldring remarks: "The ornamentation of all the plates is decidedly of the vermicular type, nothing nearly so regular as shown in the figure of Hall and Wachsmuth and Springer. Specimen No. 2 . . . shows a low, rather inconspicuous narrow ridge on the anal series which indicates a continuous row of anal plates. The series in the anal interradium appears to run 1–3–5. The first two anal plates and

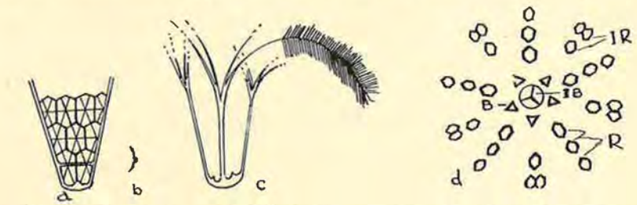

Fig. 1. *Dimerocrinus mifflinensis* Witmer. *a*, Side view of calyx showing arrangement of plates and ornamentation. *b*, Vertical cross-section of radial plate showing distinct horizontal ridge. *c*, Diagram illustrating rays, branching, arms, pinnules, etc. *d*, Diagram of plate sequence, B = basals, IB = infrabasals, R = radials. Figures *a* and *c* natural size.

the basal in this interradius show an inconspicuous node at the center of the plate."

The specimens show that the new species differs from the four most nearly related species, *Dimerocrinus* (*Thysanocrinus*) *liliformis, D. brachiatus, D. inornatus* and *D. occidentalis*. There seem to be sufficient differences from these to justify the erection of a new species. Our species resembles *D. liliformis* somewhat in ornamentation, but that species lacks the anal ridge and has but ten arms, whereas *D. mifflinensis* has twenty. *D. brachiatus* is dissimilar in the cup-shaped calyx, and pentagonal stem; and it has only ten arms. *D. inornatus* differs in having more depressed interbrachial areas, and no anal ridge. Our specimens are probably closest to *D. occidentalis*. That species possesses a subturbinate cup, strong radial ridge, but no strong anal ridge. The radial ornamen-

tation is similar as is also the wedge-shaped form of the arm plates. Checking back to Wachsmuth and Springer,[4] it is quite apparent that *D. occidentalis* possessed only ten arms, thereby distinguishing it from *D. mifflinensis* with twenty.

Occurrence. The species takes its name from its occurrence near Mifflintown, Pennsylvania. The specimens, six in all, occur in a block of Keefer sandstone found about three miles northwest of the town.

Type specimens are private collection of the author.

GEOLOGIC SECTION IN SOUTHERN SOMERSET COUNTY, PENNSYLVANIA[1]

By R. W. Stone

Pennsylvania Geological Survey

In the field seasons of 1935 and 1936 the writer was engaged in mapping the geology of the Berlin and Meyersdale quadrangles in southern Somerset County, Pennsylvania, the object being to complete the mapping for the report on the geology and mineral resources of the whole county.

It became apparent shortly that the Mississippian section did not agree with measurements in adjacent areas.

The generalized section of rocks in the Somerset and Windber quadrangles in the northern part of the county, as reported by Richardson,[2] is as follows:

	Feet
Pottsville formation: Thick-bedded gray sandstone with some shale and clay and thin beds of coal.	200
Mauch Chunk shale: Brownish-red, locally green and drab sand and clayey shales, subordinate thin-bedded sandstone, and lenses of gray and reddish limestone.	150
Loyalhanna limestone: Blue-gray cross-bedded siliceous limestone.	40
Pocono formation: Gray sandstone and subordinate sandy shale.	1,000
Catskill formation: Bright red sandy and clayey shale, thin-bedded, fine grained, red sandstone, and subordinate gray sandstone and shale.	1,800–2,000
Chemung formation: Alternating beds of fine-grained fossiliferous greenish-gray sandstone and sandy shale.	2,000

[4] Wachsmuth, C., and Springer, F., North American Crinoidea Camerata, Mus. Comp. Zoöl., Mem., vol. 20–21, 1897. Also confirmed in letter from G. Arthur Cooper referring to E. Kirk to Willard, March 9, 1937.

