H. A. Etter

PROCEEDINGS

OF THE

PENNSYLVANIA ACADEMY OF SCIENCE

VOLUME IX

1935

HARRISBURG, PENNSYLVANIA
1935

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OFFICERS

1934–35

President	EDGAR T. WHERRY, Philadelphia
Vice-President	THOMAS D. COPE, Wayne
Secretary	T. L. GUYTON, Harrisburg
Assistant Secretary	V. EARL LIGHT, Annville
Treasurer	H. W. THURSTON, JR., State College
Editor	R. W. STONE, Harrisburg
Press-Secretary	BRADFORD WILLARD, Harrisburg

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CONTENTS

PENNSYLVANIA ACADEMY OF SCIENCE

MINUTES OF THE ELEVENTH ANNUAL MEETING OF THE PENNSYLVANIA ACADEMY OF SCIENCE

DICKINSON COLLEGE, CARLISLE, APRIL 19 AND 20, 1935

The session was called to order at 9:00 a.m. by Doctor S. H. Derickson. Invocation by Doctor Clyde A. Lynch, President of Lebanon Valley College. The secretary's report was given and adopted as follows:

REPORT OF THE SECRETARY—1935

The tenth annual meeting of the Academy convened at Albright College, Reading, March 30 and 31, 1934. A full program of papers was presented and later included in the eighth volume of the Proceedings. This volume was mailed to the members on August 17, 1934, from Harrisburg. Copies were also sent to other State Academies and to a few libraries.

The membership of the Academy as of March 15, 1935, is 366. Of this number 197 are also members of the American Association for the Advancement of Science. Twenty-one persons were elected to active membership at the last annual meeting and fourteen were so elected at the summer meeting. Your secretary has the record of only one death—Miss Helen Purcell, Department of Public Instruction, Harrisburg, Pennsylvania, July, 1934. Six members resigned.

Your secretary represented the Academy at the annual meeting of the State Academies of Science in Pittsburgh, Pennsylvania, December 27, 1934. The establishing of local branches of the American Association for the Advancement of Science in the several States called for considerable discussion. The first of these branches was organized at Lancaster, Pennsylvania, with a membership of 60, in 1934.

These branches have frequent meetings for lectures and discussions. At present they are not supported financially by the parent organization. It was thought that these local groups may well serve as profitable recruiting grounds for members for the State Academy.

The matter of the money allowance by the American Association to the State Academies was discussed. Several representatives of the Academies present were called upon to state how important the receiving of this allotment was to the well-being of their Academy. A few

Academies seemed to be well enough off financially not to need the support of the American Association. Your representative expressed the opinion that the publication of our Proceedings would be seriously handicapped if the funds should be withdrawn.

The summer session of the Academy met at Mount Gretna. The Cornwall mine was visited and studied. The flora and fauna of the districts were studied at certain favorable points. Drs. Wherry, Light, Gress, Derickson and Stone served as leaders for the meetings.

Through Dr. M. W. Eddy, Dickinson College, Carlisle, extended to the Academy an invitation to come to Dickinson for the eleventh annual session in 1935. By correspondence with the executive committee it was decided to hold this session at Carlisle. Local members of the executive committee visited Dickinson to look over meeting rooms. Dr. M. W. Eddy was appointed by the president to serve as chairman of the committee on local arrangements.

T. L. GUYTON, *Secretary*

A report was given, and adopted by the Academy, of the action of the executive committee at its meeting April 18 as follows:

That the president appoint a committee of three to wait upon the group of physicists meeting at Dickinson College on April 19 to invite them to the meetings of the Academy, including the dinner and public lecture, and to join the Academy. John C. Johnson, Thomas D. Cope and Karl F. Oerlein were made members of this committee.

That a permanent committee of five members of the executive committee be appointed to schedule meeting places at least two years in advance, these members to serve for five years and the president and secretary to be members *ex officio*. The members of this committee are E. M. Gress, Chairman, R. W. Stone, Robert T. Hance, Edgar T. Wherry and T. L. Guyton.

The treasurer gave the following report which was later examined and checked by George H. Ashley and P. W. Whiting of the auditing committee:

FINANCIAL STATEMENT
MARCH 27, 1934 TO APRIL 11, 1935

Receipts	
Balance on hand March 27, 1934	$248.36
Dues received March 27, 1934 to April 11, 1935	526.00
From A. A. A. S.	110.00
Sales of PROCEEDINGS	34.00
Extra pages in PROCEEDINGS	67.54
	$985.90

Disbursements	
Science Press Printing Co. for PROCEEDINGS	$586.89
Pine Tree Press — stationery, etc.	31.25
Secretary	64.51
Treasurer — stamps	22.00
Editor	5.34
Expenses — Junior Academy	5.98
Membership Committee	1.50
J. C. Johnson	1.50
Check tax	.20
Balance on hand April 11, 1935	266.73
	$985.90

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

Examined and checked
GEO. H. ASHLEY
P. W. WHITING

The following committees were appointed:

Resolutions:	*Auditing:*	*Nominating:*
W. N. Martin	George H. Ashley	E. M. Gress
C. A. Horn	P. W. Whiting	Norman H. Stewart
John C. Johnson	L. K. Darbaker	Robert T. Hance

A program of 57 subjects was given by members on Friday and Saturday. These are to appear in the ninth volume of the PROCEEDINGS.

The report of the committee of the Academy on certification of science teachers in the secondary schools in Pennsylvania was presented by John C. Johnson. This report was adopted and the committee continued. The membership is as follows: John C. Johnson, State Teachers College, West Chester; S. S. Shearer, State Teachers College, Shippensburg; R. A. Waldron, State Teachers College, Slippery Rock; Rodney True, University of Pennsylvania, Philadelphia; Robert T. Hance, University of Pittsburgh, Pittsburgh; Frank D. Kern, Pennsylvania State College, State College; B. L. Miller, Lehigh University, Bethlehem; R. P. Marsh, Gettysburg; E. A. Vuilleuimer, Dickinson College, Carlisle; G. N. C. Henschen, Harrisburg High Schools; W. N. Martin, Wyomissing High School and Earl H. Tscheedy, Hazleton High School.

The president's address "The First Decade of the Pennsylvania Academy of Science" was given at the annual dinner, at the Argonne Hotel. The dinner was attended by 214 members of the Academy, Junior Academy, and guests.

The guest speaker, Dr. W. W. Cort, Johns Hopkins University, addressed the public meeting on "Biological Studies of Human Parasites."

His lecture was well received by his audience. The thanks of the Academy were expressed to Dr. Cort.

The chairman of the membership committee gave the names of 47 persons for active membership. This report was adopted and the following persons were so elected:

John E. Anderson, State Teachers College, West Chester.
Walter P. Bitner, Chambersburg.
R. H. Bradley, 3464 West Queen Lane, Germantown, Philadelphia.
Charles K. Cabeen, Lafayette College, Easton.
Allan Claghorn, West Nottingham Academy, Colora, Maryland.
Dorothy M. Connolly, 458 Union Street, Luzerne.
William Stuart Cramer, 216 Woodbine Street, Harrisburg.
Kenneth N. Dearolf, 71 Park Road, Wyomissing Hills, West Lawn.
Lincoln Dryden, Bryn Mawr College, Bryn Mawr.
Raymond T. Greb, Skin and Cancer Foundation, 4518 Winthrop Street, Pittsburgh.
Ruth E. Guiher, Waynesburg.
Leroy N. Heilman, 115 West Main Street, Annville.
Charles C. Hill, 231 Conway Street, Carlisle.
F. L. Holdridge, R. 7, Lancaster.
Henry Idzkowsky, Department of Zoology, University of Pittsburgh, Pittsburgh.
Harry A. Itter, 641 Parsons Street, Easton.
Tom Husband Jones, 169 Hillside Avenue, Kingston.
Jerome H. Kantor, 289 South Nineteenth Street, Newark, New Jersey.
E. Eileen Kekilty, 245 Melwood Street, Pittsburgh.
V. Everett Kinsey, 541 East End Avenue, Pittsburgh.
Maxwell H. Kolodny, 241 Riverdale Avenue, Yonkers, New York.
Norman Lazin, 225 Cumberland Street, Lebanon.
Charles F. S. Lewis, 1735 McCullough Street, N. S. Pittsburgh.
Harry J. Lipman, University of Pittsburgh, Department of Zoology, Pittsburgh.
Alfred G. Lisi, 7016 Elmwood Avenue, Philadelphia.
Stanley D. Michaelson, 14 West Church Street, Bethlehem.
John H. Michels, 149 West Apsley Street, Philadelphia.
Ralph LeRoy Miller, 46 East Church Street, Bethlehem.
J. E. Noonan, Mountain House, Plymouth.
Sister Mary Crescentia O'Connor, R. S. M., College Misericordia, Dallas.
Charles W. Palmer, Westtown (Chester County)
Clarence D. Rothenberger, South Second Street, Newport.
Herbert J. Schlenker, 440 Walnut Street, Kutztown.
Edward C. H. Schmidt, Jr., 6901 Church Avenue, Ben Avon.
Earl B. Scott, 5680 Munhall Road, Pittsburgh.
Ruben T. Shaw, 245 South Fifty-first Street, Philadelphia.
Donald E. Shay, 603 Gilford Street, Lebanon.
Wallace J. Snyder, Edinboro.
Ruter W. Springer, Carlisle.
William F. Starkey, Department of Zoology, University of Pittsburgh, Pittsburgh.
Chester A. Stiteler, 509 East Tulpehocken Street, Philadelphia.
Louise F. O. Tanger, 318 North President Avenue, Lancaster.

J. K. Thornton, 716 Hickory Street, Hollidaysburg.
Mary H. Twarowski, 348 East Green Street, Nanticoke.
Edward H. Watson, Bryn Mawr College, Bryn Mawr.
T. Walley Williams, Jr., Department of Zoology, University of Pittsburgh, Pittsburgh
Leonard N. Wolf, 928 Lincoln Way, McKeesport.

The Resolutions Committee report:

We, the members of the Pennsylvania Academy of Science, desire to express our sincere thanks to the administrative officers of Dickinson College for the privilege of meeting on their campus and for the cordial hospitality shown in many ways.

We particularly wish to commend Dr. Eddy, Dr. Vuilleumier, Prof. Herber and the other members of the local committee for their efficient management of both the Junior and Senior Academy local affairs.

We wish also to thank Dr. W. W. Cort, School of Hygiene and Health, Johns Hopkins University, for his fine address on the hookworm disease and related problems.

Especially do we wish to commend Dr. T. L. Guyton for a decade of loyal service as secretary, R. W. Stone as the editor of the Proceedings of the Academy for many years and the present officers who have handled this year's meeting so well.

We express our sorrow at the passing of two members—Miss Helen Purcell, Harrisburg, and Robert T. Paesoler, Wilkes-Barre.

Respectfully submitted,
W. N. Martin
C. A. Horn
John C. Johnson

This report was received and adopted by the Academy.

The committee on places of meeting reported as follows:

Summer meeting for 1935—Pocono Mountains, probably Stroudsburg. Annual meetings: 1936—Washington and Jefferson College, Washington. 1937—Bucknell University, Lewisburg. Report adopted.

The report of the nominating committee:

For *President*—Edgar T. Wherry
Vice-President—Thomas D. Cope
Secretary—T. L. Guyton
Assistant Secretary—V. Earl Light
Treasurer—H. W. Thurston, Jr.
Editor—R. W. Stone
Press Secretary—Bradford Willard

Upon motion, the secretary was instructed to cast a ballot in favor of each of these nominations. The ballot was so cast. The new president was escorted to the chair and the session was closed.

T. L. GUYTON, *Secretary*

EDITOR'S REPORT

Volume VIII of our Proceedings was issued August 17, 1934. Its 160 pages contained 42 papers, the proceedings of the first meeting of the Junior Academy, and a list of our members.

500 copies were printed at a cost of $587.00 or $1.18 per copy, 4¢ less per copy than the preceding volume. The bill included $107 for illustrations and $17.00 for authors' changes in proof. The changes cost about 10¢ per line.

The price per page was $2.55 for 10-point type with extra charge for 8-point and tabular matter, the same as in 1932, but higher than the rate for 1933.

Seven papers overran the allotted 5 pages of 10-point and the authors were charged for the excess.

All cuts have been presented to the authors of the papers in which they were used.

The editor read all manuscript and proof, sent all proof to the authors. The printer received orders for 4600 reprints of 34 papers.

R. W. STONE,
Editor.

TEACHING ZOOLOGY TO THE BLIND

BY ROBERT T. HANCE
Department of Zoology, University of Pittsburgh

Special models that are essentially outline drawings done in soft wire cemented to cardboard have been prepared of the more important animals and organ systems. Braille labels attached to spiral guide wires indicate the parts to be studied. Models have also been developed of mono and dihybrid crosses using the symbols of long rod dominant to short rod, and large ring dominant to small ring. The results over a period of two years of these models used in conjunction with specimens that are large enough to indicate their morphology to the sense of touch have been entirely satisfactory.

PRESIDENTIAL ADDRESS

THE PENNSYLVANIA ACADEMY OF SCIENCE IN RETROSPECT

BY S. H. DERICKSON
Lebanon Valley College, Annville

Upon casting about in the realm of thought for a suitable topic on which to address you on this occasion as the retiring president and not feeling justified in robbing my students of the time necessary to carry to completion a piece of research worthy of presentation, and knowing my inability to discourse to you upon the profound philosophy of Science, I thought that it might be both interesting and profitable for me to attempt to lead your thinking, in retrospect, in a consideration of the accomplishments of the Pennsylvania Academy of Science in the first decade of its existence.

The conception of our organization was the result of the consciousness of the need of conference with others in quest of truth. The consciousness of that need caused a group of scientists from Pennsylvania to assemble with others from every State in the Union, at Cincinnati, in December, 1923, meeting as the American Association for the Advancement of Science. Almost a score of the men from Pennsylvania in attendance at this meeting were called together for the consideration of the need of a State organization. I have been unable to learn which one of the individuals of that assembly made bold to express his sense of inadequacy and raise the cry for help, and thus became the father of our Academy. If that fact is known to any one in this assembly I shall be glad to incorporate it in this paper and thus rescue our organization from that subtle uncertainty. No doubt several of those assembled, for there were a number who had served our State for many years, felt that there was a body of scientific truth about Pennsylvania for which they as Pennsylvania scientists were personally responsible.

The responsibility for a scientific truth does not end when it is established as the result of research. Just as each word has its own meaning when standing alone but has its usefulness multiplied when in combination with other words it is used to express a profound thought, so each scientific fact, although valuable in isolation, has its value greatly enhanced when integrated with other scientific truths in deducing the great philosophies of the universe.

As a result of the discussion in Cincinnati it was agreed that E. M. Gress, C. R. Orton, and W. A. McCubbin should constitute a committee

to elicit the attitude of those associated with the scientific work in the State toward effecting an organization. These dauntless men encouraged by less than one hundred favorable replies from the two thousand inquiries, sent out a call for an organization meeting which was held at Harrisburg, April 18, 1924.

At this meeting Frank D. Kern, Pennsylvania State College, was chosen as chairman and S. H. Derickson, Lebanon Valley College, secretary. A motion that the "Pennsylvania Academy of Science" be organized was passed unanimously. The chairman appointed a committee consisting of George H. Ashley, G. W. Martin, and C. R. Orton to prepare a constitution, which was adopted temporarily, and the committee continued. A committee appointed to nominate officers reported the following, all of whom were elected as the first officers of the Academy;

President, O. E. Jennings, University of Pittsburgh.
Vice-President, C. E. McClung, University of Pennsylvania.
Secretary, Joseph S. Illick, Pennsylvania Department of Forests and Waters.
Assistant Secretary, T. L. Guyton, Pennsylvania Department of Agriculture.
Treasurer, Frank D. Kern, Pennsylvania State College.
Editor, George H. Ashley, Pennsylvania Department of Forests and Waters.
Press Secretary, J. P. Kelley, Pennsylvania State College.

Advisory Council: Gifford Pinchot, Governor of Pennsylvania; Edgar Fahs Smith, Provost Emeritus, University of Pennsylvania; Henry S. Drinker, President Emeritus, Lehigh University; W. J. Holland, Director Emeritus, Carnegie Museum, Pittsburgh.

Executive Committee: O. E. Jennings, President; C. E. McClung, Vice-President; J. S. Illick, Secretary; F. D. Kern, Treasurer; B. L. Miller; John A. Miller; S. H. Derickson.

Legislative Committee: J. M. McKee; John S. Fisher.

It was decided that all persons in attendance at the organization meeting as well as those seeking membership prior to the adoption of a permanent constitution, should, upon payment of dues, be considered charter members. This list as published in the first volume of the Proceedings, includes the names of 195 persons of whom 43 were present at the organization meeting.

The constitution which was adopted April 11, 1925, has proven so effective that it has not been altered or amended. Inasmuch as the distribution of Volume 1 of the Proceedings is quite limited and the supply of reprints of the constitution is almost exhausted, we have thought it desirable to re-present the constitution for the benefit of those who have more recently become members of the Academy.

Constitution of Pennsylvania Academy of Science
Adopted April 11, 1925

Article 1

Section 1. This association shall be called the Pennsylvania Academy of Science.

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

Article 2

Section 1. Membership in this Academy shall be made up of the following classes: 1. active members; 2. associate members; 3. honorary members, and 4. non-resident members.

Section 2. Any person engaged in any department of scientific work, or in any original research in any department of science, shall be eligible to active membership. Active members shall pay an admission fee of two dollars, which shall also cover the first year's membership fee, and thereafter an annual fee of two dollars. Active members who have removed from the Commonwealth may continue as active members by the payment of annual dues.

Section 3. Any resident of Pennsylvania interested in science but who does not qualify for active membership may be elected to associate membership. Fees for associate members shall be the same as for active members.

Section 4. Honorary members may be elected to this class of membership in the Academy on account of special prominence in science or other branches of learning. They shall be exempt from the payment of dues.

Section 5. Any person not residing in Pennsylvania who is eligible to membership in the Academy may be elected to non-resident membership. Such members shall pay the regular admission fee and annual dues.

Section 6. Application for membership in any of the foregoing classes shall be referred to a Membership Committee, which shall consider such application and report to the Academy before the election.

In any case a three-fourths vote of the active members present at any meeting shall elect to membership.

SECTION 7. The privilege of voting in this Academy shall be restricted to the class of active membership.

Article 3

SECTION 1. The officers of this Academy shall be chosen by ballot at the annual meeting and shall hold office one year or until their successors may be chosen. They shall consist of a President, Vice-president, Secretary, Assistant Secretary, Press Secretary, Editor, and Treasurer, who shall perform the duties usually pertaining to their respective offices and in addition, with the ex-Presidents of the Academy, shall constitute an Executive Committee. Additional members of the Executive Committee shall be elected annually, sufficient to bring the total number of such additional members to four, until such time as past-Presidents become available. The President shall, at each annual meeting, appoint a Program Committee and a Local Arrangements Committee, each of two or more members, which shall prepare the programs and have charge of the arrangements for all meetings for one year. There shall also be a Committee on Publications, consisting of the President, Secretary and Editor.

SECTION 2. The Academy may also elect an Advisory Council to consist of the Governor of the Commonwealth, and an indefinite number of others as may be determined from year to year.

SECTION 3. The annual meeting of the Academy shall be held during the Easter vacation of each year and at such place as may be determined by the Executive Committee. Other meetings may be called at such time and place as may be decided upon by the Executive Committee. Th Executive Committee shall transact any necessary business not especially provided for in this constitution, in the interim between general meetings.

SECTION 4. The regular publications of the Academy shall, include the transactions and all other papers deemed suitable by the Committee on Publication. All members shall receive gratis all current publications of the Academy.

SECTION 5. This constitution may be altered or amended at any annual meeting by a favorable vote of three-fourths of the members present, provided that a copy of the proposed amendment shall be sent to all members at least thirty days previous to the annual meeting.

The Membership

The traditional saying of Mark Hopkins might be paraphrased into saying that an Academy of Science is 'An enthusiastic Scientist on one

end of a log and a Sympathetic Listener on the other.' In other words the life of the organization depends upon the activity of its membership. From the 'lone wolf' that raised the cry in the lobby of the Cincinnati hotel that brought the fifteen sympathetic listeners into cooperation to generate the necessary moral courage for the committee of three to flood the State with 2000 questionnaires, there came the potential membership of the organization meeting.

The charter membership of 1924 included 195, of whom 25 were women; 124 were located in the eastern half and 71 in the western half of the State. A study of the membership as recorded in the PROCEEDINGS indicates a constant ingathering of new members. Nearly 800 names have appeared on the roster. There is abundant evidence of certain modern tendencies in the relationship between member and Academy, savoring of trial marriage, the divorce court, and by far the largest list of separations have been based on the charge of "non-support."

Due to tendencies just referred to, the membership curve and that denoting the ingathering of new members does not coincide. The highest point in the former occurring in 1933 with 388 on the roster and the largest number of accessions occurring in 1930 when 74 new members were elected. For lack of other evidence the addition of only 20 in 1933 and 30, in 1934, might be attributed to the depression. If this interpretation be true the fact that the highest point in membership was reached in this same year indicates that the stability of interest and loyalty of the membership is improving. Sixty-five of the original 195 charter members are still enrolled, indicating a loss of 66⅔ per cent. in a ten-year period. Less than a score of these have been lost through death. Of our present membership less than 20 per cent. have been in from the beginning. The roster published in 1934, Volume VIII, includes 363 names, of whom at least 32 are women. Of these 151 are in the western and 205 in the eastern half of the State and 18 out of the State.

An analysis of the membership on the basis of fields of scientific interest has not been possible from published data and we have not had the time to study the secretary's files, but it is evident from the data secured from an analysis of the programs presented, which will be referred to later, that by far the larger number are interested in some phase of biology. This is probably due to the fact that the Academy has had its conception in connection with the American Association for the Advancement of Science and that although there are sections of the American Association devoted to the physical, chemical and geological and other related sciences, the major national organizations of these

sciences do not usually meet at the same time and place with the A. A. A. S., as do the national organizations of the biological sciences. This situation constitutes a real problem which needs serious consideration and effort if the Academy is to become a well balanced and truly representative organization of all of the scientific interests of the Commonwealth.

Another indication of the improvement in quality of our membership is indicated by the number of our members who also are members of the A. A. A. S. In 1928 there were 146 out of 321; in 1930, 216 out of 367; in 1933, 246 out of 388. This indicates not only a wholesome professional spirit but also a loyal support of the parent organization.

Only two citizens of the Commonwealth have been honored by being elected to honorary membership in the Academy. While it is true that this provision of the constitution should not be cheapened by too frequent use, are there not a few residents of the State who have attained international recognition as authority in their special field who should be elected to honorary membership?

Meetings

The coming together of the members in meetings is the physical integration of the Academy. The preliminary and organization meetings have already been discussed. Subsequent meetings have been of two kinds deemed essential to provide the facilities and opportunities needed to realize the aims set forth in the constitution. One type of meeting was arranged for the discussion of research, the diffusion of knowledge, and to promote intercourse between those engaged in scientific work. These meetings, with the exception of the first, which was held in Harrisburg on the 28th of November, 1924, have been held each year on the Friday and Saturday preceding Easter. The second type, "to assist by investigation and discussion in developing and making known the material, educational and other resources and riches of the Commonwealth," have been arranged in the summer when conditions are favorable for the study of materials at first hand in their natural habitat. Ten annual meetings have been held, seven in the eastern half of the State and three in the western. Nine summer meetings have been held, five in the east and four in the west. Annual meetings have been held at Harrisburg, 1925, 1926, 1927 and 1931; Pittsburgh, 1928; State College, 1929; Bloomsburg, 1930; West Chester, 1932; Huntingdon, 1933; and Reading, 1934. Summer meetings at Benton, 1926; Bear Meadow, 1927; Mount Alto, 1928; Cooks Forest, 1929; Erie, 1930; Scranton, 1931; Slippery Rock, 1932; Ohiopyle, 1933 and Mount Gretna, 1934.

Programs

The presentation of the results of the research and thinking of the individual members before the Academy is the thought-provoking process out of which should grow the most valuable fruits of the Academy. It is here that hearing what some one else has done on their research problem stimulates fresh and new methods of attack on your own. Hearing another teacher present his method of demonstration ofttimes stimulates others to think of a better method or extends the value of the method expressed far beyond the range of its inventor.

An analysis of the programs reveals the following interesting facts. There have been 372 papers presented: 16 in 1924, 15 in 1925, 18 in 1926, 17 in 1927, 30 in 1928, 36 in 1929, 41 in 1930, 36 in 1931, 62 in 1932, 58 in 1933 and 43 in 1934. They were distributed in 15 scientific fields as follows: Animal Parasitology 11, Astronomy 5, Botany 39, Chemistry 14, Diseases of Plants 11, Ecology 31, Education 26, Genetics 40, General 11, Geology 43, Health 7, Mathematics 6, Physics 26, Physiology 33, Zoology 69. Grouped with broader designation there were 241 biological, 94 physical, and 37 general. The program of 1933 stands out as the best balanced; all of the fifteen fields of science listed one or more papers. Geology and Zoology are the only sciences that have had at least one paper each year.