[1] Published with the permission of the State Geologist of Pennsylvania.

[2] Richardson, G. B., U. S. Geol. Survey Geol. Atlas: Somerset-Windber folio (No. 224), 1935.

In the Maryland quadrangles on the south, Martin[3] found the following generalized section:

	Feet
Pottsville formation: Sandstone and conglomerate with some shale, coal, and fire clay.	325–375
Mauch Chunk formation: Red and green shale with some sandstone.	650
Greenbrier limestone: Massive limestone at top; red and green shales with thin limestones in middle; calcareous cross-bedded sandstone (Loyalhanna or "siliceous" limestone) at base.	225
Pocono sandstone: Sandstone and conglomerate, with some gray shale, especially near base.	450
Catskill formation: Red and green shale and sandstone.	1,200–2,200

In the southeast corner of the Meyersdale quadrangle on Big Piney Creek the writer found 279 feet of Mauch Chunk exposed and an unknown thickness concealed between the top of the section and the base of the Pottsville. About seven miles northeast of this locality on the Western Maryland Railroad between Keystone and Glade City, on the west edge of the Berlin quadrangle, a fairly well exposed section from the base of the Pottsville to the top of the Loyalhanna measures 544 feet. The length is uncertain by about 50 feet because although 30 feet of the Loyalhanna limestone is exposed, the position of its top is indefinite. If the Loyalhanna is 50 feet thick, then the Mauch Chunk formation at this place is about 525 feet instead of 544.

In the gorge of Casselman River two miles northwest of Garrett in the Meyersdale quadrangle, a continuous section of the Mauch Chunk 180 feet thick directly on top of the Loyalhanna is exposed along the Baltimore and Ohio Railroad and up a small run. Higher beds in the Mauch Chunk are concealed. In the road leading down to a limestone mine and crusher at this point, red shale is exposed 340 feet directly above an outcrop of the Loyalhanna, and gray Pottsville sandstone at 440 feet. This leaves the thickness of the Mauch Chunk uncertain, but it is not less than 340 and may be more than 400 feet.

In the southwest corner of the Meyersdale quadrangle the vertical distance between the top of the Loyalhanna and the first Pottsville conglomerate boulders in a saddle on a spur is 310 feet. The outcrop of the basal Pottsville was not seen and the thickness of the Mauch Chunk may be much greater than 310 feet. On the other hand, Mr. Forrest T. Moyer, of the Pennsylvania Geological Survey, reports that near the southwest corner of the county the Mauch Chunk is only about 200 feet thick. The

[3] Martin, G. C., U. S. Geol. Survey Geol. Atlas: Accident-Grantsville folio, (No. 160), 1908.

thickness and character of the Mauch Chunk in Big Savage and Little Allegheny Mountain in the southeast corner of the quadrangle are yet to be determined.

This thickening of the Mauch Chunk from 200 feet in the northern and southwestern parts of the county to 400–500 in the south-central part and to 825 feet in Maryland (Martin's Mauch Chunk 650 feet and Greenbrier limestone 225 feet, minus the Loyalhanna, approximately 50 feet) may be explained by the unconformity at the top of the Mauch Chunk, by original differences in a deltaic deposit, or by a combination of the two. If the differences in thickness are due to deposition on a delta, then the source of the material presumably was to the southeast.

In contrast with other descriptions of the Mauch Chunk, the formation in south-central Somerset County may be described as follows:

	Feet
Red shale.	20
Irregular, thick to thin, greenish, buff to tan, micaceous sandstone and sandy shales, in places limy and cross-bedded.	150
Greenish platy micaceous soft sandstone and shale, red shale in lower part.	150
Blue and muddy fossiliferous limestone in alternate layers with red and mottled shale.	20–40
Red and green shale.	15
Thin-bedded, cross-bedded, greenish micaceous sandstone.	15
Gray sandy massive, slightly cross-bedded, non-fossiliferous limestone.	7
Red and green limy shales.	45
Greenish massive sandy limestone.	8
Red and green mottled limy shale with thin white and buff limy sandstones.	25
	445

This description of course is generalized. The lower sandy limestones may be lacking in some places and a 5-foot bed of conglomerate containing half-inch quartz pebbles in a sandy matrix occurs 200 feet above the blue fossiliferous limestone at one place. The fossiliferous limestone is one of the distinctive features of the formation. It ranges up to 40 feet of alternating massive limestone, red and green mottled limy shale, and muddy greenish limestone, the latter consisting in large part of more or less broken and contorted fossil shells, mostly brachiopods and bryozoa.

The fossiliferous limestone ranges from 100 to 180 feet above the Loyalhanna. A massive gray limestone occurring in some places directly on top of the Loyalhanna but markedly different in physical aspect, in contrast with the blue limestone, carries only rare minute fossil shells so far as has yet been discovered.

If, as has been postulated, the red and green shales and sandstones of the Mauch Chunk were deposited on subaerial deltas under semi-arid conditions, then the several limestone beds in the lower part of the formation represent repeated incursions of the sea.

The Pocono formation appears to be thinning to the west and south in this area, decreasing from 1,000 feet or more in the eastern part of Somerset County to about 300 feet in Fayette County.[4] The writer's estimate of 1,100 feet for the thickness of the Pocono east of Meyersdale is on lithology only, being the thickness of the beds between the base of the cross-bedded siliceous Loyalhanna limestone and the top of a considerable thickness (1,300 to 1,500 feet) of red Catskill beds.

SPIRALING IN *PARAMECIUM CAUDATUM*

By Robert Cassel

Zoological Laboratory, Johns Hopkins University

Introduction

The direction of spiraling in swimming of seven different species of *Paramecium* was observed in 1930 by Bullington. *P. caudatum*, one of the seven considered, was never seen to spiral to the right. In the species which did show spiraling to the right, the activity was very labored, indicating that it was only temporary or "learned."

In "right" spiraling the animal was viewed from the rear, and appeared to be revolving, or spiraling, as it swam, in a clockwise direction. "Left" spiraling was just the opposite, or counter-clockwise.

Methods

Paramecia were kept on hand in large quantities by culturing in simple hay infusion. Single individuals in a watch glass, or under a cover glass on a slide were studied in the first work. Later, another method of study was followed.

Several cubic centimeters of hay infusion culture were removed from the quart stock jars to a watch glass and observed under a binocular microscope. When several individuals were found spiraling to the right, the liquid in that region was removed by pipette and transferred to another watch glass. Then with a capillary pipette it was usually a simple matter to obtain a single right spiraling individual. This isolated individual was placed in a square watch glass and 4 cc. of fresh hay infusion liquid was added. Growth was allowed for five days. Study was made by removing ½ cc. of the culture and putting in another watch glass. Ob-

[4] Moyer, F. T., Structure and Stratigraphy of Fayette County: Penna. Top. and Geol. Survey, Bull. 115, p. 16, 1937.

servations were continued under the binocular microscope. This was repeated five times for every culture, so that a total of 2½ cc. of the culture was closely perused for individuals showing right spiraling. A single right spiraling specimen from the culture was again isolated and cultured as above. This procedure was repeated 4 times, so that 4 generations were studied among 16 cultures. In this way it was possible to show that right spiraling in some individuals was not a learned activity, which was given up in some generations, but could be traced through the progeny.

Observations

The average length of 40 individuals was 237.6 micra. The average width was 50.0 micra. Numerous specimens showed 1 micronucleus on staining with neutral-red. The general shape also compared favorably to the key descriptions for *Paramecium caudatum*.

Before the above outlined cultures were started 5 individuals were studied for 30 minutes each by following around in a watch glass under a binocular microscope. All showed right spiraling 75% of the time studied. In the remaining 25% of time swimming was done with a left spiral motion. This means that if an individual were studied 20 minutes it would show right spiraling 15 minutes, and left spiraling 5 minutes. *P. caudatum* was able to shift its spiraling from left to right, and also back again to the original type of spiraling.