While only a few of the papers have been outstanding contributions to the knowledge of our State we must remember that even a magnificent Cathedral of Learning is made up of minute grains of sand held together by still finer particles of cement, and so these fragments of science need but the mind of a philosopher to bind them together into a structure out of which may be drawn sound principles of adjustment and happy relationships.

Publications

The meetings and programs of the Academy would be quite worthwhile in themselves but their value becomes permanent through the publications of the papers in the Proceedings. At the meeting a year ago our efficient editor presented an analysis of our publications to date which included seven volumes of Proceedings containing 999 pages at a cost of $3805.63. On account of limited funds it has been necessary to limit papers to not more than five printed pages averaging 450 words to the page. A member for whom a five page paper is printed receives $12.72 worth of printing in exchange for his $2.00 dues. It pays to be an active member.

Affiliations

On April 27, 1926 the Academy became affiliated with the A. A. A. S. Through this affiliation the Academy receives fifty cents per year from the A. A. A. S. for each of the members belonging to that Association. Members of the Academy who join the A. A. A. S. are also exempt from the usual $5.00 entrance fee. It pays to join the Academy first and then join the A. A. A. S. Through this affiliation the Academy is entitled to a representative on the Council of the A. A. A. S. and participation in the conference of representatives of the State Academies of Science. Our secretary has quite properly stressed each year the importance of our members joining the American Association for the Advancement of Science.

Now that the A. A. A. S. is stressing the formation of local branches of that organization it is equally important that the State Academy form an affiliations with the local branches of the parent organization that are within the State.

The proposal made to the Academy three years ago in a paper presented by Mr. Karl F. Oerlein, that the Academy should enter into an affiliation with the Science Clubs of the high schools in a relationship to be known as the Junior Academy, has, under his efficient leadership, become a happy realization. The enthusiastic meetings enjoyed by these junior members since their organization will surely be reflected in better service rendered in their local activities, and if our senior programs are what they should be, there will be a sustained desire on the part of the juniors to grow up into the senior organization.

We share common interests with still other organizations with which affiliation might prove mutually profitable, such as the Science Section of the Pennsylvania State Educational Association and some of the older local organizations which developed in the larger educational centers of the State before a State Academy of Science was possible. Some of these might be willing to try having some of our meetings at the same time and place with a symposium held in common, to our mutual advantage.

Some Unsolved Problems

Perhaps our greatest unsolved problem is that of securing an adequate income. I believe the solution to this is in maintaining an enlarged membership. There are two phases to this problem. First, getting new members; second, keeping the members after we have them. Why have more than half of those whose names have been on our rolls dropped out? Can we by a careful study of the problem, without sacrificing

the dignity of our programs, modify our practices so as to hold their interest and provide activities in which they can participate. Since participation on the program is voluntary, the answer to this problem will require individual initiative and trying untrodden paths.

Another unsolved problem is that of incorporation. Committees to which the problem has been referred have always reported on it favorably. Here again the answer has been—"lack of funds." The solution of this problem also lies in the direction of an enlarged membership. Here again we are in a vicious circle, for we should be incorporated before we can accept gifts or grants.

There is an old adage that "He who pities starving birds should scatter crumbs as well." Permit me in closing to scatter some crumbs in the form of recommendations.

Recommendations

That we sanction and favor the formation of local branches of the Pennsylvania Academy of Science.

That the officers of the Academy be authorized to cooperate and, if possible, affiliate with local branches of the A. A. A. S. and the Science Section of the P. S. E. A.

That the plan of securing meeting places by awaiting invitations be abandoned and the Executive Committee be authorized to secure meeting places by offering a meeting to an institution in the section of the State where the meeting should be held and that meeting places be arranged and announced at least two years in advance, thus distributing the meetings equitably to the members throughout the State.

That a permanent committee on Necrology be appointed whose duty it shall be to prepare a brief biographical sketch of each deceased member and report at the annual meeting.

That a volunteer be called for who will secure photographs of the founders, past Presidents, and other members that attain prominence in their respective field and arrange, if possible, to maintain a file of the same in connection with the lantern slide or some similar depository in the State capitol where they will be accessible to members and the public.

That the President appoint a Sectional Chairman for the Biological Sciences and one for the Physical Sciences to preside when sectional programs are rendered.

That the Program Committee be instructed to arrange sectional meetings for Friday afternooon for the reading of the more technical papers, and the other papers on a general program for Friday and Saturday mornings.

That the Program Committee have the programs ready for distribution one month before the time of meeting.

That the Membership Committee be instructed to prepare a pamphlet describing the Academy, its aims, purposes, nature of membership, local chapters, Junior Academy, publications, meetings, affiliations and advantages for its members and have same ready for distribution at least one month before the next annual meeting.

That the Membership Committee be composed of at least one member from each of the several fields of science, Botany, Chemistry, Education, Genetics, Geology, Mathematics, Physics, Psychology, and Zoology.

That the Membership Committee, working under the direction of the Vice President, shall make a special effort to solicit new members by sending the descriptive pamphlet, a copy of the constitution, a copy of the program, and a personal invitation to join the Academy, to those of their profession throughout the State who are not members of the Academy.

That every member boost the Academy with a zeal and steadfastness of purpose that shall insure its permanent growth and usefulness to the State and to mankind everywhere.

Founders of Pennsylvania Academy of Science

A list of those who attended the organization meeting and later paid dues:

Ashley, George H., State Geologist.
Baer, Clarence E., New Castle High School.
Copeland, W. A., Carnegie Institute of Technology.
Derickson, Samuel H., Lebanon Valley College.
Fencil, Calvin F., Lebanon Valley College.
Fish, H. D., University of Pittsburgh.
Fisher, George E., Susquehanna University.
Gress, E. M., State Botanist
Guyton, Thomas L., Department of Agriculture.
Henschen, George N. C., William Penn High School, Harrisburg.
Hill, Ben J., State College.
Hoke, Elmer R., Lebanon Valley College.
Illick, Joseph S., Department of Forests and Waters.
Jacobs, M. W., Jr., Harrisburg.
Kelley, J. P., State College.
Kern, F. D., State College.
Kirby, R. S., State College.
Kocher, Ralph N., Reading Boys High School.
Kuntz, William A., State College.
Lauer, K. W., Bureau of Plant Industry.
Martin, George W., Washington and Jefferson College.

Maxfield, Francis N., Department of Public Instruction.
McCubbin, W. A., Bureau of Plant Industry.
McKee, John M., Department of Agriculture.
Millard, Julian, State Supervising Architect.
Miller, Benjamin L., Lehigh University.
Nicholas, Herbert M., Department of Forests and Waters.
Nixon, E. L., State College.
Orton, C. R., State College.
Overholtz, L. O., State College (Attended organization meeting but joined in 1928)
Palmer, C. M., State College.
Penderbaugh, J. F., Lock Haven High School.
Pond, Frederick L., Meadville High School.
Potts, George C., Harrisburg Natural History Society.
Rex, Edgar G., State College.
Roddy, H. Justin, Millersville State Teachers College.
Stone, R. W., Geological Survey.
Stuart, R. Y., Department of Forests and Waters.
Surface, H. A., Susquehanna University.
Taylor, P. R., Department of Agriculture.
Ward, H. A., Harrisburg Natural History Society.
Williams, John R., Department of Forests and Waters.
Thurston, H. W., Jr., State College.

The names of three others appear in the lists published in the Harrisburg papers of those attending the organization meeting. They are not included in the first published list of members (Vol. 1 Proceedings) and probably never paid dues upon which actual membership depended. They were: P. B. Lewis, Wilkes Barre High School, J. D. Strible, State College, and Salome Comstock, Bureau of Plant Industry.

The above list probably is incomplete as it contains the names of two men known to have participated in the meeting but not included in the published list. It is desirable that the list of founders be as authentic and complete as possible. The present list includes 43 names.

EFFECT OF THE EXTIRPATION OF SKULL PARTS IN RATS

MARCUS H. GREEN
University of Pittsburgh and Albright College

The intention of this paper is to give a curtailed description of the gross morphology of a rat's skull which has undergone distortion and of the atrophied brain of another rat, both of which were induced by excision of skull parts.

If the traction is eliminated on one side of a bilateral system of musculature, the tension becomes unilateral and has the power to warp the involved bony structure. This is quite evident in the muscle-skull relationships of the head. Figure A gives an idea of the power of unilateral traction. In excising the right-hand parietal, part of the interparietal and the dorsal portion of the squamosal of the same side, the jaw musculature no longer had a firm foundation while on the other side the muscles were not disturbed. Since the pull of the muscles on the left side was not compensated for by the right-hand muscles, the skull buckled. The premaxillaries, the nasals, and the maxillaries bend to the direction of pull. The nasal septum and ethmoid bones in this case have become very much twisted, as evident in figure A′.

The discussion of the brain of another rat of the same series is restricted to the cerebrum alone and the adjoining skull parts. Excision of skull parts which are contiguous to parts of the cerebrum will cause the underlying cortical tissue, at least, of the cerebrum to atrophy. This atrophy generally invades much more of the cerebral lobes than the portion recumbent beneath the naked skull area. Under certain conditions, hydrocephalus appears which accelerates and makes more inclusive the degeneration of the lobes.

In many of the specimens the entire upper portion of the hippocampus and fornix is discontinued. In others, such as the specimen under consideration, the hippocampus is not entirely reduced, but is highly deformed. In spite of the extent of the reduction of the septum lucidum, fornix, hippocampus and other structures, the presence of anosmia has never been in evidence. This is in agreement with the findings of H. G. Swann. It might be added here that the picture of the olfactory area of the nasal cavities differs little from that of the normal rat. In no case were the primary olfactory tracts interfered with.

As was mentioned in a previous paper, the white matter representing the nerve processes is the first to come under the influence of degeneration. The cortex then follows in order and then the corpus striatum is affected although it is highly persistent.

Figures B and C do not exhibit the atrophy which is evident farther back. In figure D is seen the first evidence of the atrophy. The lateral ventricles have been united into a large continuum. This large cavity can be followed in Fig. E. Here the caudal portion of the septum lucidum is visible. Figure F reveals the most craniad projection of the pillars of the fornix as they bend downward and backward. On Fig. G the distorted hippocampus with its fascia dentata lies in the enormous cavity formed by the loss of the gray matter on the sides and the roof. The atrophy is not uniform, for it has not yet attacked that portion of cerebral wall lying beneath the unmolested cranial wall as on the other side. That the gray matter is first to disappear is well demonstrated in this view. Figure H shows the almost complete obliteration of the cerebral walls. The hippocampus, however, is not as much reduced or distorted as in the more cranial region.

From these observations, the extirpation of skull parts exerts an effect upon the configuration of the skull itself and induces an atrophy in the cerebral lobes.

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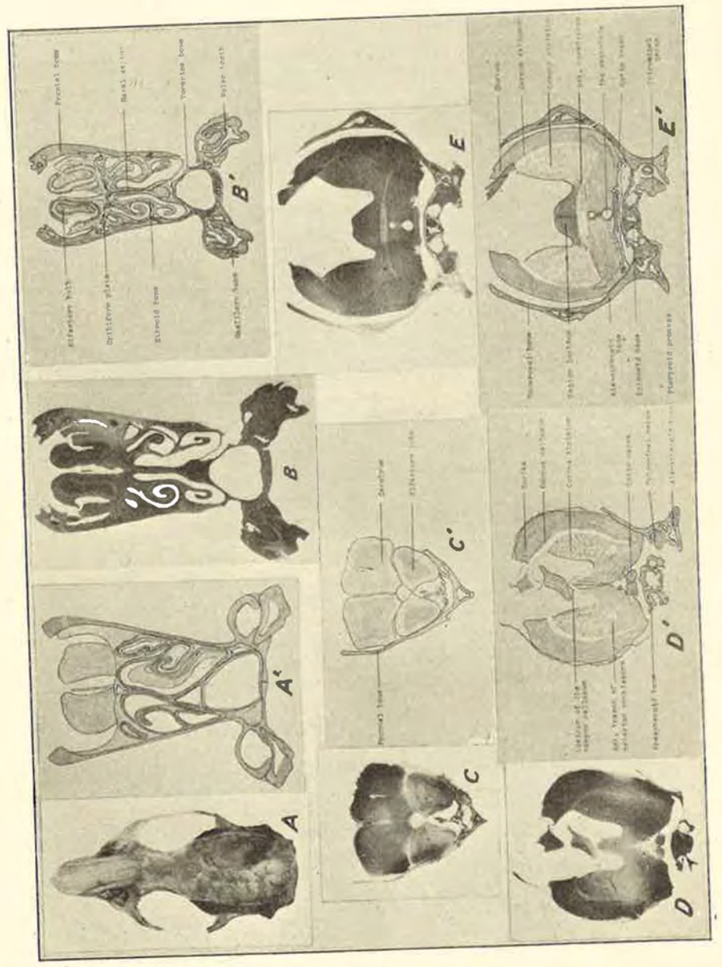

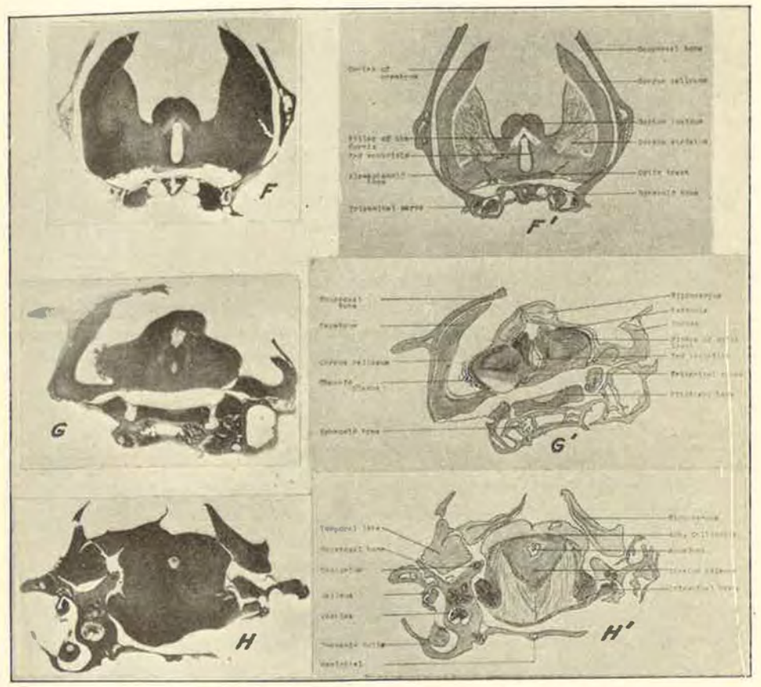

FIG. A. Dorsal side of skull of rat after uni-lateral muscle excision.

FIG. A′. Cross-section through nasal cavity of Fig. A.

FIGS. B, C, D, E, F, G, H are photomicrographs of cross-sections of brain and skull of a rat from which a portion of cranial roof was excised.

FIGS. B′, C′, D′, E′, F′, G′, H′ are corresponding cross-sections of same rat skull.

THE LIFE SPAN OF SPLENECTOMIZED RATS

By Clarence A. Horn
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Notes on the Life Span of Splenectomized Rats

It is generally believed that the spleen is not essential to life. The ancients had a similar idea, because frequently the spleen was removed in order to improve the running ability of their carriers and runners.

This study inquires whether a splenectomized animal is able to live a normal length of life. Very little data on the subject are available. T. J. C. Combes, 1933, reports a boy twelve years old, splenectomized five years ago, and in very good health. William Mayo reported on 500 human splenectomies at the Mayo Clinic between April, 1904, and March 1, 1928. There was a ten per cent. mortality in the hospital. The 80 per cent. who fully recovered from the operation were in good condition and the ultimate results were even more satisfactory. J. A. W. McClurkie and Janet S. F. Niven, in a study of immunity in infectious anemia in splenectomized rats, report on 40 animals, of which group one rat lived two years.

Review of Literature of Infectious Anemia following Splenectomy in Rats

Lauda (1925) showed that a few days after extirpation of the spleen approximately 75 per cent. of the rats developed a severe and often fatal hemolytic type of anemia, accompanied by leucocytosis and haemoglobinuria. The occurrence of anemia following splenectomy was confirmed by Mayer, Borchardt, and Kekuth (1926), who noted that the red cells of the affected animals contained structures similar to bodies previously seen in the blood of the rats infected with Trypanosomes. The organisms they discovered were short and stout, cocco-bacillary forms, which take the Giemsa's stain well. These authors gave the name of *Bartonella muris ratti,* on account of its resemblance to *Bartonella bacilliformis* which is found in Oroya fever and *Verruga peruviana* (Barton, 1909). Some workers believe that they have cultivated the organisms on Noguchi's media. Cannon (1927) found that five days following splenectomy, anemia developed. The animals showed a pronounced pallor of the eyes and mucous membranes, a greatly increased respiratory rate, and in many cases extreme haemoglobinuria and marked weakness. McClurkie (1930) found *Bartonella muris* 24 hours after splenectomy, in others after 9 days. At first they appeared sparsely and

before the symptoms appeared. They persisted from 7 to 35 days, an average of ten days, then they disappeared.

Procedure in this Investigation

The animals used in this study were albino and hooded rats from the Pittsburgh University stock. These animals were bred and raised in clean, well-kept cages. Their diet consisted of a well-balanced ration. With every group of five to ten splenectomized rats in a cage were kept two normals of the same age and litter. These normals lived their normal span of life of about two years. Henry H. Donaldson of the Wistar Institute of Anatomy and Biology states a rat three years of age would correspond to a man of 90 years. Slonaker of Leland Stanford University reported a rat to have lived 45 months, which would be equivalent to a man of 113 years.

This report is made of 104 cases of splenectomized rats. The spleens were removed at different ages, beginning at 9 days after birth and continuing through the life of the animals up to 419 days after birth. The blood of every animal showing the symptoms of anemia was examined for *Bartonella muris.* After death every animal was autopsied to observe any changes which might have taken place in the organs and tissues.

Changes in the Lymph Nodes and Liver after Splenectomy

The earliest reported changes in the lymph system was made by Tizzoni and Fileti (1881) who observed in splenectomized dogs, enlarged thoracic and retroperitoneal lymph nodes. In dogs splenectomized 54 days they found new spleen-like nodules in the omentum. Winogradow described these same structures in splenectomized dogs. He believed that these structures took part in blood destruction, in this way accounting for the anemia which followed splenectomy. Warthin also reports in splenectomized sheep and goats many enlarged lymph and haemolymph glands with greatly increased number of pigment bearing phagocytes, eisinophiles, and also a great proliferation of lymphoid tissue. Krumbhaar reports on his findings of many splenectomized dogs no evidence of hyperplasia of lymph nodes and haemolymph glands. He, however, explains a temporary enlargement of these glands in animals shortly after splenectomy, but in animals splenectomized for several months no such structures could be found.

In this study following the splenectomy in rats, the enlarged lymph nodes are found along the mesenteries, usually lying close to the wall of the intestines in long rows. Many of these lymph nodes are on an average

one centimeter in length. The haemolymph glands lying medial and anterior to the suprarenal and one pair in the anterior dorsal mediastinum lateral to the thymus are greatly enlarged. The lymph patches found in the wall of the intestines between the muscularis and submucosal layers also were very much enlarged in some animals. The number of these patches in some cases was greatly increased. In animals which died during the first several days to the first month following splenectomy, the lymph nodes were not even visible. The enlarged lymph nodes were most prominent in those animals which showed symptoms of anemia and recovered; especially was this well shown if the animal showed symptoms several times. Some animals showed symptoms as many as four or five times during the first three months following splenectomy, then during the remainder of its life showed no more symptoms of the disease. However those animals which lived 500 days following splenectomy showed no hyperplasic lymph nodes. The liver was also greatly enlarged especially in those animals which recovered from one or more attacks of anemia.

Causes of Death in Splenectomized Rats

The causes of death of the 104 cases reported were anemia and pulmonary abscesses with central necrosis. In many cases, in regions of the lungs containing no abscesses, the alveoli were filled with a mucoid exudate. This condition was not due to *Bartonella muris* infection, but it is due to a secondary infection. It is apparent that between 115 and 270 days after splenectomy some animals died of anemia, while others died of the pulmonary abscesses. Seventeen of the 86 rats dead of anemia died of this disease between 115th and 270th day period. Ten animals died after 250 days from pulmonary abscesses. Two of these animals lived 505 and 530 days respectively. Both these died of pulmonary

TABLE I

The transition of causes of death between 115 and 270 days following splenectomy, in number of rats

Number of days following splenectomy	100–150	150–200	200–270	Total number of rats
Anemia	7	5	5	17
Pulmonary abscesses	4		4	8

abscesses. No rat showed any symptoms or died of anemia after 270 days following splenectomy. All deaths earlier than 115 days after splenectomy were caused by anemia.

Relation of Life Span to the Age at which Splenectomy Was Performed

It is a well established fact that anemia follows splenectomy. The spleen, therefore, is the margin of safety between health and infection. However, some of these rats showed that following an infection of the disease, an immunity is established and that a corresponding hyperplasia

TABLE II

Life of rats following splenectomy

Number of rats operated on, age in days at time of operation, and days lived after splenectory, with averages of days lived by groups

No.	Age	Lived	No.	Age	Lived	No.	Age	Lived	No.	Age	Lived
1	9	27	1	27	530	1	40	347	1	55	4
1	9	28	1	28	6	5	41	3	1	55	152
2	9	31	1	28	72	1	41	4	2	55	154
1	9	32	1	28	270	1	41	11	1	55	178
1	9	33	1	28	45	1	41	12	1	55	349
1	9	39	17		97.32	1	41	16	1	58	5
1	9	94				1	41	17	1	58	25
8		39.37	1	30	53	1	41	32	1	58	190
			1	30	380	1	42	19	21		154.8
1	11	3	1	31	240	1	42	42			
1	13	1	2	32	6	1	42	179			
1	13	346	1	32	85	2	45	19	1	60	5
1	13	25	1	34	11	1	45	220	1	62	368
1	13	53	1	34	16				2		186.5
1	14	3	1	36	3	18		78.77			
1	14	4	1	37	11				1	109	1
7		62.14	1	37	13	1	51	242	1	109	206
			1	37	44	1	52	6	1	109	213
1	20	110	1	38	38	1	52	255	1	109	229
1	20	57	1	38	195	1	52	265	1	141	28
1	20	69	1	39	14	1	53	5	1	141	30
1	20	226	1	39	60	1	53	144	1	156	5
1	23	33	1	39	69	1	53	145	1	220	140
1	23	36	1	39	168	1	53	150	1	240	26
1	23	78	1	39	180	1	53	505	1	419	115
2	26	5	1	39	270	1	54	19	1	419	140
2	26	33	20		93.6	1	54	34	11		96.8
1	27	45				1	54	270			

of the lymph glands occurs. In those which die of anemia soon after splenectomy, this hyperplasia of the remaining lymph system does not take place. Cannon and McClelland showed by blocking the lymph system with india ink and trypan blue to be followed with the symptoms of anemia in several days. McClurkie and Niven found ligation of the splenic vessels without removal of the spleen to produce a severe infectious anemia. These authors believe as do other investigators that the reticulo-endothelial system provides immunity either as phagocytes or as the producers of antibodies.

The following table gives a summary of the deaths of rats at various ages:

TABLE III

Number of days rats lived after splenectomy at all ages

Days	1–5	6–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
Number of rats	21	5	13	5	12	4	2	4	2
Per cent	20.1	2.9	5.7	4.8	11.53	3.8	1.92	3.84	1.92

Days	81–90	91–100	1–100	100–200	200–300	300–400	400–500	500–600
Number of rats	1	1	70	15	12	5	0	2
Per cent	.96	.96	67.3	14.4	11.05	4.8	0	1.92

Summary

The reason for the varied average death rates of the several groups shown in the above tables is the lack of a compensatory mechanism of defense against the infective organism *Bartonella muris*. In those animals splenectomized at nine days, and between 109 and 419 days the coordinating mechanism is most likely not fully developed. Those animals splenectomized from 11 days to 60 days are well coordinated in all respects. It is in this group in which two rats lived seventeen months following splenectomy. Here the reticulo-endothelial system fully compensated for the loss of the spleen. However it seems the reticulo-endothelial system in general and the spleen especially prohibit the development of the *Bartonella muris* and establish the latency of the infection. Interference with the system either by ablation or by saturation of the phagocytic cells which particulate matter, allows the organism to develop with the resultant anemia, unless the coordination in the system is so well developed that with the loss of the spleen compensation is established by the remaining reticulo-endothelial system.

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ORIGIN OF BANDING IN FISSURE VEINS

By Donald M. Fraser and Joseph M. Wolf

In a recent paper[1] B. M. Shaub outlines the causes of banding in fissure veins. After discussing the several theories of origin he states in

[1] Shaub, B. M., The Cause of Banding in Fissure Veins: Am. Mineralogist, vol. 19, no. 9, pp. 393–402, Sept., 1934.

his summary, "It is probable that the banding in some fissure veins is caused by filling of shear fractures in an originally unbanded vein, by replacement along the contact of two crusts, by the change in color of different crusts of the same mineral, or the operation of diffusion in gels as outlined by Leisegang. It is suggested, however, that in those veins which show a more or less regular crustification, particularly due to alternating bands of two different minerals, the process of rhythmic fractional crystallization, as previously described, explains as well as any the mode of deposition of the individual bands. The process is in conformity with the laws of physical chemistry, and seems more logical than the assumption that the solutions rising in the fissure were constantly changing."

The writers of this paper are heartily in accord with the above conclusions if "rhythmic fractional crystallization" as a cause of banding is limited to those veins wherein highly concentrated solutions are possible; that is, to those veins wherein magmatic solutions having a concentration similar to that of Spurr's[2] "ore magmas" may have been present.

As Shaub[3] has pointed out, "Fractional crystallization is a common and important process in the industries for separating salts of various kinds from a common solution, and it seems not unreasonable to suppose that it might also operate in fissure veins."

In the case of ore-bearing solutions a high degree of concentration may prevail in the zone closer to the magmatic source where not only temperature is higher but also where there has been little opportunity for the loss of mineralizers or hyperfusibles which aid in keeping materials in solution and lower the crystallization temperature of the dissolved materials. It is in a system of this kind that it seems possible and likely that "rhythmic fractional crystallization" would produce banded vein filling.

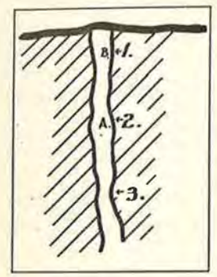
Beyond the zone in which highly concentrated solutions or "ore magmas" would be likely to exist one would encounter the true hydrothermal veins in which the parts more remote from the magmatic source must certainly have been formed from what was essentially aqueous solution. It seems to the writers that solutions of this type, due to the loss of temperature and hyperfusibles as they travel away from the magma and also due to the insoluble nature of the silica and sulphides they contain, are not capable of producing banded fissure veins by "rhythmic fractional crystallization." If the solution contains only small amounts of dissolved material, even if all of it were deposited from the solution at

[2] Spurr, J. E., The Ore Magmas: McGraw-Hill—1923.

[5] *Op. cit.*, p. 398.

any one time, only a very thin layer would result in comparison to the volume of solution. Thicker layers could form if the solution moved through the fissure and deposited continuously. Under these conditions, however, the same mineral is deposited at any given point and a second will be precipitated only if there is (a) a change in temperature, (b) a change in pressure, (c) a change in composition of the solution.

If these possibilities are considered we discover that any one of them may ultimately be considered as causing a change in the composition of the solution depositing material at any given point. In Fig. 1, a solution is depositing mineral A at point 2 and mineral B at point 1 which is a considerable distance away. As long as the temperature, pressure and solution composition conditions are constant A and B will continue to be deposited at their respective points. A decrease in temperature, however, may cause A to precipitate at point 3. As a consequence mineral B may be deposited at point 2 on a previously deposited layer of A. In this manner banding results but only because in the zone where banding occurs the solution from which precipitation takes place has changed its composition. Other temperature or pressure changes produce similar results.



If in Fig. 1 the fissure is assumed to be filled with a solution highly concentrated with mineral matter, "rhythmic fractional crystallization" can take place only if the fissure filling is not circulating through the fissure. This theory of origin further implies that there is sufficient material in solution to fill the fissure entirely or nearly upon crystallization or precipitation. It must therefore be concluded that circulating solutions or solutions of not extremely high concentration cannot cause banding in fissure veins by such a process, and if banding does result from these latter solutions, changing composition is the important factor in their origin.

Examples of changes analogous to the changing of solutions at their source are found in the realm of igneous rocks. There are numerous examples[4] of the changing composition of the lava flows representing

[4] Fenner, C. N., Katmai Magmatic Province: Jour. Geol., 34, 1926, pp. 673–772.
Bowen, N. L., The Evolution of the Igneous Rocks: Princeton Univ. Press. 1928, pp. 113–114, etc.
Powers, H. A., The Lavas of the Modoc Lava-Bed Quadrangle, California: Am. Mineralogist, vol. 17, no. 7, July, 1932, p. 282.

successive extravasations in the given area. If the magma is capable of sending to the surface masses of molten rock of varying composition it should not be difficult to accept the theory of changing solutions from a similar source. Batholiths too are not always unit masses but exhibit numerous facies, sometimes[5] with intrusive relations indicating that the magma from which they were formed was continually changing its composition. It would not be unlikely if under these conditions the magmatic solutions passing into the surrounding fissures should show a variation in their composition. Furthermore pegmatites, which among the silica and silicate veins or dikes most closely approximate the type of fissure filling in which "rhythmic fractional crystallization" would operate, notably illustrate[6] replacement effects indicating changing solutions.

In conclusion we subscribe to the theory of "rhythmic fractional crystallization" as a cause of banding in those fissures wherein concentrated solutions not dissimilar to "ore magmas" may exist in proximity to the magmatic source, but for the banded fissure fillings of the shallower zones and at greater distances from the source magma it seems that the theory of changing composition of the depositing solutions is more tenable.

IGNEOUS ASSIMILATION NEAR MACUNGIE, PENNA.

By Donald M. Fraser
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The hills south of Macungie, Penna., are part of the "Reading Prong" extension of the New England upland and are made up in large part of Precambrian crystalline rocks which show variation not only in their degree of metamorphism but also in their mineralogic composition. The two types most readily identified are a relatively dark-colored hornblende-rich diorite or gabbro and a light-colored potassium-feldspar-rich granite.

In the northeast nose of the ridge lying just southwest of Macungie, granitic juices have invaded the dark-colored rock of dioritic affiliations and have intimately penetrated this basic rock. The minerals of the diorite have been attacked and partially absorbed by the invading granitic material which has occasioned varying degrees of assimilation.

[5] Fitch, A. A., The Sierra Nevada as a Co-Magmatic Region: Am. Jour. Sci. 5th ser., vol. 24, Dec., 1932, pp. 481–495.

[6] Schaller, W. T., Mineral Replacements in Pegmatites: Am. Mineralogist, vol. 12, no. 3, March, 1926, pp. 59–63.

A detailed description of some of the assimilation features observed in thin section and the petrogenic conclusions to be drawn therefrom are given below.

The invaded rock is in most places made up of hornblende and andesine with occasional grains of magnetite and apatite. In some places both biotite and hornblende are found but the usual occurrence is the hornblende-rich type in which hornblende makes up somewhat less than half of the volume of the rock. Commonly this rock is gneissic, showing definite banding due to the concentration of the dark grains, but it may appear in granulose facies, in which the hornblende is more equidimensional than in the gneissic types, and a decussate structure is suggested.

The biotite-bearing specimens where invaded by granitic material altered as follows: Biotite broke down and was largely replaced by zoisite, the fine grains of zoisite retaining the structure of the biotite except where the whole mass has been replaced through assimilation by the granite. In both the biotite-bearing and hornblende-bearing types the andesine shows alteration to both sericite and epidote, which usually occur along the contact of the andesine with the attacking granite minerals (Fig. 1 B), and in addition may appear throughout the crystal as disseminated flakes and grains (Fig. 1 A) without arrangement; or they may be concentrated along twinning planes, or in other grains there may be almost complete sericitization and epidotization (Fig. 2). The borders of the attacked grains show a variation from those that have rounded outlines (Fig. 1 B) to those that have very irregular jagged outlines (Fig. 1 A). The former are thought to indicate that the chief action of the invading material was to dissolve the andesine crystal and produce some sericitization of the margin of the attacked grain. The irregular, jagged type of grain outline likely indicates a more caustic attacking solution. This suggestion seems to be substantiated by the outer zone of the grain which is free from the alteration flakes of sericite. This zone is interpreted as having been formed by the leaching from it of lime, leaving an enriched soda-plagioclase (albite) border to the original andesine grain.

Fig. 1. A. (Lower). Photomicrograph of andesine (An) crystal being replaced by quartz (Qz) (at extinction). Note the disseminated flakes of sericite, the irregular jagged outline of the replaced border and the zone of fresh feldspar free from alteration flakes at the margin of the andesine grain. This zone is soda-rich as a result of the leaching of lime. B. (Upper). Photomicrograph of andesine (An) and hornblende (Hb) being replaced by quartz (Qz). Note the rounded outline of the replaced grains and compare with the outline shown in 1 A. Andesine is altered to sericite along the border and to a smaller extent inward. Hornblende shows practically no alteration.

FIG. 1. A. Andesine crystal being replaced by quartz. B. Andesine and hornblende being replaced by quartz.

The hornblende-andesine type exhibits similar alteration of the andesine and demonstrates the greater resistance of hornblende over biotite to decomposition by the granite invasion. In a specimen of this facies (Fig. 2) quartz, orthoclase, and microcline are found throughout the mass as irregular grains penetrating to the interior and replacing along the margins of both hornblende and andesine. The abundance of replacing material varies so that in places the rock appears as a hornblende-andesine diorite with isolated patches of quartz, orthoclase, and microcline while again where greater assimilation has occured, the main mass may be composed of quartz, orthoclase, and microcline with only

FIG. 2. Photomicrograph showing andesine (An), hornblende (Hb) and orthoclase (Or) being replaced by quartz (Qz). Orthoclase had previously replaced andesine along the margins of grains as shown in the grain at the upper left. Note the intense sericitization of this grain and also the one at the right between the two quartz areas.

remnants of the original more basic rock minerals. In all cases the granite minerals are remarkably fresh and unaltered while andesine invariably shows alteration along the assimilation contact, if not throughout the grain. Where hornblende is in contact with the invading material it is partially dissolved without marked alteration of the remnants.

Grains of sericite, epidote, and zoisite are found as inclusions scattered through some of the quartz and orthoclase grains. These are regarded as having formed from part of the material taken up by the

invading granite. Also, grains of andesine and hornblende larger than those of the diorite and showing less alteration to sericite and epidote but showing partial replacement are thought to have been formed by the recrystallization of previously assimilated andesine and hornblende. Furthermore, it appears that in some places quartz has encroached on orthoclase (Fig. 2) or microcline although it is possible that the latter two are later than the former.

In general the sequence of processes is interpreted to be as follows:

1. The granite invaded the diorite and assimilated large quantities of the latter and at the same time spread granite juices throughout the unassimilated diorite which partly altered andesine, biotite, and hornblende.

2. As the magma with its assimilated dioritic material continued to cool, hornblende and andesine crystallized out.

3. Orthoclase and microcline formed next and in places encroached on and replaced the original andesine.

4. Lastly, quartz crystallized and encroached on andesine, hornblende, and orthoclase.

It appears then that in the case of each successive crystallization product a reaction occurred with the previously formed minerals resulting in the partial replacement of the earlier minerals.

THE DEVELOPING SKELETON AS SHOWN IN ALIZARIN RED S STAINED MAMMALIAN FETUSES—*A DEMONSTRATION*

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The author ('35), using his modification of Dawson's ('26) technique, has prepared a demonstration showing the use of Alizarin Red S in the study of the bones of developing embryos. There is on exhibit an extensive series of pig embryos ranging from four to eight centimeters in length. Several decapitated pig heads are stained and show very well the ossification centers in the skull. Rat and cat fetuses stain readily. At the present time the staining of four or five human fetuses has been attempted and several more are going through the process. Considering the inherent difficulties, they have turned out reasonably well.

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MIDDLE–UPPER DEVONIAN CONTACT IN PENNSYLVANIA[1]

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Introduction

The separation of the Middle from the Upper Devonian in Europe is based upon the recognition of a zone of *Hypothyris cuboides* (Sowerby) at the base of the latter. A similar criterion is applied in central New York State, where the Tully limestone carries *Hypothyridina venustula* (Hall). This is commonly accepted as defining the earliest Upper Devonian, since *Hypothyridina* is a close relative of *Hypothyris*. No such means of separating the Upper from the Middle Devonian was known in Pennsylvania prior to the recent recognition of Tully limestone carrying characteristic fossils.[2] It is now possible upon this basis to establish the boundary over an appreciable part of the State. Where the limestone is absent, chronologically and stratigraphically equivalent beds can usually be recognized upon which the separation may be made. In most sections the contact is believed to be in the nature of a disconformity or diastem, but transitional beds are also recognized.

Middle-Upper Devonian Relations in Pennsylvania

Middle and Upper Devonian formations are widely distributed in Pennsylvania. They enter the State from Maryland and extend northward along the Allegheny Front from Bedford County to Lycoming County. From the "Front" east, exposures are numerous throughout the central part of the State chiefly in the valleys of the Susquehanna and Juniata rivers. Eastward from Perry County a long, narrow band continues into the upper Delaware Valley in Pike County and thence crosses over into and continues in New York and New Jersey. The variations of the stratigraphic succession of the Middle and Upper Devonian across the State may be tabulated for clarity:

The Contact

Throughout nearly the entire region where the Middle-Upper Devonian contact is exposed, the top of the Hamilton group is clearly

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

[2] Willard, Bradford, A Tully limestone outcrop in Pennsylvania: Penna. Acad. Sci., Pr., vol. VIII, 1934, pp. 57–62.

———————, *Hypothyridina venustula* (Hall) in Pennsylvania: Am. Jour. Sci., 5th ser., vol. 29, 1935, pp. 93–97.

———————, Portage group in Pennsylvania: Geol. Soc. Am., Bull., Proceedings of 1934 meeting, p. 49, *abstract*.

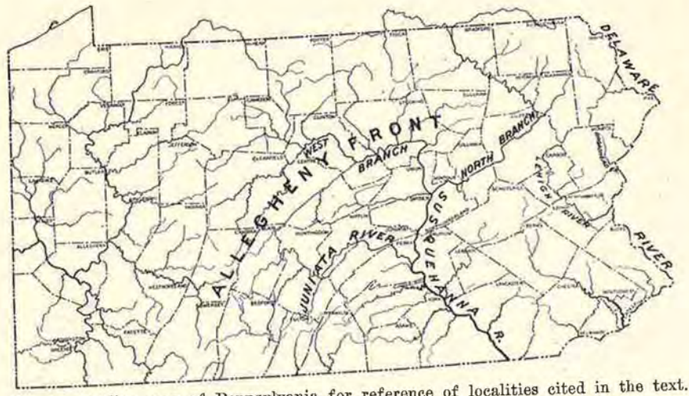

FIG. 1. Outline map of Pennsylvania for reference of localities cited in the text.

GENERALIZED SUMMARY OF MIDDLE AND UPPER DEVONIAN STRATIGRAPHY ACROSS PENNSYLVANIA FROM THE ALLEGHENY FRONT TO PIKE COUNTY AND INTO NORTHERN NEW JERSEY

Allegheny front	Susquehanna valley	Lehigh valley	Brodhead Creek	Upper Delaware valley	Northern New Jersey
Catskill	Catskill	Catskill	Catskill	Catskill	Catskill
Chemung	Chemung				
Braillier	Trimmers Rock	Trimmers Rock	Trimmers Rock	Trimmers Rock	
Harrell	Braillier				
Burket	Harrell				
Tully	Burket	Burket	Laurens*		
Hamilton**	Hamilton	Hamilton	Hamilton	Hamilton	Hamilton

* Faunal zone, equals closely the Laurens members in eastern New York.

** This is the Hamilton group composed of two to four formations.

N.B. The Portage group includes the Trimmers Rock ("Ithaca") sandstone, Braillier greenish shale, Harrell dark gray shale, Burket ("Genesee") black shale and Tully limestone. The local Losh Run shale is omitted from the table and also the Parkhead sandstone.

defined. In many instances it carries a *Vitulina pustulosa* zone with or without *Spirifer tullius*, but usually the lithology and fauna of the overlying strata, because of their striking dissimilarity to the Hamilton, are the best evidence for locating the contact. The Tully limestone with characteristic fauna is known to rest directly upon the Hamilton all along

the Allegheny Front between central Bedford County and eastern Lycoming County and again in a small area in southeastern Northumberland County. The gray, massive or banded limestone furnishes a sharp lithologic break from the underlying, clayey, dark gray, buff-weathering, Hamilton shale.[3] No truly transitional beds between the Hamilton and the Tully have been observed anywhere in the State. The faunal change is also distinct and significant. Eastward from the Allegheny Front where the Tully disappears, the Burket ("Genesee") shale succeeds the Hamilton. Again, a sharp lithologic difference is observed at the Middle-Upper Devonian contact. The same type of dark gray, clayey, nonfissile, upper Hamilton shale is overlain by the black, fissile, Burket shale. Again, no transitional phase has been recognized in Pennsylvania. Paleontologic differences are as distinctive as the lithologic dissimilarity. The upper Hamilton is usually quite fossiliferous with a characteristic fauna. The Burket, on the contrary, is customarily nearly barren save for *Buchiola retrostriata,* or allied forms, and the ubiquitous, but not particularly diagnostic, *Styliolina fissurella*. The Burket has been recognized as far east as the Lehigh River Valley near Lehighton. East of that it has not been found and is thought to have been displaced laterally by coarser, clastic sediments with an Ithaca fauna, the lower part of the Trimmers Rock sandstone.

Because of its eastward disappearance, the black shale no longer furnishes a means to separate the Middle from the Upper Devonian. Instead the Trimmers Rock sandstone rests directly upon the Hamilton in our most eastern sections. However, in Monroe County on Brodhead Creek north of Stroudsburg *Hypothyridina venustula* was discovered in a faunal zone in the base of the Trimmers Rock sandstone. The stratigraphic position and the fossils associated there warrant the correlation of this zone with the Laurens member of eastern New York.[4] Such a correlation is substantiated by the fact that the *Hypothyridina*-bearing stratum occurs immediately above the topmost beds of the Hamilton with their characteristic fauna. This occurrence of mixed Tully and Ithaca organisms appears to be unique for eastern Pennsylvania. Consequently, east of Brodhead Creek the Laurens fauna also fails as a means of identifying the basal Portage. Simultaneously, *Vitulina pustulosa* is no longer found at the top of the Hamilton. Prosser did not report it from Pike

[3] Willard, Bradford, Hamilton groups of central Pennsylvania: Geol. Soc. Am., Bull., vol. 46, 1935, pp. 195–224.

———, Hamilton group along the Allegheny Front, Pennsylvania: Geol. Soc. Am., proceedings of 1934 meeting, p. 72–73, *abstract*.

[4] Cooper, G. Arthur, Stratigraphy of the Hamilton group of eastern New York, Part II: Am. Jour. Sci., 5th ser., vol. 27, 1934, pp. 1–12.

County,[5] nor has the author found it east of Brodhead Creek. Both Hamilton and Portage groups in Pike County are dominated by sandstones of similar lithology, and their respective faunas are intimately mingled. Their relations are held to be transitional with no definite line of separation here between Middle and Upper Devonian.

In Pike County the marine Portage merges above with the Catskill fresh-water facies. Farther east in the isolated, Green Pond Mountain region in north-central New Jersey the Catskill continental facies first appears in early Hamilton time, and thereby entirely displaces the marine Portage.[6] Presumably, between there and Pike County the marine Portage passed entirely over into continental red beds, but all trace of such a transition has been removed or is concealed throughout this critical section.

Thus, from the Allegheny Front eastward across Pennsylvania, the lower limit of the Upper Devonian is drawn successively at the base of the Tully limestone, of the Burket black shale and of the Trimmers Rock sandstone with a Laurens faunule. Still farther east, none of these criteria remains, and transitional relations obtain between the Middle and Upper Devonian. This variation is attributed to the fact that the fine textured, western members of the Portage group pass eastward into sandstones which supplant them by lateral displacement until only the coarser clastics remain. In south-central Pennsylvania a somewhat different story may be recounted. From central Bedford County southeastward into southern Fulton County, the top beds of the Hamilton are overlain successively by Tully, Burket, Harrell and Braillier members of the Portage. Here slightly different facies succeed one another more rapidly than in eastern Pennsylvania.

Interpretation

The Hamilton group in Pennsylvania represents at least the latter part of the progressive or on-lap phase of a marine, sedimentary cycle. The Upper Devonian completely records the regressive or off-lap phase of the same cycle. The earlier Portage members, the Tully and Burket, were formed during or immediately after the time of maximum inundation. It is significant to recall Ver Wiebe's suggestion[7] that widespread black shale may mark the beginning of an interval of diastrophism.

[5] Prosser, C. S., The Devonian system of eastern Pennsylvania and New York: U. S. Geol. Surv., Bull. 120, 1894.

[6] Willard, Bradford, and Cleaves, Arthur B., Hamilton group of eastern Pennsylvania: Geol. Soc. Am., Bull. vol. 44, 1933, pp. 757–782.

[7] Ver Wiebe, W. A., Present distribution and thickness of Paleozoic systems: Geol. Soc. Am., Bull., vol. 43, 1932, pp. 495–540.

That diastrophism in adjacent Appalachia began during the time of deposition of the Burket black shale is deduced from the succeeding off-lap of the coarser, Upper Devonian sediments which themselves marked the reversal of the sedimentary processes of Hamilton time. This off-lap is illustrated by the series of different members which, as basal Portage, overlie the Hamilton from east to west. The neritic magna facies typified by the Trimmers Rock and succeeding Chemung sandstones overwhelmed the fine-grained, peletic muds, the future Burket, Harrell and Braillier shales, and were themselves blotted out in a westward spreading of Catskill continental magna facies, whose base grows younger progressively westward from New Jersey to the Allegheny Front.[8]

Conclusions

Evidence cited anent the contact between the Middle and Upper Devonian in Pennsylvania indicates that a disconformable relation between them exists over much of the State from the Allegheny Front at least to the Lehigh River and probably to Monroe County. This involves successive changes in the basal Portage beds eastward until transitional Hamilton-Portage relations are attained in Pike County because of the gradual disappearance through lateral merging of the finer, lower Portage members eastward with the lower part of the Trimmers Rock sandstone. In other words, Portage and Hamilton sandstones which are in transitional contact in the east are, to the west, separated first by the black Burket shale only, then by the Burket plus overlying Harrell dark gray shale and Braillier greenish shale, and finally by the addition of the Tully limestone wedging in between the Burket and the Hamilton.

Is there a disconformity at the base of the Portage group in Pennsylvania? If we understand such a structure to represent a break in sedimentation due to uplift and subaerial erosion, there certainly is nothing of the sort. However, the abrupt, post-Hamilton change in sedimentary type and faunal content of the beds everywhere save in the extreme eastern sections can hardly be interpreted as other than a more or less complete cessation of sedimentation, a diastem. The sea continued to cover the area, but only a little black mud (the Burket) was laid down over much of the State during the interval of maximum, marine invasion. No alternative explanation appears to present itself. How long such a nearly static condition held is unknown. Perhaps it was quite brief, with the return of rapid deposition following the beginning of Portage time, but, however brief the diastem, it seems to have endured long

[8] Willard, Bradford, "Catskill" sedimentation in Pennsylvania: Geol. Soc. Am., Bull., vol. 44, 1933, pp. 495–516.

enough for a pronounced faunal change to have taken place over much of Pennsylvania west of the neritic zone where continual deposition went on from Hamilton into Portage time. The termination of this break was brought about by the resumption of diastrophic activity (uplift) of Appalachia soon after the opening of Portage time, and corresponding marine and succeeding continental off-lap followed as direct expressions of that movement.

It should be observed that the faunal change is pronounced only when there is a marked change in sediment. Thus, the Trimmers Rock sandstone carries a modified Hamilton fauna, but the Portage shales are either nearly barren or enclose Naples forms. The Tully, although dominated by Hamilton species, does mark the appearance of four or five new kinds of organisms which are unrecognized in the Middle Devonian of Pennsylvania. Some of these new arrivals survived into post-Tully time. With the completion of detailed faunal analyses of the Tully this change should become more apparent. Incidentally and conversely, among the Tully faunules in Pennsylvania, occur organisms (as *Buchiola*) more usually thought of as associated with the Naples than with the Hamilton. These observations are of interest in connection with the recently published remarks of George H. Chadwick in his welcome analysis of the Upper Devonian faunas.[9] Mr. Chadwick admits that in New York there is still some doubt as to the assignment of the Tully to the Upper or the Middle Devonian. From this faunal analysis he would evidently align it with the Hamilton and make it Middle Devonian, but the physical relations are in part contradictory of the faunal. It is a stratigraphic axiom that a disconformity traced far enough laterally tends to pass over into transitional beds. This expresses precisely the Middle-Upper Devonian relations in Pennsylvania. The stratigraphic break at the top of the Hamilton is recognized and is accompanied by the advent of new species in central Pennsylvania. Eastward, this disconformity dies out and faunas mingle. Deductions based upon New York stratigraphy and faunas almost seem conclusive for that region, but are only part of the story. With wider perspective, the doubt as to the Middle or Upper Devonian age of the Tully is dispelled. Pennsylvania stratigraphy and paleontology show the Tully to be the base of the Upper Devonian.