Numerous specimens were prodded with a needle while swimming or feeding. Right spiraling was not abandoned for left, but continued in another direction. When individuals were soaked with distilled water, right spiraling became very fast. Several specimens were cut in half with a knife. The parts continued a feeble right spiral motion. Three

Extent of Right Spiraling in a Strain of *Paramecium caudatum*

A	B	C	D	A	B	C	D
6	600	55	72	16	900	79	72
7	600	53	85	17	Died		
8	100	20	65	18	400	73	90
9	300	116	80	19	300	44	88
10	200	40	55	20	400	105	96
11	100	61	80	21	300	28	98
12	1000	155	65	22	Died		
13	Died			23	700	92	95
14	100	20	60	24	500	97	94
15	Died			25	400	52	88

A. Culture number. Cultures 1–5 died.
B. Approximate number to culture.
C. Number of individuals studied.
D. Approximate time seen right spiraling, percent.

specimens were observed in the process of fission. A very slow right spiraling was observed. At times it shifted to left spiraling. When the organisms finally divided, both new individuals in all three cases swam away with right spiral motion. Numerous specimens were studied in an Engelmann gas chamber, using carbon dioxide, oxygen, nitrogen, and hydrogen from tanks under pressure. In every case the right spiraling motion was as evident as before.

In the table appears a list of approximately 6,900 individuals to the cultures made. 1,090 of these were studied individually. Some of the cultures near the end of the experiment showed specimens which spiraled continuously to the right. The **underlined** cultures indicate that those in the group above belong to one generation, and those below to its progeny.

Conclusions

1. A culture of *Paramecium* was studied. The average length was 237.6 micra, the average width, 50.0 micra. Neutral red staining showed 1 micronucleus. The general shape conformed to the key descriptions of the species, *caudatum*.

2. In this strain of *Paramecium caudatum* the right spiral was used more often in swimming than the left.

3. Right spiraling was not found to be a 'learned' activity. It was not abandoned for left spiraling when several types of abnormal conditions were presented. Right spiraling appeared to be the more natural type of activity, as much or more so than left spiraling.

BIBLIOGRAPHY

Bullington, W. E., 1930. A further study of spiraling in the ciliate Paramecium. Jour. Exp. Zool., V. 56, No. 4, July 5.

A VAPOR PRESSURE APPARATUS

By E. A. Vuilleumier

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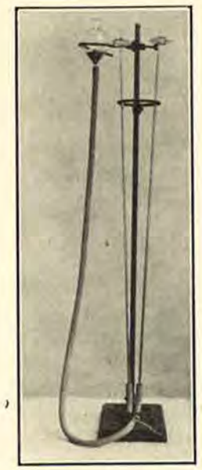
To demonstrate and measure the vapor pressure of volatile liquids the apparatus shown in the accompanying figure was devised. It consists essentially of two vacuum-tight glass stopcocks, to which are sealed long glass tubes, which are connected to a leveling bulb.

The air in the tubes is displaced by mercury, by raising the leveling bulb. The stopcocks are closed, and the sample to be investigated is introduced into one of the wells by means of a drawn-out medicine dropper. The bulb is lowered slightly, and a portion of the sample is drawn through

the opened stopcock, which is then closed. The leveling bulb is now lowered beyond the barometric value, and the difference between the levels of the mercury in the two tubes is the vapor pressure of the liquid.



Samples are replaced by raising the bulb, removing the old sample by means of the medicine dropper, followed by rinsing with the fresh material.

The purpose of the well on the second tube is for making direct comparisons between the vapor pressures of two samples, as in the estimation of acetone in the presence of ethyl alcohol. (Vuilleumier, Industrial and Engineering Chemistry, vol. 17, p. 174, 1925.)

The tubes are 80 centimeters long and have an outside diameter of 6 millimeters. The wells are 2 centimeters deep.

It is likely that a somewhat similar vapor pressure apparatus has been invented many times before.