[9] Chadwick, George H., Faunal differentiation in the Upper Devonian, Geol. Soc. Am., Bull., vol. 46, 1935, pp. 305–341.

PHOTOCHEMISTRY AND THE PHOTOFLOOD LAMP

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Frequently in the synthesis of organic compounds the time factor can be reduced materially by illuminating the reaction system. Even more striking is the fact that an entirely different product may sometimes be obtained in the presence of light. In this regard perhaps nothing is so illuminating as the bitter debate waged for several years between the organic departments of the Universities of Strassburg and Leipzig. A reaction was carried out repeatedly in both laboratories with different results. It was finally discovered that the hoods in the Leipzig laboratory were built against the wall, while those at Strassburg stood in the windows. It was the bright Alsatian sunlight that accounted for the difference in the products.

If the organic preparant is unable to carry out his phototropic reactions in bright sunlight he has been advised to use a large electric bulb. This he finds a feeble and perhaps costly substitute. He has, however, in the photoflood bulb a source of illumination not only inexpensive but potent actinically.

The 25 cent bulb, everywhere available, drawing 250 watts at 110 or 115 volts (about 2 amperes), is equivalent to 750 watts in standard lamps. It should, of course, be equipped with a reflector, or at least a housing to protect the eyes. Particularly since many reactions demand only a brief illumination is it a real economy to equip the lamp with a 110 volt pushbutton, or, as we have, with an insulated telegraph key. The disadvantage of the latter is its almost irresistible temptation to every past, present, and future student of the Morse code.

THE INJECTION OF THE LYMPHATIC SYSTEM OF *TRITURUS VIRIDESCENS VIRIDESCENS* (RAF.)

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Introduction

The work described in this paper is essentially a modification of the technic developed by Francis ('32) for the injection of the lymphatic systems of several European species of the Salamandra; it forms a part of the study of the lymphatic system of *Triturus viridescens* now undergoing completion at the Department of Zoology, University of Pittsburgh, under the direction of Dr. H. H. Collins.

Technic

Francis carried out his investigations on animals that had been killed with chloroform, injecting them immediately after death; but the writer found that it was futile to prepare specimens of *Triturus viridescens* in this manner, for the injection mass, when injected into the palm of the hand, would pass no further into the body than the region of the axilla. The sole of the foot, and one or two of the other larger sinuses were also used as points of injection, but with no more success. Further investigation proved that the lymphatic systems of dead animals would not take the injection medium, no matter how soon after death injection was attempted.

Work was then carried out on specimens that were anaesthetized in Ringer's amphibian solution, to which chloretone had been added (30% Ringer's 4 parts to .6% chloretone 1 part). The injection of animals prepared by this method was quite successful; perhaps due, in part, to the action of the lymph hearts, a series of contractile vesicles along each side of the body, in the sulcus lateralis, and to the other contractile parts of the vascular system. This suggestion is made as the result of observations on specimens that died during the process of injection; for it was noted that with the death of these animals, the injection mass ceased to be conveyed through the rest of the body.

The injection medium found to be most suitable for the small vessels of viridescens was a prussian blue gelatin mass, made up as follows:

An appropriate quantity of the best white gelatin is soaked in an excess of water for twelve hours (or overnight). The water is then drained off, and the remaining gelatinous mass slowly melted; to this are added a few crystals of thymol, just enough to prevent decomposition. The material may then be stored away in a refrigerator and used as stock gelatin.

To 60 gm. of the stock gelatin (melted) are added:

6 gm. potassium iodide, 65 cc. pure glycerine, 250 cc. saturated solution of prussian blue in water.

This mass is fluid at a temperature of 23° C., and flows freely through a canula of finely drawn glass; it sets, when slightly cooled, to the consistency of commercial "Jel-lo." Though the setting of this material is a delayed action, it is well to use the apparatus slightly warmed; this is accomplished very simply by utilizing the heat of a desk lamp, the rays of which are directed, from a distance of about two feet, onto the apparatus and the specimen being injected.

The process of injection was carried out with a gravity pressure of 250 cc. of water, the water being syphoned slowly into a gallon air

storage tank, tightly sealed; this created a steady but low air pressure, which was, in turn, directed onto the injection mass contained in the body of a 20 cc. hypodermic syringe. The fine glass canula was attached to the syringe by a small length of 2 mm. rubber tubing; upon this tube was placed a stop-cock, controlling the flow of the injection mass.

The anaesthetized animal was placed on its back, the cannula carefully inserted under the palmar skin of one hand, while the skin of the other palm and the soles of the feet were pricked; the injection was found to be sufficiently completed when the mass had begun to flow freely from these three points. This usually took place in about 45 minutes. To hasten and assure the setting of the mass, the animals were immediately immersed in a 5 per cent solution of formalin.

The lymphatic systems of specimens prepared in the manner described above were adequately injected for detailed study. As the prussian blue does not precipitate, either in the canula or the lymphatic vessels, the minute subcutaneous systems and the larger sinuses were found to be well filled, with a minimum distortion of their walls.

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ANATOMICAL MODELS CONSTRUCTED OF DENTAL IMPRESSION WAX

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Introduction

This technic of using dental impression wax was developed primarily to obtain anatomical models of absolute accuracy in size, proportion, and minute detail of the structures involved. Though the writer has done nothing more than to construct a few such models, it is hoped that demonstrations of this type will prove to be of value in the anatomical laboratory and class room; for so frequently does the laboratory instructor prepare, with much care and concern, demonstration dissections that he would like to preserve for future reference—only to have his dissections dry out or become irreparably damaged by handling, etc. By means of the following method, we believe that such special dissections could be reproduced faithfully, and preserved indefinitely, with the expenditure of a moderate amount of time and effort.

Method and Materials

The four major steps involved in the construction of this type of model are: 1. The arrangement of the area of dissection to be reproduced. 2. Making the mold. 3. Making the cast. 4. Touching up, and finishing the cast.

Using these four steps, I shall endeavor to describe the construction of one of the two models now on demonstration; namely, the model of the thoracic organs of the cat—the heart, lungs, and their associated structures. It should be kept in mind that these organs were taken from an embalmed specimen; consequently they appear to be in a typically shrunken condition.

The structures were cut from the thoracic cavity and arranged on a suitably shaped block of ordinary plastic clay, warmed so as to make it more pliable. Clay was utilized for two reasons: the organs could be arranged on it conveniently, and at the same time be held in place; where a structure became too unruly, a straight pin was thrust through it and into the clay.

A word about the substance with which the mold is made: This is "Reprolastic," a reproducing elastic material for dental impressions, and the most important item in the construction of the models. At house temperature "Reprolastic" is solid, and slightly pliable. But when a stick of this substance is heated in an equal volume of water, it becomes quite mobile; and when applied to the structures to be reproduced, in this mobile condition, "Reprolastic" is capable of taking impressions of the most delicate tissues; and, because it is pliable and elastic when set, the difficulty of under-cuts and deep crevices is removed. This does away with the necessity of making the mold in two or three sections—the usual procedure involved when plaster paris is used for the same purpose.

The heated "Reprolastic" was applied to the organs with a soft half-inch paint brush, the material being dipped, rather than brushed onto the structures and surrounding bed of clay; a thin coat of this substance is all that is necessary. When the "Reprolastic" had hardened sufficiently, a plaster paris "soup" was made and brushed onto it, providing a hard, protective coat over the whole surface. Half an hour later the mold was turned upside down, the clay was stripped from the organs, and they were very carefully probed and displaced from the "Reprolastic" leaving the mold intact.

Another bowl of plaster paris "soup" was mixed and poured slowly into the mold, being evenly distributed over the whole inside surface. Enough time having been allowed for the cast to thoroughly harden, the protective coat of plaster was then chipped away from the "Reprolastic," and the "Reprolastic" was in turn broken away, bit by bit, from the cast. The broken pieces of "Reprolastic" were stored in a jar for future use, first having been cleaned and soaked in water. Any bits of the mold that remained in the crevices and under-cuts of the cast were easily removed with fine needles and forceps. Air holes and other cavities were filled with very thin plaster, applied with a fine camel hair brush.

The model was then completed, except for coloring. The plaster paris, due to its porous quality, will readily take many forms of coloring matter; the writer found that show card water colors served the purpose admirably, if they were later fixed with a coat of transparent varnish.

MELANIN PRODUCTION IN LARVAL TRANSPLANTS ON THE ADULT NEWT *TRITURUS VIRIDESCENS VIRIDESCENS* (RAF.)

By Henry Idzkowsky
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Whereas melanin is known to be found in accumulations in the skin and in such organs as the liver, and in specialized pigment cells, melanophores, of the newt, *Triturus viridescens viridescens* (Raf.), it is not generally found to be freely distributed, either in the form of granules or included in specialized cells, throughout the loose connective tissue in either the adult or the larvae of this form.

After fragments of the larval form of the newt, Triturus, have been transplanted to the adult, histological preparations of the transplants show that this so-called pigment is distributed in the form of freely dispersed granules throughout the entire mass of the transplant and especially throughout the loose connective tissue found in the transplant.

The pigment is found to be most dense in the transplanted fragments after a post-operative period of from two to three months, during which time all of the three principal stages of the formative cycle of the pigment, red, brown, and black are present.

A histological and cytological study of the transplants shows that there occurs simultaneously with this pigment formation a certain degree of cellular necrosis (cell death) due to post-operative shock and host antagonism and a de-differentiation, or reversionary process, of the persisting cellular elements as an adaptive response to this new environment in which the fragment is placed. The transplant during this period is comprised mainly of masses of indifferent cells and interposed, loose connective tissue.

Gross examinations of the transplants show that within a post-operative period of six weeks the transplant becomes translucent throughout its mass—this period of partial transparency persists for approximately two weeks. From this time up to a period of from two to three months there is a gradual darkening of the implanted fragment. After a post-operative period of three months the transplant reaches its maximum darkness. This observation parallels the melanin deposition as seen in histological preparations of the fragment.

Two well known facts can be presented in order that an interpretation of the observations might be made. First that melanin is an end product, and a waste product in most cases, of cell metabolism; melanin is formed by a reaction of an enzyme, tyrosinase, on an amino-acid, tyrosine. Secondly, tyrosine and tyrosinase are present in all types of cells to a greater or lesser degree. Since these facts are established it is a logical assumption that all of the melanin present in the transplant, in addition to that which was present in the dermis of the skin at the time of transplantation must have been produced chiefly through the death of cells and possibly as a product of cellular de-differentiation within the transplant. That it is due to cell death is more likely because the protein content of the cells, due to cell death, would be broken down to amino-acids, one of which is tyrosine. Consequently with cell death tyrosine would be liberated and would then be acted upon by the tyrosinase present in the implant to produce the pigment, melanin. If this is true, it can be concluded that cell death, thus tissue death, and perhaps cellular de-differentiation in the transplant, are gradual, transitory processes as is evidenced by the fact that there is a gradual, progressive change in the amount of darkness within the larval fragments which, in other words, is a gradual progressive deposition of melanin pigment.

SPECIFICITY OF A CERTAIN TYPE OF CONNECTIVE TISSUE CELL (MACROPHAGE) FOR MELANIN IN LARVAL TRANSPLANTS OF THE ADULT NEWT, *TRITURUS VIRIDESCENS VIRIDESCENS* (RAF.)

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A long series of studies, by various investigators, has shown that certain cells, which are scattered throughout the entire animal body, are able to take up particulate matter and to store foreign substances brought to them in colloidal solution. These cells are the macrophages (sometimes referred to as clasmatocytes or resting wandering cells) of the loose connective tissue of the body.

The macrophages may be found resting as fixed, nonmotile cells, or as rounded amoeboid cells.

According to Bloom, '34, a characteristic property of the fixed macrophage, in mammals, is their elective storing of certain electronegative, acid aniline dyes in colloidal solution, such as trypan blue, and of lithium carbonate.

Because of the ability of the macrophage to phagocytose certain foreign elements, they play an important rôle in general metabolism and in the socalled general and local "defense" reactions. The storing of vital dyes is a special case of their "defense" mechanism.

It has been shown in the preceding paper that in larval transplants to the body of the adult newt, Triturus, there is invariably produced in the transplant a free distribution of melanin granules. Microscopial observation of the transplants shows that this type of connective tissue cell, the macrophage, is highly specific for melanin produced in the transplant. The ultra-microscopic granules of melanin enter the cell body in an unknown manner and aggregate in the cytoplasm into large particles as the cell becomes filled. This process is evidently a gradual one, leading eventually, at least in some cases, to a condition in which the cytoplasm of the cell becomes so engorged that the nucleus of the cell is partially hidden by the included mass of melanin granules. The cell, in such cases, is larger, due to the abnormal distention of its cell wall, than it has shown itself to be under normal conditions.

The nucleus of the cell, in the normal resting condition, is finely granular. The granules are homogeneously distributed throughout the body of the nucleus. In the engorged condition the granules are clumped into several circular masses having radiating processes at the periphery of the mass. This alteration is undoubtedly due to a physiological change within the nucleus. The nature of this change, however, is not known.

Pigment cells (chromatophores and melanophores) are highly differentiated connective tissue cells. In the larval form of the newt, Triturus, these cells occur rarely in the loose connective tissue of the body, but they are numerous in the corium of the skin. This is particularly true of the melanophore, a black-pigment bearing cell. In contrast to this condition engorged macrophages were rarely found in the corium of the skin of the larval transplants, but rather in the loose connective tissue of the larval transplant.

Bloom, '34, has stated that some investigators believe the melanophores to have a close genetic relationship to wandering cells of the loose connective tissue. Consequently a similar generalization can be made that there might possibly be some genetic relationship between the melanophore and the macrophage. An investigation with regard to this problem is in progress.

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THE USE OF ANTUITRIN IN EGG-LAYING INDUCTION IN THE AMPHIBIAN, *TRITURUS VIRIDESCENS VIRIDESCENS* (RAF.)

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Pituitary grafts and extracts have been successfully employed in the experimental induction of egg-laying in various Amphibia. In this laboratory, Antuitrin-S (the anterior pituitary-like principle from pregnancy urine) has been extensively used for the experimental induction of egg-laying in the newt, Triturus.

Pituitary grafts, though effective, are somewhat disadvantageous in that the animals from which the glands are taken must be killed. Thus, if many animals are to receive implants of the pituitary bodies, one's stock becomes rapidly depleted. Antuitrin-S injection is by far the better of the two methods insofar as less time is consumed in the operation and there is no need for a sacrifice of stock animals. Nevertheless, Antuitrin-S, too, has its disadvantages. Beside the fact that Antuitrin-S is quite expensive, it is highly toxic with respect to the newt, Triturus, and no doubt with respect to other Amphibia as well. After Antuitrin-S has been injected into the newt, the animal becomes partially paralyzed for a period of from four to five hours. The partial paralysis is accompanied by extreme sensitiveness to tactile stimuli. A third disadvantage lies in this—that the solution is relatively unstable chemically; the potency of Antuitrin-S steadily decreases three months after its manufacture so that it must be used within this period, and, also, it must be refrigerated during this period in order that optimum effects might be obtained.

Injections of Antuitrin (an extract of the anterior lobe of the mammalian pituitary body) have been found to be just as effective as the two

former agents mentioned in the experimental induction of egg-laying in the newt, Triturus. However, the advantage of the use of Antuitrin, rather than Antuitrin-S, in this connection, lie: first, in its being far less expensive than Antuitrin-S; secondly, in its being less toxic; the period during which partial paralysis occurs being shortened approximately two hours, as compared with the period of partial paralysis after the injection of Antuitrin-S; and, thirdly, in its being more stable chemically than Antuitrin-S. Antuitrin may be kept, without a loss of potency, for at least one year after its manufacture.

Antuitrin and Antuitrin-S are trade names and both are products of Parke-Davis and Company.

COLOR PATTERN REGULATION IN THE URODELE *TRITURUS PYRRHOGASTER*

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Among the many interesting problems which arise in a study of tissue repair, that of the origin and movement of melanophores into a wound area is perhaps the most interesting and baffling. Do the melanophores, as most authorities hold, come from the surrounding tissues alone or is there also a vertical movement of melanophores from the peritoneum? Above all, is there an active movement of melanophores or are they simply carried passively in by the mass movements of dermal or epidermal cells? This is an extremely perplexing question and one about which a great deal of argument has arisen. It is well known that melanophores are amoeboid during the early developmental stages of an organism but is this amoeboid ability carried over into the adult stage? Several investigators claim that the contraction and expansion of melanophores, upon which the question of their amoeboid movement is based, applies merely to the granules of melanin and their movements within the melanophore and that the processes of the melanophore remain permanently expanded. However that may be, the possibility remains that, in the presence of such an acute abnormality as that produced by the removal of a patch of integument, the melanophore may regain its powers of amoeboid movement for, in the observations of melanophore behavior, many facts indicative of this type of movement have been noted.

We are, however, primarily concerned here with the question of color pattern regulation. Can the animal restore the original color pattern to a mutilated area or is the restoration in any way regulated by the surrounding tissue? Collins and Adolph ('25) in their work on color

pattern regulation in *Triturus* (*Diemyctylus*) *viridescens* found that during the process of regeneration of integument the spots were restored in such a way that the normal effect was produced although the original color pattern was not reproduced. They also traced by gross observation the migration of pigment from the surrounding tissue into the wound area.

Little work has been done on the yellow and red pigments other than to note the time of reappearance of yellow pigment in the wound. Collins and Adolph in the same study found that the red pigment failed to regenerate and a diligent search through the literature reveals no observations to the contrary. Observations in our own laboratories have shown that the red pigment is found in definite chromatophores.

Triturus pyrrhogaster was selected for this study mainly because melanophores do not occur in the epidermis of the ventrum but are concentrated in a dense melanophore plate found in the middle and outer layers of the dermis. Individual melanophores were found at times in the epidermis but their occurrence was so rare as to have no effects on the final results. The operation consisted in removing a portion of the integument from the ventrum of an animal after a careful record of the color pattern had been taken. Observations were then made daily both by gross examination and by means of the "ultropak" type of micro-illuminator. At various stages of the healing process animals were killed and serial sections of the regenerating integument were prepared according to the paraffin method for microscopic examination.

During the first two months after operation no signs of pigment regeneration could be discerned with the naked eye. When, however, the wounded area was observed under the micro-illuminator, it could be seen that within about ten days after the operation groups and individual melanophores had broken away from the melanophore plate at the cut edge, giving the edge a ragged appearance instead of the more or less clearcut break which had appeared before. These melanophores were at first in the contracted state but soon became expanded with the greater part of their processes extending in the general direction of the center of the wound area. Daily examination at this point showed a general advance into the wound area from all sides until at the end of the third week after operation in most cases, melanophores were scattered throughout the entire wound area, becoming progressively greater in number going away from the center of the wound to the periphery. The advance of melanophores still continued until, usually at the end of four weeks, they were scattered more or less uniformly over the surface of the entire wound but still having a much denser concentration at the extreme edges

than at the center of the wound. At this time nearly all of the melanophores seemed to be in the expanded condition having their processes pointing in all directions.

The animal remained for the next month in the condition described above and at about the end of two months after operation, definite clusters of melanophores or spots were observed to be forming. It is impossible to say definitely whether these spots were formed by aggregation of melanophores or by mitotic division of a single melanophore since the dense concentration of melanin granules effectually blocks out any mitotic figures which might be present. Observations, however, seem to build up a stronger presumptive case for the aggregation theory. It might also be possible that spot formation is due to a combination of the two processes. If mitotic cell division were the process followed in forming a spot, then we should expect to see as the first definite stages of spot formation, two melanophores either incompletely separated or completely separated but lying contiguously to one another. This was never seen. On the contrary the first definite stage of spot formation was a cluster of about ten or more melanophores whose cell bodies were definitely separated and not lying in contiguity to each other. The area between these cell bodies seemed to decrease gradually until they formed a compact mass. At the same time the number of melanophores in the immediate vicinity increased and they were observed to be alternately contracted and expanded. At a later period, after the spot had enlarged, there was a distinct decrease in the number of melanophores lying in regions between spots. Nearly all the spots formed near the edges of the wound where the melanophores were most numerous, sometimes even merging into the adjacent melanophore plate of the normal tissue. With only one exception spots formed near a border of the wound which touched on the melanophore plate and not near a border where red pigment was present exclusively. It might also be said that if mitotic cell division were the basis of spot formation, then we should expect to find melanin granules scattered throughout the wound area as a result of the degeneration and absorption of those melanophores which did not divide to form spots. Spot formation continued until at about the end of five months this particular activity seemed to cease. At this time there had been no restoration of either red or yellow pigment to the wound area. The spot pattern formed was not the original pattern.

It might be said here that attempts have been made to follow the movements of individual melanophores and groups as well by making daily sketches of position and shape. This proved impossible since in their alternation of periods of contraction and expansion, which seemed

to be a daily occurrence, individual melanophores changed their form and could not be identified.

Examination of serial sections of histological preparations showed that between the seventh and tenth days after operation when dermal cells are just beginning to move and long after the wound area has been covered by epidermal cells, the edges of the melanophore plate become broken and fragmented as groups and individual melanophores break off. They do not, however, travel out into the wound area with the dermis but seem to migrate upward into the epidermis. At the end of the second week after the operation they may be seen in the epidermal cells, having moved part of the way into the wound. At the same time no melanophores are seen in the dermis which has spread in a thin layer throughout the entire wound. Sections made during the fourth week after operation show the melanophores still in the epidermis but distributed throughout the entire wound area. They seem to remain in the epidermis until the seventh week after operation when they migrate downward and take up their accustomed places in the upper layer of the dermis. Only a comparatively few cases of migration from the peritoneum were observed and there was no evidence for formation of melanophores "de novo" in the epidermis covering the wound area.

According to the results, insofar as color pattern regulation is concerned, at least a primitive type of regulatory influence was exercised. The color pattern which was produced in the regenerated tissue was not the same as the color pattern of the original tissue, but, if we except the restoration of red and yellow pigment, it was restored in such a way that the normal effect was produced, although the original pattern was not regenerated. In this respect we agree with Collins and Adolph ('25) as to their results on color pattern regulation in *Triturus* (*Diemyctylus*) *viridescens*. The exercise of the regulatory influence consisted in this, that spots formed by melanophores were always found near that edge of the wound bordering on the dense melanophore plate and only in one case on an edge which bordered on red pigment. This would also indicate that such regulation is not the function of the organism as a whole but rather a function of the surrounding normal integument from whose pigment the new color pattern was derived. Whether or not this is true regulation is extremely difficult to determine but, if it be not regulation in the exact meaning of the term, then it is probably the nearest approach that can be found to true regulation in the regeneration of color pattern.

The results of this study present a fairly strong presumptive case for the theory that melanophore migration is accomplished by active movement of the melanophores themselves in contradistinction to that theory

which postulates that they are carried passively into the wound area by the masses of invading dermal and epidermal cells. In *Triturus pyrrhogaster* the melanophores are situated in the upper layer of the dermis but during the processes of wound healing they moved upward from the dermis and into the epidermis from where they migrated throughout the entire wound before moving back down to the dermis. The movement from dermis to epidermis took place after all epidermal movement into the wound area had ceased and melanophores were never found in the dermis while it was spreading over the wound. Developing blood-vessels or capillaries could not have carried the melanophores since there was no correlation in time between the movements of the melanophores and the reestablishment of circulation. Since these seem to be the only possible carriers their elimination leaves us with no other alternative than to accept the theory of active self-movement insofar as *Triturus pyrrhogaster* is concerned.

PHOSPHATASE IN THE CLAM (*VENUS MERCENARIA*)

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This work is an attempt to ascertain whether or not the phosphatase, the enzyme which is responsible for freeing of inorganic phosphate from organic phosphate compounds, in the clam is identical with that found in mammalian organs. The usual criteria for such a study are optimum pH, activating ions, and specificity. The first two methods were used in this investigation; the last was omitted due to the difficulty of obtaining suitable substrates.

The technique used in extracting the enzyme and in measuring its activity was the same as that described by Kay and his coworkers, with the exception that Michaelis' Veronal-HCl buffer was used in the research on activation by magnesium ions.