RELATION OF FLEXION OF BODY AND TWISTING OF HEART IN CHICK EMBRYO

Preliminary Synopsis of Principles of Development Involved

By S. Hoffman Derickson
Lebanon Valley College

In the development of vertebrate embryos the heart begins as a pair of parallel tubes lying on the ventral side of the body in the region that later becomes the pharynx. The middle portions of these two tubes come in contact, meet and fuse and become one tube.

During the second day of incubation of chick embryos this tube, which is the beginning of the heart, lengthens more rapidly than the part of the embryo in which it lies, with the result that the middle part of the tube bends to the right and extends so far that it projects on the right side of the embryo.

At this time the chick embryo is lying face down with the ventral side on the yolk.

The dorsal region of the embryo grows more rapidly than the ventral with the result that, beginning at the head region, the embryo becomes bent forward, as one bends the body in making a bow. This bending tends to push the head down into the yolk. The resistance of the yolk causes the head to twist to the right side. The bending of the embryo ventrally is called flexion. The twisting of the embryo to the side is called torsion. As the embryo continues to develop, flexion is continued until the embryo is bent like the letter C. Torsion is continued until the embryo lies entirely on its right side.

In addition to flexion and torsion, that is, bending and twisting of the entire embryo, there is also an additional bending and twisting of the heart that is largely independent of the flexion and torsion of the entire embryo.

Torsion has been completed early in the fourth day. Flexion is completed later in the same day. Flexion begins about the time the heart is bent strongly to the right. Normally as the head bows down in flexion the heart begins to twist anti-clockwise, and makes a half turn so that the part of the bend that was anterior becomes posterior and the part that was posterior becomes anterior. The fundamental structures of the future heart are dependent on this twist.

Relation of Flexion of Body and Twisting of Heart in Chick Embryo

What would be the result if the twisting that normally occurs between the 42d and 48th hour of incubation, in the developing heart of the chick embryo, did not take place?

In answer to this question we present the evidence obtained from a chick embryo incubated 72 hours. We must bear in mind that the evidence is limited to what one embryo did in 30 hours after its heart failed to follow the dictates of its ancestral genetic law.

The evidence may be summarized as follows:

1. As torsion of the head region is completed the tubular heart, instead of twisting, forms a loop, extending directly ventrad of the region of the last three gill arches.
2. Cervical flexure is prevented.
3. A dorsal flexure, not seen in normal embryos, occurs in the region of the tenth somite. The head region is bent rather sharply dorsad at right angles to the body.
4. A pronounced retardation in the growth of the region posterior to the dorsal flexure, probably due to interference with the circulation through the dorsal aorta and omphalo mesenteric veins.
5. Retardation of differentiation in certain regions.
    1. Area vasculosa is only as large as in 54-hour embryo.
    2. Only 28 somites have been formed instead of 36.
    3. The allantois has not appeared.
    4. Regional differentiation of brain equals that of 54 hours.
    5. Only three instead of four visceral clefts have appeared.
6. Differentiation of certain regions in coordination with the 72 hours of incubation but in advance of normal development in an embryo with only 28 somites.
    1. Wing and leg buds are prominent.
    2. Mesoderm is differentiated into somites in caudal fold.
    3. Large blood vessels have shifted posterior to a point midway between wing and leg bud.
    4. Regional differentiation of heart is in advance of that of a chick with 28 somites.

RELATION OF FLEXION OF BODY AND TWISTING OF HEART IN CHICK EMBRYO

Conclusion. The evidence indicates that the coordination of the twisting of heart and cervical flexure is essential for the development of the fowl in its usual proportions. When the heart fails to twist cervical flexure is prevented. Cervical flexure when it occurs pushes the heart in against the body in which it later becomes enclosed. When cervical flexure is prevented and replaced by dorsal flexure, the heart is carried away from the body to such an extent that it could probably never be enclosed within the body, and, if enclosed at all, would be embraced by the gill arches in the head and neck region.