Clams were obtained fresh, the mantle dissected away from the shell, ground thoroughly with washed white sand and water and allowed to stand over night at room temperature. After carefully filtering the extract, 1 cc. was added to 5 cc. of .03 M Sodium Beta-glycerophosphate and 5 cc. of glycine-NaOH buffer at pH values ranging from pH 8.4–10.2 (checked electrometrically). The mixture was incubated at 37° C. for two hours and, after the addition of 5 cc. of 20% trichloroacetic acid (Merck), the amount of inorganic P liberated was measured by the Brigg's colorimetric method. The phosphatase unit of Kay was used in

expressing the relative activity of the enzyme at the various pH values. The definition of this unit is as follows: "that amount of enzyme which, at 37 degrees C. and at the optimum pH will liberate 1 mg. of P from an excess of Sodium Beta-glycerophosphate solution in two hours."

The results of this study indicate the pH activity curve to be of sigmoid type and the optimum pH of this enzyme to be between 9.4 and 9.8. This is slightly higher than the value given by Kay for mammalian kidney phosphatase.

Jenner and Kay have found that Mg ions, in small concentrations, possess a marked effect on both dialyzed and undialyzed mammalian phosphatase extracts. 25–30 cc. aliquots of enzyme preparations were dialyzed in thin collodion bags against running water, the entire apparatus being installed in the ice box and operated for 96 hours, after which time the following experiment was carried out:

$MgCl_2$ solutions were made up which, when added to the reaction mixture, would yield the desired molarity. In addition, Michaelis' Veronal-HCl buffer at pH 9.6 was used in these experiments since glycine was found to have a slight depressing action on the enzyme. The results showed a decided activation on the part of the Mg ion. The optimum Mg concentration (not including the Mg which may already have been present in the extract) appears to be between .0025 M and 0.2 M $MgCl_2$, and is thus in agreement with the findings of Jenner and Kay for mammalian kidney phosphatase. The greatest percentage of activation for the dialyzed extract was 26.6% as opposed to 20.5% for the undialyzed extract. A much greater activation could probably have been demonstrated had a more efficient method of dialysis been employed on the extract and applied for greater periods of time.

The results here obtained seem to point to a possible close relationship between the phosphatase of the clam mantle and that of mammalian organs.

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HEPARIN AND INTERMEDIATE PRODUCTS OF PREPARATION IN THE DEVELOPMENT OF TADPOLES

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Liver and autolyzed liver products have been found to exhibit a favorable growth-promoting power upon rats. This effect is thought to be distinct from known food factors. The ether extraction product of the liver, heparin, well known as a blood anticoagulant, has been found to cause a more rapid cell differentiation and a decrease in cell proliferation in tissue culture. This proliferation is decreased in proportion to the anticoagulating activity of the preparation. A. Fischer and Nystrom found that the heparin of Howell and that of Kahlbaum promoted the growth of yeast cells, while the preparations of Schmitz and Fischer and of Reines, which are purer, inhibited growth in the order named. Thus, it was concluded that in the purification of the ether extraction products of the liver, a growth promoting substance is lost, leaving an inhibiting substance in the product.

In the present work, eggs of *Rana pipiens* were placed in solutions of four liver preparations, representing various stages in the preparation of Howell's heparin of commerce. These products consisted of a (A) crude fat-free liver product, two (B and C) intermediary products in the preparation of Howell's heparin, and (D) Howell's standard heparin preparation. The embryos were allowed to develop for 14 days in water solutions of the various extracts, at the end of which time they were measured to ascertain the total length and body length. The crude product (A) was found to have a more favorable effect upon the growth of the embryos than did the purer products (B, C, and D). Measurements of models of the eye lenses and hearts of the embryos, chosen at random from the various groups, were made. These reconstructed models were built from sheets of Kerr's dental casting wax. The measurements thus made showed that the organic development paralleled the external growth of the embryos. All of the experimental animals showed a decided increase in growth as compared with the controls.

The results here obtained confirm the findings of the earlier workers in that the growth-promoting power of the liver extracts decreased with the purification of the product. The great power of the crude extract as compared with the effect of the other extracts might indicate the presence of some nutritive factor. Such a possibility must be considered since no differential growth was observed until after the opening of the

alimentary canal, which indicates that the products used were absorbed by the intestinal tract. The products A, B, and C were found to contain protein and carbohydrates while D (Howell's heparin) is known to be a protein-free carbohydrate body. As such, it is possible that these products might act as foods. However, the protein-free heparin exhibited approximately the same growth promoting power as did the product C which contained protein, and since the concentration of the solutions was very low (1 mg.; 100 cc. water), and since all of the animals attacked the food offered them with extreme vigor, it is hardly feasible that the striking increase in growth can be attributed to a nutritive factor alone.

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RECENT X-RAY MUTATIONS IN HABROBRACON

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During the summer of 1934 with support from a grant from the Committee on Effects of Radiation on Living Organisms (National Research Council) there was carried out at the Marine Biological Laboratory, Woods Hole, Mass., a series of X-ray experiments. Mated females of the parasitic wasp Habrobracon were treated and their offspring were tested for the presence of mutant factors. Daughters, developing from fertilized eggs, should be heterozygous if a mutation had been produced either in the egg or in the sperm. Mutant-type sons should appear among the offspring of the treated females.

In Jane Maxwell's experiments with stock 25, five females treated with 3500 R produced 182 males, 139 females (64 tested); five females (4000 R) produced 127 males, 62 females (37 tested); seven females (4500 R) produced 224 males, 88 females (36 tested). No mutant-type males appeared in F_1. Two females from 3500 R mothers proved heterozygous, giving "stubby" and "club" sons respectively.

In Anna R. Whiting's experiments with stock 25, twelve females treated with 3500 R produced 340 males, 179 females (69 tested); eight females (4000 R) produced 232 males, 75 females (41 tested); 45 females (4500 R) produced 997 males, 312 females (204 tested); 14 females (5000 R) produced 161 males, 48 females (30 tested); eight females (6000 R) produced 39 males, six females (6 tested); 19 females (7000 R) produced 108 males, 8 females (6 tested). A single "footless" son was produced by a mother given 5000 R. Mutants appearing in F_2 indicating heterozygosis of the F_1 females were, from 3500 R treatment "rough," "fused," "aeroplane"; from 4000 R "silver," "inviable pupae"; from 4500 R "wrinkled," "reduplicated," "silver," "port," "broken," "short"; from 5000 R "light-ocelli."

In Kathryn Gilmore Speicher's experiments with reverted tapering stock there were 8 males, 7 females (0 tested) from 3500 R material; 55 males, 21 females (3 tested) from 4000 R; 117 males, 19 females (7 tested) from 4500 R. "Shot" occurred in one F_1 fraternity and "woozy" occurred in two, in numbers indicating that the treated females were heterozygous. Among the F_2 males "glaze" occurred in one fraternity (4000 R) and "small" in one (4500 R).

Her experiments with stock 25 showed 301 males, 111 females (63 tested) from 4000 R material; 267 males, 83 females (46 tested) from 4500 R; 295 males, 100 females (61 tested) from 5000 R; 44 males, 7 females (6 tested) from 6000 R. "Pinched" occurred in one F_1 fraternity (4000 R) and in F_2 "rough," "extended," and "lumpy" from 4000 R, and "cheese" from 4500 R.

The twenty-two mutant-types derived from the X-ray experiments are listed and briefly characterized below. Parentheses enclose number of wild-type sons followed by number of mutant-type.

"Aeroplane." Tarsi black and brittle, wings stiffly outstretched, males unable to mate. (11:5).

"Broken." Veins resembling shot-veins, sv, but wings very fragile. (9:13).

"Cheese." Body color pale, opaque, greenish-yellow, especially noticeable in the head. (13:13).

"Club." Hind feet flattened and curved down, antennae drooping terminally with deformation of three or four segments, much pupal inviability but males fertile. (14:8:7 inviable pupae).

"Extended." Wings held back but failing to fold over body, does not show when bred at room temperature. (8:6).

"Footless." Resembles footless, fo, but the wings are more frequently wrinkled. Occurred as a single male.

"Fused." Probably a re-occurrence of fused, fu. (10:6).

"Glaze." Eyes like glass, gl, but antennae and tarsi not affected. Females fertile. (15:17).

"Inviable pupae." (12:11). The five heterozygous tested sisters produced males, wild-type 139, "inviable pupae" 145.

"Light-ocelli." Eyes black. Not allelomorphic with orange, F_2 males being wild-type 185, "light-ocelli" 72, orange 245. (8:7).

"Lumpy." Somewhat like beaded, b. A single male occurred without brothers. Character appeared in progeny of some of his sisters.

"Pinched." R4 vein very short so that longitudinal veins are drawn together. Occurred as a single male in vial f.

"Port." Dark red compound eyes and light ocelli. (24:2). The two "port" males were observed to mate with six females and were left with many others but proved sterile.

"Reduplicated." Primaries more or less doubled but grade into normal. Antennae droop. Heterozygous females have normal antennae, but wings usually "reduplicated."

"Rough." R4 vein absent and adjacent veins roughened. Fertile in female. Cross with cantaloup gave in F_2 males, wild-type 142, cantaloup 233, "rough" 232, cantaloup "rough" 149.

"Short." Antennae resemble tapering, ta, but wild-type daughters were produced in the cross. (11:5).

"Shot." Apparently like previous shot-veins, sv. (13:9).

"Silver." General body-color slightly teneral and fails to darken.

"Small." Resembles small-eyes, k^s. (6:7).

"Stubby." Antennae with 7 to 9 segments in male, 5 to 7 in female. Females fertile. (7:11).

"Woozy." Some segments of legs abnormally dark, others practically without pigment, wings sometimes cupped over body. Inviable at 30° C. and perhaps overlaps with normal at room temperature.

"Wrinkled-wings." Three matings of heterozygous females to their "wrinkled" father resulted in males, wild-type 39, "wrinkled" 24, and females, wild-type 43, "wrinkled" 23.

It is likely that "rough," "shot," "silver," "woozy" and "wrinkled-wings" were running in the stock and hence these mutant-types are discounted in the following calculations.

Counts of F_1 males for the six dosages, 3500 R to 7000 R, are 530, 715, 1605, 456, 83, 108, respectively, a total of 3497. Only two mutants, "pinched" from 4000 R and "footless" from 5000 R, occurred among these.

F_1 females proving heterozygous for mutant factors among total females tested are for the six dosages as follows: four among 133, 3.0%; four among 144, 3.0%; six among 293, 2.0%; one among 91, 1.1%; none among 12; none among 6. Total rate is 15 among 679, 2.2%.

It is believed that low rate of occurrence of mutants among F_1 males and failure of increase in rate among F_2 fraternities with increasing dosages may be due in part to dominant lethal genetic effects occurring simultaneously with "visible" mutations. Lethals may be "filtered out" during maturation of the eggs of F_1 females.

For the six dosages, percentages of females in the F_1 fraternities are (325:855) 38%, (269:984) 27%, (502:2107) 24%, (148:604) 24%; (13:96) 14%, (8:116) 7%. The decreasing female ratio is interpreted as due to dominant lethals induced in the spermatozoa.

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A COMPARATIVE STUDY OF THE SPINAL MUSCULATURE OF THE DOMESTIC CAT AND THE RHESUS MONKEY

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In a comparison of the Rhesus monkey with the domestic cat and a supplementary study of the human, it is noted that the monkey and the human are much more similar to each other than either is to the cat. This is in a large part caused by differences in posture. The Rhesus monkey travels mostly along the ground in a semi-upright position, but using all four limbs. Frequently it sits and sometimes even walks or runs in an erect or semi-erect position. The cat normally is in a horizontal position. These characteristic positions affect the musculature of the spine very definitely. To accomplish turning movements of the body, when in a sitting position, certain muscles must be strengthened or developed. Since the spinal column of the monkey is under constant strain due to the fact that it assumes a position not natural to most vertebrates, certain muscles of the back have become quite tendinous. Other structures of the back are also affected by this change in position.

Since many of the muscles connected with the movements of the spinal column have their origins or insertions in the lumbo-dorsal aponeurosis, it might be well to notice a very distinct difference of this structure in these two forms. In the monkey heavier slips of tendinous material connect the longissimus dorsi and its allied muscles with the spines of the lumbar vertebrae. These slips appear to take origin from the raphe near the tips of the spinous processes. The last three lumbar vertebrae seem to have double slips of this material, one from the cranial

aspect and one from the caudal aspect of each vertebra. In the cat this fascia has a heavier structure and there are no slips of tendon from the spinous processes. In regard to this structure a general statement may serve to clarify an outstanding difference between most primates and the cat family. The lumbo-dorsal fascia in the higher form referred to acts as a supporting structure, in that many of the long muscles are attached to it. This makes it rather difficult to do borderline dissection in the monkey, whereas, in the cat the fascia tends to make the borders of the muscles more definite.

The major differences in the spinal musculature are related to the difference in posture and movement. The flexibility of the spinal column is partially determined by the muscles which attach neighboring vertebrae. Thus the interspinosi (interspinales) in the cat appear as definite, easily traced muscle masses, tendinous only at the origin and insertions, whereas in the monkey they are only tendinous slips intermixed with muscle fibres. The intertransverarii of the monkey resemble corresponding human muscles more than they resemble these muscles in the cat. As in the human they are better developed in the cervical region than in the thoracic or lumbar regions. In these last two regions the intertransversarii are merely tendinous connections between the transverse processes. However, in the cervical region they become more muscular, and in the cranial part of this region form a heavy muscle with fibers inserting on adjacent vertebrae and the superficial fibers inserting upon the second or third vertebrae craniad. In the cat, the intertransversarii appear to interconnect only adjacent vertebrae in the cranial region. However, in the lumbar region the intertransversarii mediales connect the anapophyses (accessory processes) and the metapophyses (mammillary processes) of adjacent vertebrae.

The rotatores in the cat constitute a deep layer of the multifidius spinae which is not a separate muscle but which is fused with other layers of the multifidius. The transversospinales are small slips of muscle which connect the transverse processes of one vertebra with the spinous processes of the first or second next craniad spines in the thoracic region. In the monkey and the human the rotatores are between the transverse process of one vertebra and spinous process of the lamina of another. In the monkey the rotatores connecting adjacent vertebrae are called rotatores brevis, those connecting the second adjacent vertebrae, the rotatores longus.

The muscles of the back of the neck or nuchal region in these two forms differ greatly because of the skeletal differences caused by the semi-upright position of the monkey and the horizontal position of the

cat. In the monkey, as in the human, the articulation of the spine with the skull has moved, through evolutionary changes, to the under side of the skull, which would be the ventral aspect of the cat skull. Therefore, the muscles connecting the upper end of the spinal column to the skull must be altered to suit these conditions. In the cranial part of the intervertebral muscular system of the monkey, several muscles are fused in order to make this accommodation possible. Thus a muscle connecting the spine of the axis to a point near the base of the skull (rectus capitis posterior medius) in the cat is not found in the monkey. The corresponding muscle (rectus capitis posterior major) of the monkey is a separate one and has practically the same origin and insertion. Another feature of this group of muscles is that instead of being parallel with the longitudinal axis of the body as in the cat, they are at an oblique angle, that is, they slope backward, away from the ventral surface, to insert on the base (nuchal line) of the skull. The atlas and the axis are quite different in these two forms. The axis in the monkey has reduced the large spinous process which is so characteristic in the cat. The atlas of the monkey has also lost the large ear-shaped transverse process. The muscles which connect the spinous process of the axis to the transverse process of the atlas and to the skull (obliquis capitis inf. and sup.) are greatly modified and reduced in the monkey in their attempt to orient themselves to the altered skeletal condition of the upright position.

Several points are to be noted in a comparative study of these forms of vertebrates. We see that during the evolution to the upright position, the articulation of the spinal column with the skull has changed so that the face will be forward in the position most frequently taken by the animal. Thus the cat has this articulation at the back of the skull, the monkey and the human on the ventral or lower side of the skull, so that in an erect position the face will be forward. The muscles connecting these two parts of the skeleton are also changed to adapt themselves to these changes in the skeleton. As was explained, the muscles of the spinal column have also been altered to suit these new conditions of upright posture. The literature on these spinal muscles indicates that the innervation of these muscles in the cat and monkey has not been fully determined. At the present time this information is being sought in our laboratory by comparative studies of these animals.

EVOLUTION OF HYDROGEN FROM X-RAYED TISSUE: MECHANISM OF ITS FORMATION AND POSSIBLE SIGNIFICANCE

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A working hypothesis that x-rays affect tissue metabolism by disrupting, not so much the chemical constituents of the cells, but their electrochemical equilibrium, was the basis of the following experiment.

Normal and pathological human tissue explants were irradiated with large doses of x-rays. The gases remaining in the closed respirometer used for irradiating were then analyzed for hydrogen; this gas was found in every case in amounts varying from one to two cubic centimeters. Approximately 0.25 gms. (wet weight) of tissue was used in each case. The following controls were run: (1) the empty respirometer, (2) the Ringers solution and (3) asphyxiated tissue in Ringers were irradiated, and the gases in every case analyzed. Two further controls consisted in letting the tissue explants respire freely in the respirometer. All of the controls were negative for hydrogen.

A second person who was in no way connected with the experiment and who received unknown numbered samples, made all of the hydrogen analyses. Due to improper facilities for studying the problem quantitatively the work had to be discontinued temporarily. It is hoped that by suggesting a source of the hydrogen in the tissue, and by pointing out a possible significance of its formation that others may be led to similar lines of investigations.

It should be noted that Fricke and Brownscombe conclude that air-free water is not decomposed by x-rays. When organic impurities are present, however, they found a few micro-mols/ liter of CO and hydrogen. The quantity is independent of the dosage above several kiloroentgens and the amount of hydrogen seems to vary inversely with the amount of oxygen present. The latter along with greater refinement in measuring would account for the negative results obtained in the experiment cited wherein Ringers solution and Ringers plus dead tissue were irradiated in an atmosphere of air.

When the tissue respires, however, hydrogen is evidently produced in considerably increased quantity notwithstanding an appreciable oxygen tension in the cells. This fact points to a difference in the source of the hydrogen in the case of the living tissue. Although there is no doubt that certain chemical changes take place in the constituents of the cell

even a few minutes after death, the essential difference between living and non-living tissue is that of metabolism.

Let equation (1) represent a type oxidation-reduction reaction.

$$2\,RH \rightleftarrows R\text{–}R + 2\,H^+ + 2\,e \quad (e = \text{electron}) \qquad (1)$$

(Glutathione, succinate-fumarate, lactate-pyruvate are examples of this type of reaction). Since in ordinary cell metabolism no free hydrogen molecules are found, it may be assumed that the hydrogen ion just set free does not recombine, but unites with a hydrogen acceptor, *e.g.*, oxygen, in which case H_2O_2 is formed. For simplicity other hydrogen acceptors present may be neglected. The arguments to follow hold equally.

Equation (2) illustrates what is thought to take place in normal tissue metabolism.

$$2\,H^+ + O_2 \rightarrow H_2O_2 \qquad (2)$$

If now the media in which such cellular reactions take place is so changed that in addition to the oxygen acting as an acceptor for the H^+, or protons, innumerable electrons which will act in the same capacity are present, the equilibria of the system will be appreciably altered. This is the condition of the tissue during irradiation with x-, gamma or beta rays. Under these circumstances a certain proportion of the hydrogen ions should recombine according to the following reaction:

$$2\,H^+ + 2\,e \rightarrow 2\,H \rightarrow H_2 \qquad (3)$$

The hydrogen molecule being inactive at body temperatures will quickly diffuse through the cell wall and escape. This of course is essentially the same as ordinary electrolysis, and at once explains the presence of hydrogen in x-rayed tissue and the effect of oxygen tension upon the amount of hydrogen evolved.

The probability that H_2 as such would be set free from any organic compound appears to be exceedingly small.

Perhaps the above explanation of the presence of hydrogen and its effect in disturbing metabolic equilibrium represents an oversimplification, but it is hard to believe that the acceptance of hydrogen by any compound, and oxygen in particular, should not be affected by the relative concentrations of other hydrogen acceptors which may be artificially created.

While it is not meant to take up a detailed explanation of the mechanism of short wave radiations on tissues, the effect on the equilibrium of removing hydrogen ions from any reversible system of the type illus-

trated in equation (1) is not the only consequence of hydrogen formation.

A factor which appears to be of even greater importance is this: reaction (3) really involves two steps, first the formation of 2 hydrogen atoms from the combination of 2 hydrogen ions and 2 electrons, and second, the recombination of these atoms to form a molecule. Now the heat of reaction for this recombination is slightly over 100 kg. cal./mol. The importance of this can better be judged when one considers that biochemists are generally agreed that the maximum heat of reaction in any single step for biological material is approximately 20 kg. cal./mol. It would seem, therefore, that the temperature in the areas immediately surrounding such reactions is approximately five times as high as the normal. The effect of such a local rise in temperature would likely be exhibited, among other ways, in denaturation of proteins composing the tissue.

It should be pointed out that the total amount of heat supplied to the tissue may not be any greater than normally; and that the heat energy from the absorbed x-rays is infinitesimal as compared with that coming from the recombination of hydrogen atoms.

It may be tentatively concluded then that the formation of hydrogen from x-rayed tissues influences tissue metabolism directly by disturbing the chemical equilibrium of oxidation-reduction systems and, because of the high heat of reaction of the formation of H_2, by denaturing the proteins of the tissue.

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FURTHER STUDIES ON THE EFFECT OF ALIZARIN RED S ON EMBRYONIC MATERIAL

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Alizarin Red S (alizarine sodium monosulfonate, sodium sulphalizarate) when used under the proper conditions is an excellent means of showing degree of ossification. The author ('35) in a recent paper gave his modification of the original technique of Dawson ('26) as applied to embryonic bone development. Since the technique is not well known it seems justifiable to repeat the method. Fixation is best accomplished in 95% alcohol from three to seven days. After fixation the specimen is placed in a 2% solution of KOH until the opaque bones are clearly visible through the jelly-like body tissues. If the specimen is not thoroughly cleared the entire body tissue takes the stain. After clearing, the specimen is placed in a very dilute solution of Alizarin Red S in KOH. The specimen is usually left in this solution over night, or until the desired color is obtained in the bone. After staining, the specimen is placed in increasing concentrations of glycerine; and is stored in pure glycerine. If kept away from direct sunlight the specimen will retain its original color for years.

The author ('35) originally found the staining of chick embryos difficult. By rigorously following the technique and by fixing in alcohol for at least a week several chick specimens were prepared. The stain originally used was purchased from the Coleman & Bell Company, five or six years ago. Several series of specimens were run on stain purchased within the last year from the National Aniline and Chemical Company. The results obtained were the same as those of the original stain. This proves that aging does not lessen the power of the dye when kept in the powdered state.

Work is in progress at the present time to stain a sequential series of chick embryos by this method. This series will show the period when ossification sets in and will give a picture of the degree of ossification as compared to the age of the embryo. At the same time the amount of phosphatase in the entire body will be measured daily throughout development. This phosphatase content will be compared with the degree of ossification shown by the Alizarin Red S staining method.

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WATER HEMLOCK KILLS CWA WORKER

By E. M. Gress
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About 2:30 P.M., March 28, 1934, two young men working on a CWA project in Somerset County, Pennsylvania, found some roots which they thought were those of sweet anise, but which proved to be roots of water hemlock. Both men ate some of these roots. One man, Clyde Ferrell, fell to the ground in a very severe convulsion at 4 P.M.,

and continued to have convulsions every five to eight minutes until 7:15 P.M., when he died. He never regained consciousness after the first convulsion.

The other man who had eaten the roots drank some water shortly afterwards and vomited. He, too, became suddenly ill and had some convulsions, but in two or three days, he recovered and was able to return to work.

The physician who attended these young men and who gave the above information further describes the case as follows: I saw the patient about thirty minutes after the first convulsion. On first examination the heart action was much stimulated. The pulse was 140, full and bounding. Later the heart action became weaker and shortly before he died the pulse was only 38 to 40.

The jaws were so firmly set that it was impossible to force the mouth open even during the intervals between the convulsions. There was extreme cyanosis during the spasms.

A post mortem the following day found the stomach empty, which showed that the roots had been digested and passed into the intestines, and enough assimilation had taken place to poison the brain centers.

On March 30, 1912, a similar poisoning occurred at Smithmill, Clearfield County, Pennsylvania, when Willard and Chester Mulhollen and Harold Fun mistook the roots of water hemlock for artichokes. The doctor who attended these three writes as follows:

"All three became suddenly ill a few minutes after they stopped eating. Chester started toward the house about 100 feet distant and fell in the doorway in a convulsion, never regaining consciousness. Harold dropped where he was in convulsions. Willard became ill a few minutes later, and acted exactly like the others. The neighbors induced vomiting in the two latter, but were unable to force Chester to swallow. He did not vomit at any time. Chester died at 3:00 P.M. (The eating took place between 11:00 and 12:00 M.) The other two are recovering rapidly. They both are able to walk about, and have no pain. I did not reach the scene until two hours after the convulsions began. The boys were totally unconscious and do not remember anything that happened after becoming ill. Their pupils were widely dilated, the iris hardly visible. They had a small weak pulse, 30 to 50 per minute. The facial muscles contracted rapidly. Their eyelids would almost snap with eyeballs protruding. Eyes turned inwardly. Extreme cyanosis during the spasms. Jaws set so that it was almost impossible to force the mouth open at any time. Convulsions almost continuous, both tonic and clonic. All the muscles were rigid. Chester's spasms never ceased until death."

Many other instances could be given, but it is unnecessary to enumerate more since it is definitely known that water hemlock is extremely poisonous and that much loss of livestock, and sometimes human beings, is caused every year by this plant, which is very abundant throughout Pennsylvania.

SOME EFFECTS OF HIGH FREQUENCY CURRENTS ON MITOSIS IN CORN SEED RADICLES

By Earl B. Scott
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Bennedetti (1926) worked on the germination of corn seeds at 20° C., after exposing the seeds in an electro-magnetic field from 30 minutes to one hour. From this experiment he found that the exposed seeds grew faster than those which were not exposed to the field. Since, as he found, this radiation raised the temperature ½° C., the control group was held at about ½° C. above room temperature. He felt that the acceleration in growth of the exposed corn was not due to the increase in temperature caused by the radiation.

The apparatus used by Bennedetti was of a type that produced an impure wave. The modern vacuum tube oscillator used today produces a pure wave of high frequency and can be tuned and held at a desired frequency.

McKinley (1930) tested the effects of high frequency electric fields on the growth of Golden Bantam corn seedlings. The exposures of from five minutes to one hour were highly lethal to the seeds. Since the amount of temperature produced was high, he suspected the heat as the lethal cause. On the other hand, he found that exposures of one minute slightly retarded the growth of seedlings. In this case an increase of internal heat was also found. As a third part of the experiment, seeds were exposed for a period of 30 to 40 seconds. In this case acceleration was found in the early germination period and the internal heat of the seeds during the period of exposure was negligible.

In 1933 McKinley again reported on the effect of sub-lethal pregermination treatment of corn seeds by a high frequency field. Here it was found that a slight acceleration of growth was produced. At this time the temperature rise in the exposed seeds was measured by the Dewar-flask method. A temperature increase of less than 1° C. was found. In view of the fact that the temperature at which the control seeds were kept fluctuated 1° C. more or less, the temperature increase in the exposed group was not believed to have been responsible for the acceleration.

The Golden Bantam corn seed chosen for this work was obtained from the Crockette-Bradley Company, Cleveland, Ohio. One hundred dry seeds were selected at random, 50 of which were to be used for radiation and 50 for controls. The experimental seeds were treated for one hour at a wave length of six meters. The apparatus employed was a UX210, 7.5 watt tube. The plates of the condenser of the oscillating circuit were eight cm. square and spaced at 4.3 cm. The filament voltage was held constant at 7.5 volts. The internal heat generated in the radiated seeds was not more than 1° C. above room temperature. The control group was kept at room temperature.

Soon after radiation, all seeds were prepared for germination. This was done by placing about one-eighth inch of water in pans, into each of which two stacks of paper toweling, having twelve towels in each stack, were placed. The stacks of toweling were saturated with water and the grains placed between the first and second sheets of each stack. In this way all corn seeds were kept moist and above the water line. Of the two stacks of paper toweling in each pan, one was used for the germination of the radiated seeds and the other for controls. The pans holding the seeds were then placed in an incubator. Care was taken that the water level in each pan remained fairly constant for the entire period of germination. After 96 hours of germination the tips of all radicles which were approximately nine centimeters long were cut off and fixed in B15. About one-half of the selected grains had to be discarded because of molds and deterioration of the tips. After fixation the tips were dehydrated, sectioned at ten microns, and stained with Iron Haematoxylin.

The control and experimental groups of radicles were similar and typical in gross histological appearance. Observing the parts (8), starting at the apex, four regions were differentiated. First, the root cap, in which the cells ranged from large oval cells filled with cytoplasm and having large nuclei, to small cuboidal cells near the apex of the root tip. Directly posterior to the root cap was the zone of cell division. In this region the cells were small and rich in cytoplasm, contained large nuclei, and had no vacuoles. Behind this zone of cell division was a small area of cell enlargement. Here the cells were becoming elongated and vacuoles were appearing in the cytoplasm. Lastly appeared the zone of cell development in which region the cells were assuming the characteristics of maturity in shape, size, and structure. These cells were extremely long in comparison to the cells already mentioned. A large vacuole occupied the center of each cell, pushing the cytoplasm to the periphery along with the nucleus. The transition from one region to the succeeding one was gradual except in differentiating the root cap from the apical zone of the root tip. Here the change was marked. Transversely the radicles were divided into a dark central "core," the plerome, and a dark outer region, the dermatogen. Between the plerome and the dermatogen was a lighter region, the periblem.

Care was used in selecting only dividing cells; with this in mind only those cells which showed at least one of the following conditions were considered as dividing cells:

1. The chromosomes in a metaphase or an anaphase position.
2. The new wall forming between the daughter cells.

As far as could be observed there was no differentiation between the growth region in the exposed group and the growth region in the control group. Dividing cells were scattered throughout the zones of cell division. A greater number was found in the promeristem and in the periblem than in the plerome. It appeared that a greater number of cells were dividing on, or nearly on, a longitudinal plane in the test group than in the controls.

In both the experimental and the control groups, cell division, with some exceptions, took place in a plane parallel to the axis of the root tip. Of the 8195 dividing cells in the former, approximately 82 divided on a plane transverse to the axis of the root tip. Of the 6300 dividing cells in the control group, only eight were found dividing in this plane.

In comparing the means, or averages, of the experimental and control groups, it is found that the radiated group as a whole had 9.8 more dividing cells than the control group.

A most important proof of the growth of an organism is the observation of its cell division. The more rapid the cell division or the greater the number of dividing cells, the higher the rate of growth. Bennedetti (1) and McKinley (7) have shown that exposure of seedlings to high frequency fields produces an acceleration in the growth of the radicles. In correlating the facts given in this work it was found that an early acceleration in the growth of corn seedlings, after exposure to high frequency fields, was produced. This is shown in two ways. First, the distribution curves of the exposed and control groups showed that 19.55 per cent of the exposed sections had between 40–45 dividing cells per section, the comparable mode of the control sections (18.75 per cent) had only between 11–15 dividing cells per section—a difference of 30 mitotic figures in the two modes. Second, in the experimental group as a whole there was an average of 9.8 more dividing cells than in the controls. Since an increase in the number of dividing cells means a higher rate of growth and since 1895 more mitotic figures were found in those sections in which the seeds were exposed to a high frequency field, we can conclude that the radiation was the cause of the acceleration of growth.

In what way the high frequency field caused the acceleration we are not prepared to say. The previously mentioned workers both believe that the small amount of internal heat produced by the radiation was not responsible for the early acceleration of growth, since the control grains were subject to fluctuations in temperature. McKinley (7) states "it is thought possible that the displacement disturbance brought about by exposure to the field may, in very mild doses, upset the normal equilibrium of the cell without actually injuring it." This upset of the equilibrium might increase the normal metabolism of the cells and in such a manner increase mitosis.

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MEANDERS IN RAYSTOWN BRANCH OF JUNIATA RIVER[1]

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Description

The course of Raystown Branch of Juniata River from Everett in Bedford County to its mouth below Huntingdon in general is very direct along the west side of Broad Top Mountain, but in detail is complicated by very considerable meanders. In a straight line the distance from Everett to the mouth is less than 40 miles but the channel is about 85 miles. The stream makes a complex loop at Juniata Crossing east of Everett where the general course changes from east to north-northeast, and there are

[1] Published by permission of Geo. H. Ashley, State Geologist.

extra-long hairpin loops near Saxton and just above the mouth. A comparatively straight stretch occurs near Hopewell and Riddlesburg.

Streams meander when regional or local base level has been reached. On a peneplane streams usually assume a meandering course, winding about to follow the easiest path; they do the same on a locally base-leveled area. Should a peneplane be raised with reference to sea level or the controlling element of an interior plane be lowered, a second cycle of erosion begins. The streams will incise their courses into the surface until they again approach a condition of grade. Deeply incised meandering streams therefore indicate a raised peneplane or a lowered controlling factor.

Raystown Branch meanders laterally from one to two miles and is incised about 500 feet below the adjacent hills on the west and 800 to 1100 feet below the ridge on the east. We must conclude that it acquired this winding course on a plane surface whose relation to its base level has since been altered.

Over 50 years ago, J. P. Lesley, then State Geologist, wrote: "To discover the reason for the apparently accidental and lawless course of our main streams the geologist must reconstruct the original surface before the erosion of the uppermost Coal Measures began, and follow the history of erosion down to the present time."[2]

Original Drainage

It is generally believed that subsequent to the Appalachian revolution which folded the sedimentary rocks of Pennsylvania at the close of the Paleozoic era, there was a tremendously long quiescent period which resulted in the surface being worn down nearly to a plane which in the central and eastern parts of the State sloped gently to the southeast. The Lehigh, Schuylkill, Susquehanna, and Juniata may in general be thought of as descendants of that early drainage. When this peneplane subsequently was elevated with relation to sea level, and warped, so that the highest part was along the north-central boundary of the State, these rivers were rejuvenated and began wearing away the surface. As they deepened their channels they encountered the underlying bed rock, some of which was soft and easily eroded, some hard and resistant to downcutting.

As physiographers have postulated that originally the North Branch of Susquehanna River above Scranton flowed southeast down the present course of Lehigh River and subsequently was beheaded, so it might be surmised that on the old peneplane the upper part of Raystown Branch

[2] Stevenson, J. J., The Geology of Bedford and Fulton counties: Penna. Second Geol. Survey, Report T2, 1882, footnote, p. 3.

flowed east from Everett across or south of the Broad Top area, and along the Cumberland Valley to the Susquehanna or the Potomac. I do not say that it did, but it is a point some one might consider. Or it may have gone down Aughwick Creek Valley to join the main stream at Mount Union, or followed the present valley of Tonoloway Creek to the Potomac.

Did Raystown Branch Once Flow East?

That the course of Raystown Branch once was different, in part at least, is suggested by the backhanded way in which the tributaries enter it from Big Trough Creek to Junlata Crossing east of Everett. The general trend of Yellow Creek, Sherman, French, and Tub Mill runs, is toward the south, as though their trunk stream flowed in that direction. Most of these backhanded branches, however, are short and secondary, and their course is controlled by geologic structure and lithology.

If Raystown Branch formerly flowed east and down Aughwick Valley or some other, it was on the old peneplane which was above the top of the present ridges. The lowest gap between Everett and Aughwick Creek is at 1500 feet between Sherman Run, a tributary on the south side of Broad Top, and Sideling Hill Creek, which is a head of Aughwick Creek. Both of these streams are in Mauch Chunk formation encircling the Broad Top and it is believed that their valleys and the connecting low gap, 600 feet above Raystown Branch, are explained by the non-resistant character of the rocks and have nothing to do with a former eastern course of the main stream. South of Juniata Crossing the divide between Shavers Creek and Potomac drainage is at about 1500 feet. Southeast from Juniata Crossing via Brush Creek gap through Rays Hill and Emmaville there is a wind gap at 1741 feet in Town Hill and another at 1578 feet in Sideling Hill. These three gaps lead toward Needmore and Tonoloway Creek which empties into the Potomac at Hancock.

The present elevation of Raystown Branch is 1000 feet at Everett, 950 at Juniata Crossing, and 900 feet at Saxton, but the peneplane on which it is assumed the stream may once have flowed east was at an elevation higher than the present ridges at 2000–2200 feet.

If Raystown Branch formerly flowed east to Aughwick or some other valley on a peneplane, the headwaters were captured near Everett at a later period, perhaps because the main Juniata was able to cut faster across the hard rocks now making Jacks Mountain than the other stream could deepen its course across the broad expanse of Pocono sandstone south of Broad Top Mountain.

The capture, if there was one, took place before the meanders were developed, because stream capture usually is accomplished by active headward extension, a condition which could not exist on the level surface indicated by the great loop at Juniata Crossing and by the meanders of Brush Creek near by.

Cause of Meandering Course

In searching for an explanation of the meandering course of Raystown Branch below Everett one finds from a geologic map that the stream follows pretty closely a belt of soft sandstone and shale, the Catskill formation, looping across into Chemung rocks on one side, and for a short distance on the other side cutting through the Pocono sandstone into the Mississippian group of rocks. That these soft rocks are not the whole explanation for the abundant wide meanders is evident when it is noticed that a continuation of this belt south of Everett and a broad band of these formations at the foot of Allegheny Front support no meandering streams.

A possible explanation of the meandering course is found in Jacks Mountain through which the Juniata passes in a long gap between Mill Creek and Mount Union. Jacks Mountain, with a present elevation of 2200 feet and more, is an anticline with the Juniata sandstone at its core and the tough Tuscarora quartzite on both flanks. These rocks are raised in a high arch, together with the overlying Clinton and Cayuga formations, the Helderberg limestone, and Oriskany sandstone.

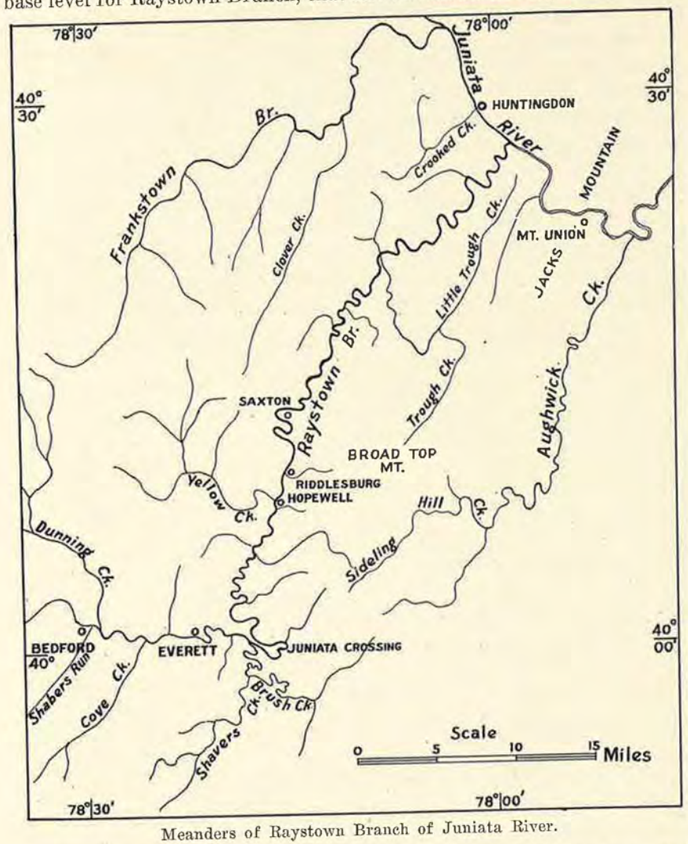
When the tough resistant beds in the middle of the arch were uncovered by the downcutting of the main stream on a raised peneplane, considerable difficulty was encountered. The river had a real job on its hands. The deeper it cut into the arch, the wider was the exposed edge of the resistant beds and the job tougher. That the rocks in Jacks Mountain are resistant and not yet worn down to grade is shown by the fact that Juniata River falls 8 to 10 feet per mile through the gap, whereas, Raystown Branch has a grade of 4 to 6 feet per mile below Bedford.

The rocks in this anticline formed a barrier or dam, a base-level element which restrained downcutting in the Raystown Branch. When a notch in Jacks Mountain had been cut down from 2200 feet to about 1500 feet or 1000 feet less than the present depth of the gap, the lowering of the gap became so slow that Raystown Branch, no longer able to deepen its channel and having attained a temporary base level, began widening its valley and wandering across it from side to side. It was restricted on the east for the most part by the Pocono sandstone, and on the west by the upturned Devonian and Silurian rocks.

The present channel is largely confined to the Catskill formation. Where the outcrop of these comparatively easily eroded rocks is wide the

stream looped widely, and where the outcrop is narrow the meanders are shorter.

When, eventually, the main river deepened the gap and so lowered the base level for Raystown Branch, that stream incised its meanders, and we



Meanders of Raystown Branch of Juniata River.

now find it flowing in a crooked trench several hundred feet deep. The fairly straight course for six miles, above and below Hopewell, may be explained as due to the stream incising in the narrow band of Mauch Chunk shale confined between the less easily eroded Pocono and Pottsville sandstones upturned on either side.

After the stream developed a temporary base-level at about 1500 feet on which it meandered widely across upturned edges of hard and soft rocks alike, base-level was lowered and the meanders incised. Above and below Riddlesburg, however, the channel cut across the upturned Pocono sandstone. This lesser barrier may have been enough to make the stream sluggish and cause it to wander widely, forming the great loops near Juniata Crossing.

A METHOD FOR TEACHING GENERAL ZOOLOGY
(A demonstration of materials)

By Robert T. Hance
Department of Zoology, University of Pittsburgh

A series of printed mimeographed sheets is presented to illustrate the organization of the material offered in the second semester course in General Zoology at the University of Pittsburgh. The essential features of the method for which certain advantages are claimed are: (1) a dated series of titled lectures with text references, type of illustrative material and the dates of major examinations indicated; (2) abstracts of lectures with suggested additional references issued in advance of the lectures; (3) sheets of special biological information not readily available are issued at various intervals.

The student need never be at loss as to the ground covered in the course and has the lecture abstracts to prepare him for taking an intelligent interest in a lecture and to aid him in reviewing the subject.

TEACHING ZOOLOGY THROUGH EXHIBITS

By Robert T. Hance
Department of Zoology, University of Pittsburgh

The necessity in recent years of demonstrating the work of the biologist to audiences of all degrees of training has resulted in a series of experiences for the writer that indicate the training value of such exhibits for those who prepare them. To present the essentials of a subject in graphic form to others less or not at all familiar with the material requires a much more than usual knowledge on the part of the exhibitor. He must learn a great deal in order to discard all but that which tells the story that he is trying to put across.

Exhibits of the results of studies on living things have been found useful in attracting the attention of the general public to the work of a

department in a University, in indicating to the parents in the most satisfactory way possible the sort of influences with which their children are in contact and as a climax to various courses in zoology. The general appeal of these exhibits is shown by the number of requests that have come in from the Boy Scouts and from high schools for suggestions on how they could duplicate certain of the demonstrations that had been seen at the University of Pittsburgh.

Our experience has indicated: (1) much advanced research work cannot be satisfactorily demonstrated, (2) it is better to show from fresh angles the biological phenomena with which the audience has some slight familiarity, (3) use as much living material as possible, (4) do not have too much on display and keep that as simple as possible, (5) use few microscopes unless for projection since they tend to slow up the movement of the visitors, (6) have demonstrators behind each exhibit who are enthused with what they are doing and who can present intelligible explanations of the phenomena under their care, (7) printed or mimeographed descriptive programs of the exhibit lend to its usefulness and dignity.

Such exhibits can be infinitely varied and are adaptable to any level of training.

SOME POSSIBILITIES OF THE SURVEY COURSE IN SCIENCE

By Robert T. Hance

Department of Zoology, University of Pittsburgh

There is a growing interest among educators and perhaps a growing demand among certain classes of students for courses that scan the results of human experience widely. In the opinion of the writer such courses are frequently planned with the wrong objectives, resulting in a loss of conviction and interest on the part of the teachers followed inevitably by an increasing apathy on the part of the students.

In general, survey courses in science suffer from the following causes: (1) The course lacks a sufficiently prominent theme and thereby loses unity. (2) This lack of unity may result from a poor organization of the material or from the introduction of too many lecturers into the course. It would seem better that certain parts of the course be comparatively slighted rather than to seriously break into the theme by a too generous introduction of lecturers neither familiar with the previously covered material nor sympathetic with the goal. (3) The course may be introduced at the wrong place in the curriculum. Survey courses are usually meted out to freshmen who, because of their lack of detailed information

are but poorly prepared to appreciate the generalizations based on the details. It would seem preferable to place the survey of knowledge courses in the senior year when the students have a great deal of odds and ends of information that need integrating. They are ready for such pedagogical technique; the freshmen do not seem to me to be. The survey course, under proper guidance, may be admirable for adult education classes such as are becoming common in the evening schools of colleges and universities and as a service of the college to its alumni.

An outline for a course reviewing man's mastery of the scientific and social aspects of his existence might be developed in the following manner. A. *The Origin and Conditions of Life* (1) The Living Organism (2) The Conditions of Life (3) The Beginnings of Life (4) The World in Which We Live (5) The Universe; B. *The Problems of Social Existence* (6) Social Animals (7) Early Humans (8) Modern Society (9) The History of Marriage (10) Human Government (11) Paying Our Way; C. *The Problems of Understanding* (12) Speaking the Speech (13) Painting and Singing Our Thoughts; D. *The Nature of Our Surroundings* (14) The Chemistry of the Ancients (15) The Chemist Moves Ahead (16) Chemistry in the Service of Man (17) The Meaning of the Rainbow (18) Waves, Rays, and Other Things as the Physicist Sees Them; E. *Keeping Alive* (19) The Whirlpool of Life (20) Eating to Live or to Die (21) In Touch with Our Surroundings (22) Growth (23) Perpetuating the Race (24) The Accidents of Life (25) What Is Inherited (26) The Similarity of Living Things; F. *What Is It All About?* (27) The Religions of Man (28) The Mechanism of Life (29) Learning to Live (30) Applying What We Know.

In this series of thirty topics the following fields of knowledge have been touched upon: anthropology, art, astronomy, biology, chemistry, economics, general science, geology, language, physics, philosophy, political science, psychology, sociology, and theology. Perhaps too much has been covered, but the list is offered as suggestive rather than as being wholly satisfactory even in the mind of the writer.

Survey courses should not be regarded as newly developed and therefore royal roads to learning; they cannot take the place of hard and basic study; they call for a type of teaching that every instructor cannot give. The success of such a lecture series would depend on a central and unifying theme that would always be apparent and preferably presented by one man, the ability of this man to set problems rather than to solve them, and upon the imagination used in illustrating the issues of each session. In short the culmination of the series should leave the class feeling that they saw life and its activities whole rather than as a jig-saw puzzle with various pieces missing.

A SURVEY OF THE FISHES IN THE REGION OF LEWISBURG, PENNSYLVANIA

By Norman H. Stewart
Bucknell University, Lewisburg

This survey, carried on for several years in connection with the courses in zoology at Bucknell University, has been extended to cover some 20 streams which are tributary to the west branch of Susquehanna River. These streams drain an area approximately 50 miles square and lie in the counties of Union, Snyder, Centre, Lycoming, Sullivan, Montour, and Northumberland. As this region is mountainous for the most part, the streams are rapid throughout most of their length, and slow, weedy, warm stretches are rather infrequent. This is obvious when one notes the absence of species preferring the warmer waters. The altitude ranges from that of the river which is 420 feet above sea-level at Lewisburg, up to about 2000 feet at Eaglesmere. There are few falls, however, to prevent migration, and species spreading by way of canals from distant regions could find their way far up into the streams of this locality.

The objects of this survey have been to verify and augment the records for this part of the State as they have appeared in previous studies so that they might be available to ichthyologists now working in this and neighboring States. To Dr. Carl Hubbs of the University of Michigan special thanks are due for valuable assistance in matters of taxonomy, and also to Dr. John Greeley, Ichthyologist of New York State, and to Dr. Henry W. Fowler of The Academy of Natural Sciences of Philadelphia. The following list must be considered not as a final report but as one of progress, and it is submitted at this time so as to be available to persons making fish studies in neighboring regions. Such studies include the investigations by Mr. Edward Raney of the fishes of western Pennsylvania and those by the Conservation Department of the State of New York which in the coming summer will be concerned with the fishes in streams that are tributary to the Susquehanna and Delaware rivers. The author wishes to express here his thanks to the Board of Fish Commissioners of Pennsylvania for permission to use certain equipment in the course of this survey.

Annotated List of the Fishes of the Lewisburg Region

PETROMYZONIDAE. Lampreys.

1. *Petromyzon marinus* Linnaeus. Lamprey Eel.
   No recent records. Formerly bred in the river, and certain streams.

2. *Entosphenus aepypterus* (Abbott). Brook Lamprey.
   Fowler reported the brook lamprey from Cameron County in 1919, and from the Delaware and Ohio basins. As yet none have been taken in the present survey.

CLUPEIDAE. Herrings.

3. *Pomolobus pseudo-harengus* (Wilson). Alewife, Sawbelly.
   Formerly known as far north as Scranton. No local records.

SALMONIDAE. Trouts.

4. *Salvelinus fontinalis fontinalis* (Mitchill). Brook Trout.
   Fairly common in the cold mountain streams.
5. *Salmo irideus* Gibbons. Rainbow Trout.
   Rare. Specimen from Spruce Run.
6. *Salmo fario* Linnaeus. Brown Trout.
   Common in our mountain streams. Taken in six streams.