Hence, if you will excuse the shift, the twisting of a fowl's heart at the beginning may be as essential as the twisting of its neck at the end, for providing a well-developed body for the Thanksgiving dinner.

LONGITUDINAL FISSION IN *HYDRA*

BY S. HOFFMAN DERICKSON

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Twenty-eight years ago I had an interesting observation on a Hydra which has never been repeated although I have handled many *Hydra* each year since that time. From the interest manifested by the hundreds of students who have studied the specimen it may be worth presenting to others.

In the latter part of September, 1909, while looking over a perennial culture of *Hydra* kept in a balanced aquarium in our laboratory I noticed among several large *Hydra fusca* present, one that was divided vertically to a point just below the tentacles. There were two mouths, two hypostomes and two sets of five tentacles but only one body.

Just below the region that had divided were several testes in various stages of development and a little below the middle of the body a hemispherical bulge that later proved to be an ovary.

I rigged up a low-power microscope adjacent to the aquarium so that the specimen could conveniently be kept under observation. The longitudinal fission progressed slowly from day to day. Additional sex organs appeared both above and below the region of fission. An embryo developed in the ovary first seen and in about ten days from the time first observed the ectoderm covering the embryo, that is, the wall of the ovary, was ruptured and shrank, forming a flattened mound around the point of attachment of the embryo which protruded suspended in a delicate balloon-shaped membrane. The wall of the embryonic membrane continued to thicken by the addition of secretions from the embryo. The flattened mound of ectoderm, the original wall of the ovary, may be seen to the left, just below the middle of the body.

About 15 days after first observed the longitudinal fission had progressed to the point that you observe on the specimen. At this point the specimen was killed in hot corrosive acetic, stained in diute borax carmine and mounted in balsam. As the balsam dried the glass rods supporting the cover proved too thin and the embryo separated from the parent and moved to the margin of the cover. Later the cover was accidentally broken and the specimen had to be remounted. The embryo was destroyed in the remounting.

A small part of the original body of the parent hydra may be seen with the two daughters—or perhaps one better say—the two sons and daughters,—for they both have both testes and ovaries. That this basal part would have continued to divide as did the part of the body distal to it is altogether probable, had the specimen been permitted to live a few days longer. It was prevented from doing this in order that it might serve as concrete evidence of the facts presented.

ORIGIN AND OCCURRENCE OF EARTHQUAKES

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The fundamental question in the field of seismology is "Why do we have earthquakes?" An adequate answer, explaining all the observed phenomena with reasons instead of words, cannot be given at present. In order to make progress, however, it is sometimes warranted to advance a hypothesis, even if its shortcomings are obvious. But since nothing seems to be more stimulating to discussion and research than something challengeable, a few heuristic remarks on earthquake origin may be in order.

Common to all earthquakes is a sudden release of forces which produce elastic waves. Mechanical failure and impact or chemical reaction may have such an effect and therefore earthquakes are a result of ruptures, falls and explosions. Any attempt to explain the earthquake phenomenon will have to give reasons for the question of the "where" and the "when" such an event takes place. The "where" is determined by the presence of geological forces which strain the material to the yielding point or give rise to a violent reaction. The "when" is not only determined by the energy of the aforementioned geological forces but also by any additional forces which act on the earth.

Since geological forces are acting everywhere on the earth (think of the always present erosion and sedimentation), earthquakes are to be expected everywhere. This is in accordance with the observations, which show earthquake epicenters in practically every region of the world. If any region is called free of earthquakes, it seems to be only because of the lack of observation stations or of the shortness of the observation period. The number of shocks, however, differs from region to region, due to the variation in geologic activity over the earth. For convenience we distinguish between zones of geologic mobility and zones of relative stability. In the mobile zone, crustal and subcrustal material are participating in

the orogenic, mountain-building phase of geologic activity, while in the stable zones only very gradual changes of epirogenic type take place mostly in the crustal zone. Both zones have their characteristic types of earthquakes; the cave-in type, produced by the collapse of hollow spaces in the crustal layers, is comparatively rare, and occurs mainly in regions with salt deposits, which are slowly dissolved by penetrating water.