CATOSTOMIDAE. Suckers.

7. *Catostomus commersonii* (Lacépède). Common Sucker.
   Very common throughout the region. Called "Black Sucker" by fishermen as distinguished from the whiter Moxostoma.
8. *Hypentelium nigricans* (Le Sueur). Hog Sucker, Mullet.
   Very common.
9. *Carpiodes cyprinus* (Le Sueur). Quillback, Carp Sucker.
   Fairly common in the river. We have several specimens.
10. *Erimyzon oblongus oblongus* (Mitchill). Chub Sucker.
    Seemingly common. We find it in the river and Buffalo Creek.
11. *Moxostoma macrolepidotum* (Le Sueur). Eastern Redhorse.
    Locally called "May sucker." Less common than formerly here, but an occasional fine specimen taken at Lewisburg. The only representative of the genus in the Susquehanna according to Dr. Hubbs.

CYPRINIDAE. Minnows.

12. *Cyprinus carpio* Linnaeus. Carp, German Carp.
    Very common in the river at Lewisburg and vicinity. Frequents the mouth of Buffalo Creek, Chillisquaque Creek, etc.
13. *Carassius auratus* (Linnaeus). Goldfish.
    No records known for this region, though found in the Potomac and in Lake Erie.
14. *Nocomis micropogon* (Cope). Hornyhead, Crested Chub, River Chub.
    We have it from the river and the lower larger parts of six streams. Common.
15. *Rhinichthys atronasus* (Mitchill). Black-nosed Dace.
    Very common in practically all locations.
16. *Rhinichthys cataractae* (Cuvier and Valenciennes). Long-nosed Dace.
    In the shallow rapids of certain streams. Only fairly common.
17. *Margariscus margariscus margarita* (Cope). Pearl Dace.
    Abundant in two cold streams, Elk Creek and Spring Creek. Recently also taken in Pine Creek, Centre County. Local.

18. *Clinostomus elongatus* (Kirtland). Red-sided Dace.
Specimens in our collection are from Mill Creek, Tioga County, but as yet none taken in Lewisburg region.

19. *Notropis heterodon* (Cope).
As this species occurs in the upper Hudson River it may be also in the Susquehanna. No records to date.

20. *Notropis heterolepis atrocaudalis* (Eigenmann and Eigenmann). Black-nosed Minnow.
The only specimens we have were received from Dr. A. H. Wright who collected them near Syracuse, N. Y. Probably our lack of warm, weedy, sluggish streams accounts for our failure to collect any to date.

21. *Notropis volucellus volucellus* (Cope). Ghost Shiner.
Common throughout New York State and in western Pennsylvania. If this species is found in this region we have failed to recognize it to date, or the closely related *Notropis delicious stramineus* (Cope).

22. *Notropis hudsonius* (Clinton). Spot-tailed Minnow.
Notropis hudsonius amarus (Girard).
This species, only fairly common in this region, has given us some difficulty in identification. The specimens seem closest, however, to the subspecies amarus.

23. *Notropis whipplii spilopterus* (Cope). Silverfin, Satin-finned Minnow.
From six streams, including the river. Usually abundant wherever found. Common.

24. *Notropis analostanus* (Girard). Silverfin, Eastern Silverfin.
These last two species are very much alike. Analostanus is smaller, deeper-bodied and has usually fewer than 37 scales in the lateral line, whereas whipplii has more than 37. This species seems to be much less common than the previous one, though we have taken some specimens.

25. *Notropis antherinoides* Rafinesque. Lake Shiner.
Dr. Greeley says: "We consider this the most plentiful fish of Lake Erie." It is uncommon or rare in the rest of New York, and while it occurs in western Pennsylvania we have no reports for it locally.

26. *Notropis rubellus* (Agassiz). Rosy-faced Shiner.
We have it from the Loyalsock, Penn's Creek and the river. Fairly common.

27. *Notropis cornutus cornutus* (Agassiz). Red Fin. Common Shiner.
This subspecies is probably the one we have here as one of our most common fishes. The distinctions between it and the other two subspecies, *Notropis cornutus frontalis* (Agassiz) and *Notropis cornutus chrysocephalus* Rafinesque, are difficult to determine. Dr. Greeley is cooperating to fix the identity of our local subspecies. The red fin occurs in all but our coldest streams, being most abundant in the pools.

28. *Notropis procne* (Cope). Swallow Minnow.
Uncommon. A few only have been identified to date.

29. *Notropis bifrenatus* (Cope). Cayuga Minnow.
Though Dr. Fowler identified one of my specimens as of this species, we have failed of late to take more of them. Dr. Hubbs writes that we should find it in the weedy backwaters along the river.

30. *Notropis photogenis amoenus* (Abbott). Attractive Minnow.
Seemingly rare. Dr. Fowler has identified specimens I have sent to him as belonging to this species and notes that there are records of its occurrence in eight counties within the Susquehanna drainage.

31. *Hyborhynchus notatus* (Rafinesque). Blunt-nosed Minnow.
Common. Occurs in most of our streams.

32. *Campostoma anomalum* (Rafinesque). Stone-roller Minnow.
Uncommon. Only a few taken from warm streams.

33. *Leucosomus corporalis* (Mitchill). Fallfish, White Chub.
Common except in the colder streams. Common in the river.

34. *Semotilus atromaculatus* (Mitchill). Chub. Horned Dace.
Very common especially in the lowlands and the river.

35. *Exoglossum maxillingua* (Le Sueur). Cut Lips.
Very common except in the cold trout streams.

36. *Notemigonus chrysoleucas chrysoleucas* (Mitchill). Golden Shiner.
Common locally in warm pools and backwaters.

AMEIURIDAE. Catfishes.

37. *Ameiurus nebulosus* (Le Sueur). Common Bullhead.
Few streams in the region adapted to the bullhead. Occurs in the river and at the mouths of streams. Fairly common.

38. *Schilbeodes insignis* (Richardson). Madtom. Stone Cat.
We have it from six streams. Fairly common locally.

ESOCIDAE. Pickerels.

39. *Esox niger* Le Sueur. Chain Pickerel, Eastern Pickerel.
Common. In the weed beds of our larger streams.

40. *Esox americanus* Gmelin. Little Pickerel, Grass Pickerel.
We have one specimen in our museum that is undoubtedly this species, but data concerning it have been lost. Probably it was taken in this region. Contrary to the opinion of many fishermen the true pike *Esox lucius* does not occur here. It is in the Ohio and Erie drainage, however.

ANGUILLIDAE. Eels.

41. *Anguilla bostoniensis* (Le Sueur). Common Eel.
Common. Not often taken in the seine.

CYPRINODONTIDAE. Killifishes.

42. *Fundulus diaphanus diaphanus* (Le Sueur). Barred Killifish.
In general rare. Common in certain coves in the river. Exact identity a matter of present study.

PERCIDAE. Perches.

43. *Perca flavescens* (Mitchill). Yellow Perch.
Fairly common in the river, uncommon in our creeks.

44. *Stizostedion vitreum* (Mitchill). Wall-eyed Pike, Pike Perch.
Also called locally "Susquehanna Salmon." Found only in the river. Rather uncommon. Many seen when killed by pollution.

45. *Hadropterus peltatus* (Cope). Shielded Darter.
Rare. A beautiful species. Found in three of our streams.

46. *Boleosoma nigrum olmstedi* (Rafinesque). Johnnie Darter.
Very abundant. In practically all our streams. The lack of number of species of darters as compared with the number found in the Ohio drainage is quite noteworthy. Fowler (1919) listed fourteen for the State.

CENTRARCHIDAE. Sunfishes.

47. *Micropterus dolomieu* Lacépède. Small-mouth Bass.
Common. Taken in seven streams and the river.
48. *Aplites salmoides* (Lacépède). Large-mouthed Bass.
Rare. Specimens in our collection are from the quiet stretches of the river, and Buffalo Creek.
49. *Helioperca incisor* (Cuv. and Val.). Bluegill.
Introduced. Not common over the region. Local.
50. *Eupomotis gibbosus* (Linnaeus). Pumpkinseed. Common Sunfish.
We have it from six streams and the river. Common.
51. *Lepomis auritus* (Linnaeus). Eastern Long-eared Sunfish.
Uncommon. Taken in three streams.
52. *Ambloplites rupestris* (Rafinesque). Rock Bass.
Common, both in the river and the quieter streams.

COTTIDAE. Sculpins.

53. *Cottus cognatus* Richardson. Miller's Thumb. Sculpin.
In general uncommon, but quite common in certain of our streams.

AN ABNORMAL *AMANITA MUSCARIA*

By Alfred G. Lisi and K. D. Doak

(Abstract)

On two successive years abnormal, reticulately gilled specimens of *A. muscaria* have been found in a portion of the Morris Arboretum of the University of Pennsylvania. The gills are intimately anastomosed so that they present a reticulated appearance rather than the normal free, spoke-like arrangement. Cultures made of the abnormal form exhibited more rapid surface growth but less aerial hyphae than cultures from normal *A. muscaria*. A study of external characters plus a comparison of the spores indicates that this form is closely related to *A. muscaria*.

THE RELATION OF RECENT ORE DRESSING DEVELOPMENTS TO PENNSYLVANIA'S NON-METALLIC MINERALS

By Stanley Michaelson*

Recent developments in the technique of mineral preparation and concentration will undoubtedly have an effect on Pennsylvania's mineral industry—especially on those non-metallic minerals which contribute a considerable portion of the State's wealth. The minerals to which these developments have already made themselves important are cement rock and bituminous coal, but other non-metallics which may be beneficiated by these new methods are graphite, anthracite, feldspar, sillimanite, chromite, and limestone for flux and chemical use. Variations of these known methods may be developed which will be used to treat other minerals such as glass sands, silica brick sands, etc. The second group mentioned above presents no difficulties in concentrating, but the commercial adoption of ore dressing methods to these products is not at the present time considered economically justified. The possible exception to this is limestone for chemical use; research is now going on to develop further the concentrating process for this.

Before considering each of the minerals mentioned, it might be well to describe briefly what these new developments are. The two fundamental modifications of modern ore dressing practice that affect these minerals are flotation, and a new development in the use of the ordinary Wilfley table that is so well known in metalliferous milling practice. This latter is called agglomeration and tabling.

Flotation, in ore dressing nomenclature, describes a process in which certain reagents are added to the ore to be concentrated, and the mixture agitated to introduce a quantity of small air bubbles. The valuable mineral adheres to the bubbles because of the action of the added reagents, and is skimmed off with the froth which forms.

Flotation as applied to the non-metallic mineral group represents a different technique than that used in metallic or sulphide flotation. Oleic acid, the reagent almost universally used in non-metallic work, tends to float nearly all minerals, so that unless suitable depressing reagents are used to inhibit the flotation of the unwanted material, the concentrate will be too highly contaminated for utilization. In simple sulphide flotation, usually a xanthate is selected which will have little

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or no effect on the gangue minerals, but will bring up, in the froth, the valuable constituent.

The use of flotation in the concentration of non-metallic minerals is a comparatively new development. It had long been known that soap (which contains soluble oleate, or a similar fatty organic salt) would float many of the oxide, carbonate, and silicate minerals, but the science of preventing the unwanted gangue minerals from floating with the concentrate had not advanced to a point where concentrates of sufficient purity could be obtained to make the operation economically worth while. It is only within the past few years that we have been able to approach a non-metallic flotation problem with any degree of confidence.

The use of flotation reagents on gravity tables of the Wilfley type is a still more recent development of the Missouri Station of the U. S. Bureau of Mines at Rolla, Mo. The original work[1] was done on the concentration of a sylvanite ore, but further work seems to indicate that this method can be applied to most non-metallics which are affected by flotation reagents, and especially on those ores in which the valuable constituent has a lower specific gravity than the gangue minerals. Suitable reagents are added to the table feed to cause the desired mineral particles to agglomerate. Actually, the process is very similar to flotation: the agglomerated mineral particles are entrapped with minute bubbles of air and are washed over the side of the table. If a classified feed is used, the separation that may be made is thorough. In the sylvanite treated by Coghill and others,[2] the difference in specific gravity between the KCl and the NaCl grains was only 0.16, yet when tabled with suitable reagents, concentrates of high grade were obtained and with excellent recovery. This principle finds application where the valuable mineral constituent is unlocked from the gangue in the ore at a mesh size too coarse for successful flotation, or for high recovery by that method.

It has long been known that carbon—either as graphite or coal—is readily floated with no reagent except that needed to produce a froth, but it has remained for a suitable demand for pulverized coal to make such a separation from the impurities economically profitable. With the increase in the number of pulverized coal installations the method has been developed to produce a high-carbon coal concentrate that is low in ash and sulphur. Three plants have recently been built in the Pittsburgh district and are now operating to float bituminous coal. The plant costs are unusually low, and the product finds a ready market. Anthracite from mines and culm banks can readily be separated from bone and sulphur by a similar method, but as yet there is no sizeable demand for the pulverized material.

The Portland Cement manufacturers in the Lehigh Valley have been faced with the necessity of importing high-lime rock to blend with their lower lime quarry rock for feed to the cement kilns. In March, 1934, the Valley Forge Cement Company placed in operation a flotation plant to produce a high-lime concentrate from their lower grade quarry rock. While the primary function of the process was to increase the lime content of the kiln feed, the flotation plant also cut down overall plant costs. This was done by (a) eliminating two shovels used to blend high and low lime rock as it was quarried; (b) reducing fuel consumption by removing uncombinable silica before burning in the kilns; (c) decreasing grinding costs of the clinker, since the hard silica was removed from the kiln feed; (d) and enabling the plant control system to be simplified. In other plants it would eliminate the purchases of high-lime rock, and, in many cases, increase the reserve of usable rock.[3]

The process of floating cement rock will enable plants to use rock hitherto considered unsuitable for the manufacture of cement, and still enable them to make a higher grade product than the average plant is now producing. Also the same plant would be able to make several different types of cement from the same rock, by first processing the raw rock, and later by adding the required materials in the necessary amount.

A similar method, but with minor variations, may be used to produce limestone of high grade for flux and for the chemical industry. Costs of treatment by this method should be phenomenally low.

Tabling and agglomeration have also been applied to the separation of limestone from flint.[4] Here the feed is coarser than that used in flotation separation but the results obtained are equally beneficial.

Other minerals which have been successfully treated on a laboratory scale, by one of the above methods, include graphite, chromite, feldspar, and sillimanite.

There are several extensive deposits of flake graphite in the coarse-grained marbles of southeastern Pennsylvania. This material could

[1] Concentration of Sylvanite Ores of New Mexico by Ore Dressing Methods: U. S. Bureau of Mines, R. I. 3271, February, 1935.

[2] *Op. cit.*

[3] Miller and Breerwood, Flotation processing of limestone: Amer. Inst. of Mining and Met. Engrs., Tech. Pub. No. 606, February, 1935.

[4] Beneficiating Cement Raw Materials by Agglomeration and Tabling: U. S. Bureau of Mines, R. I. 3247, March, 1935.

readily be treated by flotation to yield flake graphite of $\frac{1}{8}$ inch size, and a crushed marble sand of about the same diameter. No attempt has yet been made to concentrate this graphitic rock on a commercial scale, although no great difficulty is anticipated should the process be adopted.

In the same section of the state, there are many deposits of graphitic gneiss containing $\frac{1}{16}$ inch flake graphite. The graphite is easily floated from the other minerals in the ore when it is ground fine enough to effect liberation of the flake.

The difficulty in the domestic graphite is not a technical one, but rather one of economics. With the present prices for flake graphite in this country, local concerns cannot compete with the Madagascar producers.

Many small deposits of chromite occur in Chester, Lancaster, and Delaware counties, and should a deposit be found large enough to be exploited, little difficulty will be met in the concentration of this mineral by flotation. Chromite has been floated on a laboratory scale as coarse as 35 mesh.

A similar situation holds for feldspar. While the different varieties of feldspar have differences in floatability, in general the spars float readily from their usual gangue minerals. They yield finely ground concentrates of high grade, suitable for use in the pottery trade.

No large deposits of sillimanite are known to the writer; samples taken from small deposits can be floated to give concentrates of good grade.

Should the necessity of concentrating or eliminating impurities from glass and silica brick sands ever make itself felt, such an operation could easily be performed by the use of flotation, or by agglomeration plus tabling. In the case of these sands, our present knowledge would lead us to float off the impurities and leave the clean sand as a tailing since silica is one of the least floatable minerals. The process would then be the reverse of the normal one.

Other minerals than those mentioned are amenable to treatment by the methods described, but the market prices for many of them preclude such a processing at the present time. Competition of other more cheaply producing mines or quarries often prohibits treatment of the local deposits, but it is reasonable to expect that when prices advance, or the other deposits become exhausted, the methods mentioned above, or modifications of them, will be utilized in the various non-metallic industries of this State.

DAILY, SEMI-LUNAR, SEMI-ANNUAL, RHYTHMIC VARIATIONS IN ERYTHROCYTE COUNTS

By M. W. Eddy and W. P. Bitner

Dickinson College, Department of Biology, Carlisle

Abstract

In this study it was sought to determine whether any chronological rhythmic cycle of the number of erythrocytes per cubic millimeter was present in the human male. Graphic representation of the number of erythrocytes per cubic millimeter of blood indicates a possible complete cycle of 28 to 30 days, consisting of 14 to 16 days above average alternating with 14 to 16 days below average. The average was considered as the total for six months divided by the total number of blood counts. Graphs also show hourly and semi-annual variations which tend to indicate the possibilities of a daily and semi-annual cycle.

Introduction

The purpose of this paper is to present the data collected which will contribute to the justification of the hypothesis that there is a chronological cycle in the number of erythrocytes per cubic millimeter, and to illustrate graphically and explain the results.

The chief purpose, however, is to investigate the possibilities of rhythmic cycles in the number of erythrocytes per cubic millimeter in the human male. These rhythms, if present, can be found by daily counts at the same time of day, and, if a daily cycle occurs, by hourly examination.

Historical Review

The number of erythrocytes is understood to be the number of red blood corpuscles per cubic millimeter of blood. It is therefore obvious that the relative number of corpuscles depends upon the degree of concentration and the amount of water contained in the blood, and an individual sample can rarely yield a safe conclusion as to the absolute number to be found in the total mass of the blood (4).* This explains then the phenomenon of an increase in the number of red cells per cubic millimeter after profuse sweating and severe diarrheas. During this time there is a marked loss of water from the blood; thus the number of red cells increases per cubic millimeter though the total number in the body may not be changed (3).

* Numbers in parentheses refer to citations at the end of this paper.

Experiments seem generally to agree that nutrition plays an important rôle in influencing the production of erythrocytes. However, "an absolute fast of thirty days produced no marked variation in the number of erythrocytes," according to Luciani (4) (p. 105). Numerous factors, doubtless, influence the erythrocyte content. If, through hemorrhage, there is an excessive loss of erythrocytes, immature red cells may appear in the circulation, thus showing the regenerative power of the bone marrow (7 & 9).

A change in the pH of the blood plasma theoretically would affect the number of erythrocytes per cubic millimeter because an increase in the alkalinity increases the size of the corpuscle. Corpuscles of venous blood should, therefore, be larger than those of arterial, and any condition producing acidosis should increase their size (2). This difference in size is not of such magnitude that the effect can be detected, since the number of corpuscles is practically the same whether the blood be taken from the arteries, capillaries, or veins (6). However, the number is lower in blood from the lower extremity than from the upper, "probably owing to the greater proportion of plasma in the more dependent parts of the body" (6).

The parent cells of the erythrocytes are in the bone marrow. The process of formation is going on continuously throughout life, and 1/15 to 1/30 of the total number of corpuscles is destroyed every day (9). The life of a red cell after leaving the bone marrow is believed to be 30 days (7). If 1/30 of the cells is destroyed each day, then a balance between the rate of formation and the rate of destruction must be present if there is a state of equilibrium.

The change in the number of erythrocytes from the arbitrary standard may be produced by a number of physiological variants. In all such changes it is probable that it is more a question of redistribution of erythrocytes than an actual increase or decrease in the number of cells in the body.

Hourly counts probably would not indicate a change of the total erythrocyte counts of the blood content, but daily counts taken at the same hour should indicate gradual variations in the total number of erythrocytes in the blood.

Material and Procedure

For a period of six months (September 25, 1934, to February 21, 1935) an erythrocyte count was made every day and the result plotted on a graph. The subject was an unmarried male, age 24.

On every occasion the same pipette and the same Max Levy haemacytometer counting chamber slide was used. Both are products of the Spencer Lens Company, Buffalo, N. Y. The slide contains two counting chambers.

The procedure was as follows: Every day between 12:20 p. m. and 12:40 p. m. a sterilized lancet punctured the middle, ring, or little finger previously washed with 95% alcohol and dried with cotton. The puncture was made of such depth that very little or no pressure was required for the exudation of the blood. The first drop was always rejected and the second used. The pipette was placed at the usual 45° angle with the finger, and the blood drawn to the 0.5 mark. With the aid of a hand lens (magnification 5×) the level of the blood in the pipette was adjusted to the 0.5 graduation with more surety and probably greater accuracy. The hand lens was used also in the detection of air bubbles which occasionally appear in the column of blood. The blood was then diluted to the 1.01 graduation with physiological salt solution, and the hand lens was used to adjust the liquid to the proper level. The pipette was shaken for two minutes in the longitudinal axis and by rotation, thus insuring a uniform suspension without clots.

The first six drops of the diluted blood were rejected and the seventh drop, with the pipette still in a perpendicular position, was placed upon the haemacytometer slide. The eighth drop was rejected, and the ninth was placed on the other counting chamber of the slide. A clean, grease-free cover glass of standard size was placed gently on the slide so that the diluted blood could be spread under the cover glass, resulting in a uniform distribution of cells.

If the cells were not evenly distributed in the lower counting chamber, the upper counting chamber was used. If, however, the distribution in both was too unequal, a new specimen of blood was drawn and the whole procedure was repeated.

After placing the cover glass the haemacytometer slide was allowed to stand for two minutes. During these two minutes the pipette was cleaned and dried in the usual manner.

The cells were counted in 48 of the squares instead of the customary 36. The more squares counted, the greater the accuracy (5). The average per square carried to the second decimal place and multiplied to correct for dilution gave the total number per cubic millimeter of blood. This number was plotted on the graph.

Throughout the investigation the subject made an effort to live a routine life. The time of arising, retiring, and eating was regulated. He ate the same things for breakfast every day, and his lunches varied

little. The dinners varied considerably. The count was taken before lunch every day, so that the nature of the dinner of the previous evening would least influence the count. Cathartics were avoided, and mineral oil was used when a laxative was needed. No medicine of any sort was taken, and no illness, not even a cold, occurred during the entire six months.

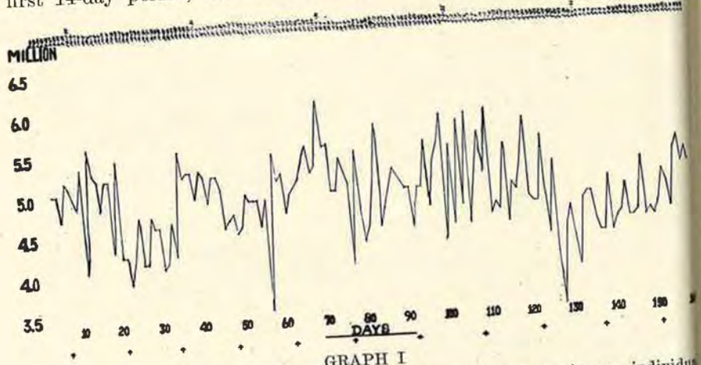
At no time were the leukocytes counted when they appeared with the erythrocytes. When an air bubble was present under the cover glass, indicating it had not been grease-free, the manipulations were repeated after cleansing in the prescribed way. All counting, of course, was done under 4 mm. objective with a 10× ocular.

On three alternate days of the same week a count was made every hour from the time of arising—7:30 a. m. to the time of retiring—10:30 p. m. The average for each hour was plotted. Meals on those days were eaten immediately following the counts at 7:30 a. m., 12:30 p. m., and 5:30 p. m.

Results

The average or norm for this individual was found to be 4,947,000. This figure was obtained by adding the counts for the entire period of six months which totaled 771,790,000 and dividing by 156, the number of daily counts.

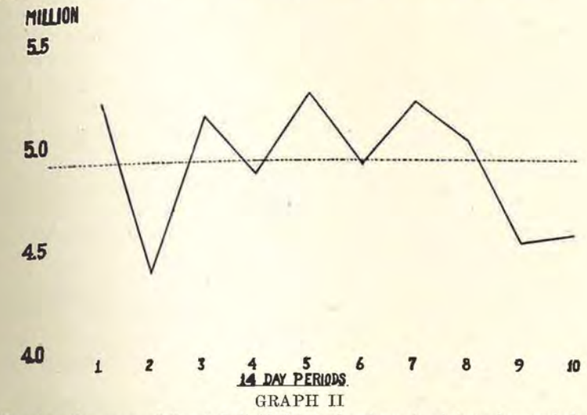
Graph I shows the variation from day to day. The average for the first 14-day period, indicated by arrow along the base line, is above



GRAPH I

Showing daily variations in number of erythrocytes per c. m. in one individual over period from September 25, 1934, to February 21, 1935.
Arrow heads indicate fourteen- to sixteen-day periods.