In the zones of comparative geologic inactivity, isostatic adjustment takes place to bring the specific light crustal material into hydrostatic equilibrium with the heavier subcrustal material. The isostatic distribution of masses is a state which will never be reached. On account of the high viscosity of the subcrustal material, the motion of adjustment lags considerably behind the original mass transport that produced it. Therefore motions are still observed in once glaciated regions where the melting of the ice brought relief from a heavy load. In the Great Lakes region a tilt of 10 cm/100 km century between the formerly glaciated and the ice-free areas is observed.[1] If such motions take place in solid rocks they will produce large stresses, which are eventually released in the form of earthquakes. In regions having inherent lines of weakness, earthquakes occur along faults and usually as single moderate shocks. Sometimes, however, new ruptures take place, often as numerous small shocks, forming a so-called earthquake-swarm.

The strongest earthquakes occur in areas of active mountain building. There subcrustal and crustal material are in motion, which in places is so rapid on the surface that it is readily measurable, reaching the order of magnitude of 1 cm/year, as in Japan.[2] The evidence that the subcrustal material is participating actively in the geologic process is the deep-focus earthquakes, occurring at the depth of 100 to 1000 km below the surface. The contention of some geologists that the deep-focus earthquakes imply geologic structure as it is on the surface and that they contradict the principle of isostasy is unfounded. Experimental data on solids under high pressure show a variety of phenomena that could explain earthquake-like reactions in these depths.[3] Polymorphic transitions as well as ruptures, due to what Bridgman terms "mechanical explosions," can take place.

The conditions that produce such changes seem to decrease rather

[1] B. Gutenberg, Tiling Due to Glacial Melting, Journ. Geol., vol. 41, 1933, pp. 449–467.

[2] U. Miyabe, Block Movements of the Earth's Crust in the Kwantô District, Bull. Earthqu. Res. Inst., vol. 11, 1933, pp. 639–691.

[3] D. T. Griggs, Deformation of Rocks under High Confining Pressures, Journ. Geol., vol. 44, 1936, pp. 541–577.

P. W. Bridgman, Shearing Phenomena at High Pressure of Possible Importance for Geology, Journ. Geol., vol. 44, 1936, pp. 653–669.

rapidly with increasing depth. A survey of 215 deep-focus earthquakes from 1918–1928 discloses a distribution according to Table 1.

TABLE 1. DEEP-FOCUS EARTHQUAKES, FREQUENCIES WITH DEPTH

Depth, km	120	180	250	310	380	440	510	570	600
Number	48	47	36	24	21	17	13	7	3

Volcanism, which is closely connected with the mountain-forming orogenic forces, has its characteristic earthquakes. They may be small tremors connected with the explosive phase of volcanic activity or shocks originating from changes (perhaps by cooling) in intrusive masses. Both, deep-focus and volcanic earthquakes, are none too frequent and of rather moderate effect on the surface quite in contrast to the disastrous tectonic earthquakes. These latter are consequence of the stresses produced by the already mentioned large block movements in the orogenic zone. The equilibrium there is so largely disturbed that most of these heavy earthquakes have a sequence of aftershocks until equilibrium is, at least temporarily, restored. The origin of earthquakes therefore may be summarized as follows:

TABLE 2. ORIGIN OF EARTHQUAKES[5]

Geologic zone	Type of quake	Focal depth		Cause
Epirogenic, consolidated regions	Cave-in		Weak	Lack of support
	Faulting	0–50	Moderate	Isostatic movements
	Rupture	0–50	Often swarms	Isostatic movements
Orogenic, active mountain formation	Cave-in	km.	Weak	Lack of support
	Deep-focus	100–1000	Moderate	Polymorphic change, mechanical explosion
	Eruptive	0–10	Weak	Explosion
	Intrusive	10–100	Little known	Magmatic changes?
	Orotectonic	10–50	Often violent with many after shocks	Folding forces

[4] Publ. in H. Landsberg, Über tektonische und Magmatische Erbdeben, Naturwissenschaften, vol. 21, 1933, pp. 894–896. A. Leith and J. A. Sharpe have published a similar distribution in Deep-Focus Earthquakes and Their Geological Significance; Journ. Geol., vol. 44, 1936, pp. 877–917, without reference to the previous work.

[5] Details and argumentation see: H. Landsberg, A Genetic System of Earthquake Origin, Transact. Am. Geoph. Un., 1936, pp. 89–92.

V. C. Stechschulte: Geological Implications of Deep-Focus Earthquakes, *ibid.*, 1936, pp. 81–93.

W. T. Thom, Jr.: Deep-Focus Earthquakes from a Geologist's Point of View, *ibid.*, 1936, pp. 108–111.

When sufficient stresses have been accumulated by the action of the geological forces the strain is ripe for release. Very often the latent stresses are set off by so-called trigger forces or secondary causes of earthquakes. These additional forces often determine the time of occurrence to such an extent that pronounced frequencies of earthquakes occur, and rather high correlations are found between the trigger forces and the occurrence of earthquakes. Only a few selected items will be mentioned here. The relationship between motions like earth tilts and earthquakes is obvious. Studies by Japanese seismologists revealed that often very irregular earth tilts precede the occurrence of earthquakes.[6] The small periodic shifts of the earth's poles can act as trigger forces by changing the centrifugal forces at a given locality. The variation in occurrence of deep-focus earthquakes seems to indicate this factor.[7]

Steep barometric gradients sometimes release stresses that produce earthquakes. It was found in numerous cases that resonnance phenomena exist in earthquake occurrence, so that heavy earthquakes in distant regions seem to occur almost simultaneously. More suspected than proven are statements that earthquakes condition each other in a given block structure, although in some cases such reaction-quakes are facts. There are other rather well developed frequencies of earthquake occurrence but their physical background is as yet unrevealed. Among them is the daily variation of earthquakes which shows a maxmium of shocks during the night. An investigation of some seismic events of the swarm type showed

TABLE 3. DAY AND NIGHT FREQUENCIES OF SHOCKS IN EARTHQUAKE SWARMS

Region	Period	Number	Per cent	
			Day	Night
Helena, Mont. all shocks	1935/36	1869	43.5	56.5
Helena, Mont. stronger shocks	1935/36	265	43.7	56.3
Gr. Gerau all shocks	1869/71	2037	39.2	60.8
Gr. Gerau stronger shocks	1869/71	190	42.7	57.3
Auerbach	1871	119	42.1	57.9
New Zealand	1920/30	197	38.3	61.7
California	1927/32	108	41.7	58.3

[6] W. Innouye, Earth tilts observed at Mt. Tukuba, Japan, Bull. Earthqu. Res. Inst., vol. 11, 1933, pp. 693–703.

[7] H. Landsberg, Über Zusammenhänge von Tiefherdbeben mit anderen geophysiklischen Erscheinungen, Gerl. Beitr. 2 Geophysik Vol. 40, 1933, pp. 238–243; V. Conrad, Die zeitliche Folge von Beben mit tiefem Herd, Gerl. Beitr. 2 Geoph. Vol. 40, 1933, pp. 113–133.

a maximum occurrence in the early morning hours which was more than could be expected from a mere chance distribution. Earthquakes in widely different regions and epochs show the prevalence of shocks during the night, as shown in Table 3.

On an average 42 per cent of the shocks occur between 6 A. M. and 6 P. M. and 58 per cent between 6 P. M. and 6 A. M. Swarm earthquakes have other peculiarities in their shock frequencies. Three of the best-observed earthquake swarms (1869, 1908, 1935–36) were statistically investigated. All show a rather similar pattern and the most peculiar observation is that between the two main maxima of daily shock numbers about 13 days elapse. This may be by accident just as the coincidence that all these swarms occurred mainly from October to December of the particular year. The seismologist is confronted here with numerous puzzling questions and much research will have to be done before the ultimate goal of knowing the physical laws governing the occurrence of earthquakes is reached.