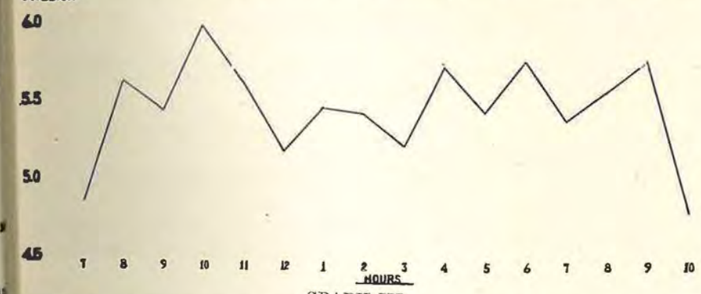
the five million line, and the average of the second 14-day period unmistakably is much lower than five million. This alternation of 14 days above the average with 14 days below the average does not continue throughout the entire six months period, as Graph II shows.



GRAPH II

Showing the curve of Graph I divided into fourteen- to sixteen-day periods.
Broken line indicates the normal for this indivdual.

Graph II is plotted on the basis of 14- to 16-day periods. Here, the second period falls far below the average and the third is above the average. The next period which reaches a low mark corresponding to the low of the second period is the ninth period. This graph gives



GRAPH III

Showing the curve of the average hourly count from 7:30 a. m. to 10:30 p. m. for three alternate days of the same week.

an indication of a rhythm which would be a semiannual or "tri-annual" cycle, which is probably a seasonal one.

Graph III shows the curve of variation in hourly counts during the day. Each point on the curve represents the average for the three days at that hour. Graphs II and III show some similarity. There is a high and a low period in each day just as there is a high and a low period each 14 days, and a low occurring every seventh to ninth 14-day period corresponding to the low hourly counts that were found upon arising and at the end of the day. This would indicate a rhythm superimposed upon a rhythm.

Conclusions

From this investigation of the number of erythrocytes per cubic millimeter of blood in one individual it is concluded that the variations indicate a daily, biweekly, and yearly rhythm.

A continuation of this problem in other individuals and covering a longer time may reveal variations in these rhythms.

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THE GYPSY MOTH SITUATION IN PENNSYLVANIA

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An infestation of the gypsy moth (*Porthetria dispar*) was discovered at Inkerman, a small mining village near Pittston, Pennsylvania, in 193 by F. Spadi, who at that time was a student at Pennsylvania State Colleg This infestation came to the attention of State and Federal entomologist on July 26, 1932.

Surveys were immediately begun to try to determine the extent of th infestation. By January 1, 1933, 110 square miles were known to contai

scattered infestations with a central area of 15 square miles generally infested. On July 1, 1933, the area was enlarged to 230 square miles and on July 1, 1934 to 470 square miles. These determinations were made possible as the result of additional scouting work. The area of general infestation centers about Inkerman and when found in 1932, defoliation of trees was common about this center. General defoliation has not occurred in other districts.

The land in this part of the State is owned for the most part by large coal companies. It is mountainous and the surface is covered by weed growth of trees and other plants, furnishing favorable conditions for the well-being of the gypsy moth.

Since finding this infestation an extensive eradication program has been carried on by State and Federal departments. To this time 83,511 acres of woodland and 2,594 miles of roadside have been intensively scouted. Worthless trees and brush have been cleared from 4,417 acres, chiefly in the area of heavy infestation. About 130 tons of arsenate of lead and 5,000 gallons of fish oil were used in spraying 8,763 town properties and 6,501 acres of woodland. A total of 2,328,826 egg masses was killed by painting with creosote and 27,109 larvae were crushed under burlap bands.

Results of extensive scouting lead us to believe that we have reached the outside of the infestation in Pennsylvania, and that many of the infestations are small and scattered.

As an adjunct to scouting, so-called assembling cages are used. These are not cages but small cans containing a benzol extract of the female genital organs. The male moths are attracted considerable distances to these cages and are caught in tree tanglefoot. These cages have been put out and attended over a large district outside of the known area of infestation. The taking of a male moth may or may not mean an infestation, but it calls for intensive scouting over the radius of half a mile. The cage catch in 1934 seemed to substantiate our belief that our scouting has delineated the outside of the infestation.

A State quarantine is in force governing the movement of plants and materials within and to points outside the known area of infestation. This quarantine restricts the movement of such materials as nursery stock, forest products and stone, and is in force during the entire year. This is to prevent artificial spread of the insect.

VARIOUS PLANTS IN THE PHYTOPHARMACOLOGICAL TEST

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Macht and Livingston (1922) showed that cocaine and its decomposition products by hydrolysis (ergonine, methyl alcohol and benzoic acid) are extremely toxic to animal tissues but are less toxic to plant tissues. Following up this work, Macht and his coworkers (1931) developed what they termed the phytopharmacological test. Using this test they attempted to determine the relative toxicities of blood sera from patients with various diseases—such as *pernicious anemia, Pemphigus vulgaris,* and many others. The test as developed by these workers is claimed to be of value in diagnosing diseases where the early symptoms are lacking or sometimes conflicting.

The technique as advocated by Macht and Pels (1931) may be summarized as follows:

1. Seeds of *Lupinus albus* Hartwegii are soaked over night in tap water.
2. The soaked seeds are sprouted in ground sphagnum, placed with the hilum downward. The sphagnum is to be thoroughly washed, to remove acids, dried and then water added to approximately 80 per cent. of the weight of the moss.
3. After about 48 hours in the sphagnum, hardy seedlings with roots of approximately equal length are selected and the root length measured in millimeters.
4. The roots are then immersed in a one per cent. solution of the serum to be tested and kept in a dark room at 22° C. for 24 hours.
5. After 24 hours the roots are again measured and the average growth is then determined.

Thus, seedlings immersed in a normal plant nutrient solution (Shive) and also those grown in a plant nutrient solution to which has been added enough blood serum from a "normal" individual to make a one per cent. serum solution, are used as control. A diagnostic test is made when the serum added to make the one per cent solution is from some clinical patient. In the latter case, if the average amount of growth in 24 hours is less than 60 per cent of the amount recorded for the controls, the test is considered positive and the patient is said to have a high phytotoxic index.

An endeavor has been made in this laboratory to evaluate the phytopharmacological test. The first attempt was to simplify the test. Enough serum to make a 10 per cent. blood serum nutrient solution was used in moistening filter paper in Petri dishes and the measured rootlets of *Raphanus sativum* (Radish) were placed therein. After 24 hours, it was found that the plants did not respond to the serum "toxins." The Petri dish apparently made an excellent moist chamber but the salts and proteins of the serum did not affect the plant growth. In all subsequent work rootlets were immersed in the solution.

One of the many experiments tried, some of which will be reported elsewhere, was to test numerous plants from widely separated groups, with the hope of finding other plants that might be more sensitive than the plant used by Macht, that is, *Lupinus.* Likewise, it was thought desirable to run parallel tests with two or more plants on the same blood serum as a critical check on *Lupinus.*

As already suggested, the first plant tried was *Raphanus.* This was found to be unsatisfactory for experimental handling. The seedlings were very small and were supersensitive to all sorts of environmental conditions. Many of them died from handling.

Another plant tried was *Fagopyrum esculentum* (buckwheat). This plant is rugged and sprouted well. It is not easily affected by handling and the rootlets grow very rapidly. However, when immersed, the root sends out numerous side or secondary rootlets which make accurate measurement very difficult.

Allium ascalonicum (onion) seedlings were found to be too small, to grow very slowly and to be very variable in their responses to serum solutions.

It was thought possible that a rootlet normally accustomed to a hydrophytic environment might be best adapted to exposure to solutions. *Salix* (swamp willow) cuttings were immersed in tap water. After about 14 days, rootlets were long enough to measure and use. During the 24 hour test period 118 rootlets grew a mean amount of .786 mm., an amount too small for experimental purposes.

However, the responses of the seedlings of *Zea* ("White Rice" popcorn) simulated those of *Lupinus* very closely. A larger percentage of the soaked seeds sprouted and these were also less affected by experimental treatment. The 198 seedlings grown in Shive solution for 24 hours attained a mean growth of 9.78 ± .3910 S.E. The standard deviation was 5.502. The mean growth for 464 Lupines exposed to similar experimental treatment was 11.26 mm. ± .1373 S.E. The standard deviation was 2.321. Consequently, these seedlings were added advantageously as test plants in many of our later experiments.

Macht and his coworkers sprouted seedlings in washed, ground sphagnum and have also reported using sawdust. Numerous tests showed

that roots of seedlings sprouted in sphagnum and then grown in Shive solution for 24 hours do not grow as long on the average, as those of seedlings sprouted on moist filter paper in large, sterilized Petri dishes and then grown in Shive solution. The 330 sphagnum sprouted *Lupinus* roots when grown for 24 hours in Shive solution, had a mean growth of 7.73 mm. ± .0872 S.E. as compared to a mean growth of 11.26 mm. ± .1373 S.E. for 464 Petri dish sprouted plants grown in Shive solution for 24 hours. Sprouting in sphagnum conditions a lower rate of subsequent growth than sprouting in Petri dishes.

It may be concluded from the data presented in this brief report that "White Rice" popcorn seedlings respond similarly to those of *Lupinus* in their reactions in blood serum nutrient solutions and may be used successfully in the phytopharmacological test. It may also be noted that seedlings sprouted in ground sphagnum did not grow as rapidly during the observation periods as did those sprouted in Petri dishes.

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THE COMMON ALGAE OF BERKS COUNTY, PENNSYLVANIA

By Warren S. Buck
Fleetwood, Pa.

Doubtless a need exists for a survey of the fresh-water algae of our State. Wolle's descriptions are often indefinite; since his time many algae have been moved to other genera, and many new genera have been established. Van Drersal has done some splendid work in the Myxophyceae of the western part of the State and various other surveys are gradually bringing to light our many species.

It is hoped that this preliminary report will contribute its share from the eastern and central part of the State.

This work is being done under the direction of the Department of Botany, Pennsylvania State College. The photographs were made in the biological laboratories of Albright College, Reading, Pa.

No attempt has been made to name each species accurately, but rather to classify the various genera. Due to the fact that fruiting specimens were not obtainable in all cases specific determination would have been barely more than a guess.

Myxophyceae

Gloeocapsa Kutzing, 1843

Found on rocks in Lake Ontelaunee. The cells are spherical, each covered with a gelatinous envelope, and the entire coenobe, consisting of several cells, is also enveloped.

Oscillatoria Vaucher, 1803

Grows in almost every pool, stream or moist situation. The cells are of greater width than length, and the free ends of the trichomes are rounded.

Merismopedia Meyden, 1839

Found in a dam at Hopewell Furnace and Kutztown swimming pool. The colonies consist of flat gelatinous masses, and the cells are arranged in groups of four.

Anabaenopsis Wolosbynska, 1912

Found near Pine Forge. The trichomes are slightly contorted, and the heterocysts are found at the ends of the trichomes.

Heterokonte

Tribonema Derbes and Solier, 1856

Common in temporary pools. The cells are barrel-shaped, and constructed of H pieces. They contain no pyrenoids, and are yellow-green in color.

Rhodophyceae

Batrachospermum Roth, 1797

Found on rocks in a swift running stream flowing into the pond at Hopewell Furnace. The thallus is freely branched, and of a gelatinous texture. The tufts when examined macroscopically resemble small dark bulbs in a gelatinous string.

Bacillarieae

Many species of diatoms are found to exist in Berks Co., but no effort has been made to determine their genera.

Chlorophyceae

Protococcus Agardh, 1824

Very common, on most every tree, stone, or fence post in a moist situation. The cells are spherical; solitary, or in clusters of two or four.

Microthamnion Nageli, 1849

Found with other algae on the glass sides of an aquarium. It is very small, and its peculiar branching, with all of the branches of the thallus having the same diameter, makes it easy to identify.

Cladophora Kutzing, 1843

Common in all parts of the county on stones in streams, in watering troughs, and in springs. The lateral branches are an outgrowth from the upper end of the cell, and a cross wall is laid down near this point of origin. Terminal cells are not attenuated.

Stigeoclonium Kutzing, 1843 (*Myxonema* Fries)

Not so common as *Cladophora,* yet similar in habitat and form. The terminal cells, however, are attenuated. The filaments are enclosed in a watery, flat, gelatinous sheath.

Draparnaldia Bory, 1808

Quite common in various part of the county. The plant body is macroscopic, pale green, and in a watery gelatinous matrix. It is often found in great abundance attached to rocks in streams of spring water.

Spirogyra Link, 1820

Common in every part of the county. It is easily identified by the spiral arrangement of the chloroplast within the cell. Gram's iodine solution is excellent to bring out the appearance of the pyrenoids and the nucleus.

Zygnema Agardh, 1824

Common in all parts of the county. An excellent pool of fruiting material exists one mile east of Reading. Each filament in *Zygnema stellata* contributes equally in the formation of the conjugation tube, and the zygote develops in the female cell.

Mougeotia Agardh, 1824

Fairly common in springs, ponds, and semipermanent pools. The genus is easily determined by the fact that the chloroplast does not extend to the end of the cell, and by the lineal arrangement of the five or six pyrenoids in each cell. The photograph was taken with a red light filter.

Oedogonium Link, 1820

Quite common. A good pool of fruiting material is found along Tulpehocken Creek near Van Reed's paper mill. The genus is recognized by a series of transverse striae. There are two types of gamete-forming cells.

Vaucheria De Candolle, 1803

Common in all parts of the county. Aquatic or growing on damp soil. Good fruiting material was obtained at Belle Alto Farms, and in a spring one mile east of Fleetwood. The filaments do not develop cross walls, and are only sparingly branched. The filaments are multinucleate, and oils, instead of starch, are usually formed.

Desmidium Agardh, 1825

Found in a ditch along the Reading Railroad between Mohrsville and Shoemakersville. The filaments are spirally twisted, and the cells have a median constriction forming semi-cells, each containing a single chloroplast.

Stichococcus Nageli, 1849

Found in a semipermanent pond in Amity Township. Trichomes when first described were thought to be in few celled filaments. (Nageli, 1849). It has been found to grow into filaments of indefinite length. The ends of the filaments are always rounded.

Ulothrix Kutzing, 1833

Rather common in Berks County. It can be determined by the fact that the chloroplast is a girdle which only partly encircles the cell.

Pediastrum Meyen, 1829

This genus is common in almost every pool and ditch. The plant consists of a stellate plate one cell thick, which may be entire or perforate. Each cell is capable of producing zoospores.

Scenodesmus Meyen, 1829

Found in practically every body of standing water. Many species occur in Lake Ontelaunee. The cells are always in twos or multiples of two, and have either smooth or spicate walls.

Closterium Nitzsch, 1817

Common in habitats similar to those of the preceeding genus. The cells are always attenuated to a point, and usually appear lunate. The cell walls are usually brown.

Cosmarium Corda, 1834

Common in ponds with other algae. The plants are unicellular, and have a deep median constriction. Each semicell contains a chloroplast.

Tabellaria Ehrenberg, 1840

Found in a pool near Douglassville. The cells are tabular, and arranged in zigzag chains, united to each other by gelatinous cushions in their corners.

Characium A. Braun, 1849

Cells are ovoid and sessile. They were found growing epiphytically on other algae.

Tetrallantos Teiling, 1916

Found in Lake Ontelaunee. The cells are curved, and arranged in four celled coenobes. Two cells lie in the same plane, and the other two are vertically joined to them. The colonies are often surrounded by a gelatinous envelope.

Ankistrodesmus Corda, 1838

Found in many pools and in aquaria. The cells are slightly lunate, long, narrow, and gradually tapering to a point.

Rhizoclonium Kutzing, 1843

Found in stagnant pools. The cells resemble those of *Cladophora*, except that they are either not branched at all, or the branches are only one or two cells in length.

Hydrodictyon Roth, 1800

The plant consists of a reticulated coenobe. The space in the reticulum is usually bounded by five or six cells. Young colonies form a sac-like reticulum.

Volvox Linnaeus, 1758

Found in a semipermanent pool near Shoemakersville. The colony consists of a large number of cells. The peripheral cells bear two flagella.

Staurastrum Meyen, 1829

Fairly common in stagnant pools; many were also found in Lake Ontelaunee. Most of the cells are radially symmetrical, and triangular in end view. They are variously ornamented with symmetrical designs.

PLATE 1

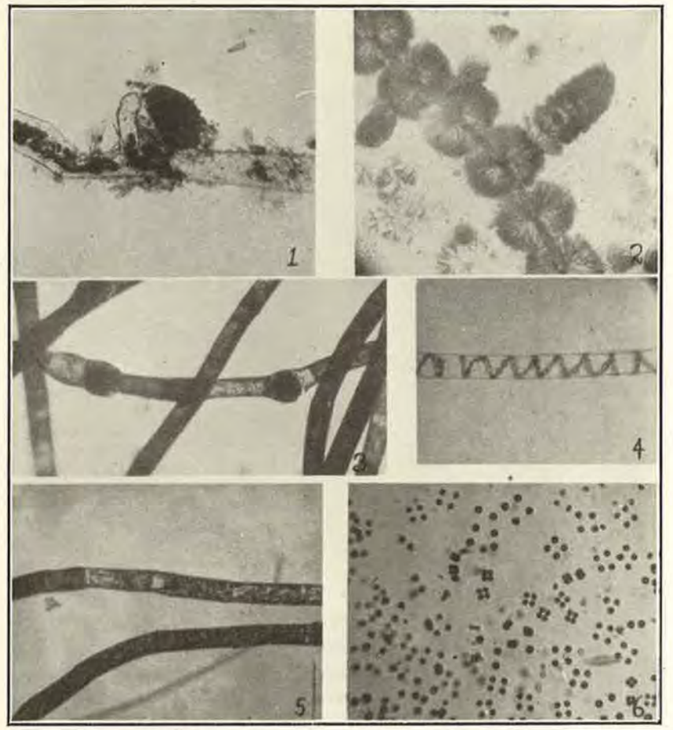

PLATE.—1. Vaucheria, showing sex organs; 2. Batrachospermum; 3. Oedogonium, showing female sex organs; 4. Spirogyra; 5. Oedogonium, showing male sex organs; 6. Merismopedia.

PLATE 2

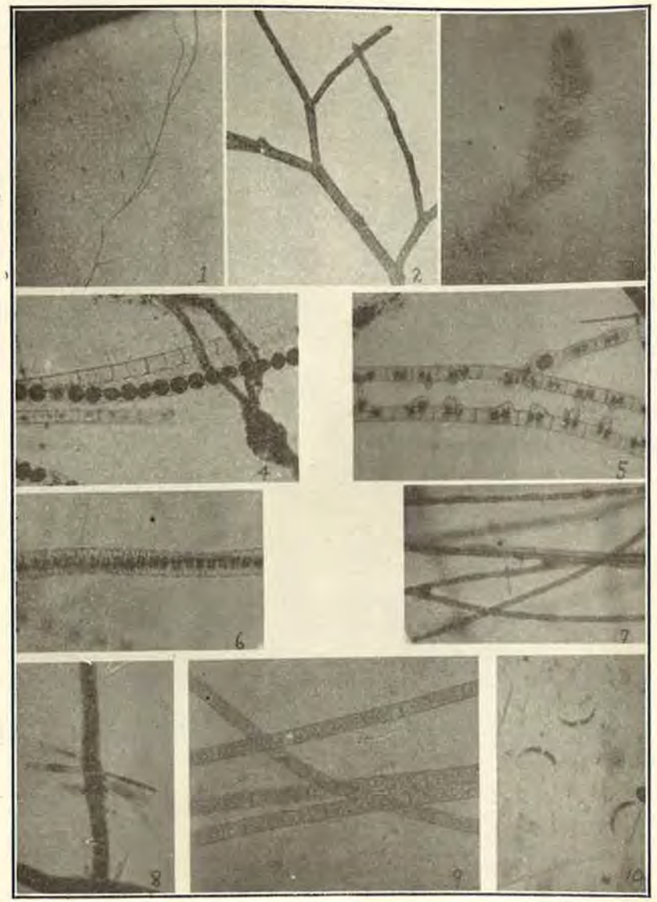

PLATE.—1. Stigeoclonium; 2. Clodophora; 3. Draparnaldia; 4 and 5. Zygnema; 6. Desmidium; 7. Tribonema; 8. Diatoms; 9. Mougeotia; 10. Closterium.

EUGLENOPHYCEAE

Euglena Ehrenberg, 1838

Found commonly in protozoa cultures. They are green, uniflagellate, free swimming, and have a red eyespot at the anterior end.

Phacus Dujardin, 1841

The motile green cell is flattened ventrally, rounded dorsally, and somewhat twisted. The periplast is ornamented with longitudinal striae. It has been found in cultures with other protozoa.

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SOME EFFECTS OF CASTRATION AND OF GONAD GRAFTS ON CONODUCTS OF *TRITURUS VIRIDESCENS VIRIDESCENS*

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The conditons to be discussed resulted from experimental modification of the secondary sexual characters of adult aquatic forms of the red-spotted newt, *Triturus viridescens viridescens* reported by Higbee (1934). The internal changes to be described are the effects produced by the following types of experimentation: (1) Castration; (2) supersexing; (3) testicular grafts in castrated female animals; (4) testicular implants in castrated male animals; (5) ovarian grafts in castrated male animals.

To determine effects on internal organs, autopsies were performed when the operated animals died and the following points were noted: (1) whether the grafts (ovarian or testicular) had persisted; (2) whether the host's gonadal tissue (ovarian or testicular) was present along with the transplant; (3) to what tissues of the host had the transplant if present become attached; (4) whether the graft had induced any changes in the male or female reproductive structures, especially the rudimentary oviducts, or the mullerian ducts.

Internal Conditions Found in Hosts

A thorough search for testicular nodules or for fragments of ovaries which might have been left behind and regenerated in any of the 60 cases of male and female animals used in the feminization and masculinization experiments failed to reveal the presence of any gonadal tissue other than the particular implant. In the 53 cases of castrated males no trace of testicular tissue could be found. However the transplanted tissue varied in size. In the ovarian tissue the number of eggs which it contained varied. The attachments of the implants to tissues in the body cavity also varied. The grafts were found attached to one or two of the following tissues of the host's body, (a) body wall, (b) fat body, (c) liver, (d) mesentery of the intestine, (e) lungs. Quite frequently the testis implant was found attached at the caudal end to the fat body and at the cranial end to the liver or to the lung. In other cases the testis graft was found attached by a tubule to the mesovarium. Efforts were made to place all testicular implants in supersexed males between the dermis and muscle layer, but on autopsy some of the transplants were found under the epidermis, and still others were found in the muscle layer between the dermis and the peritoneal lining of the body cavity. In the latter cases the bulge of the pocket instead of extending to the outside of the animal's body protruded into the body cavity.

A check of the points of attachment showed the following numerical distribution of the contacts. In 40 of the animals it was found that the grafts were attached to the body wall (either in the incision or to the peritoneum lining the body wall), or to the mesentery of the intestine. In five of these animals it was found that the implant was also attached to the end of the liver by a fine strand of mesentery. In six animals the testis grafts were connected by a fine mesentery of the intestine. In two animals the engrafted material was found connected by a thin mesentery to the upper end of the lung. As has already been mentioned two grafts were found attached by a tubule to the mesovarium. In ten cases the implants were found with only one point of attachment and that was to the incision in the body wall. The attachments of the graft to the body wall and liver were the most favorable points of contact for the graft (placed in the body cavity) as they seemed to possess the most abundant supply of blood. This observation agrees with those made by Adams (1930), who states, "Those grafts which had united with the liver or body wall possessed the most abundant blood supply, were generally largest in total bulk of tissue, and also contained many large oocytes with a goodly amount of yolk and pigment, besides the medium and small-sized developing eggs." Histological examinations will have to be made to determine whether mesenteric cells hold the implants or if cells of the organs involved are responsible.

Adams (1930) in her work on *Triturus viridescens viridescens* found that ovarian implants in the male caused the rudimentary oviduct to become larger and markedly convoluted so that the regional differences stand out more clearly. De Beaumont (1929) in his work on *Triton cristatus* and Adams (1930) both point out that this enlargment seems to be due to the number of oocytes present in the graft which were forming yolk at the time. In my castrated males with ovarian grafts I also found the rudimentary oviducts had become larger than they are in normal male animals.

In the castrated animals no particular internal changes have been noticeable enough to describe at this time.

The writer has found the following specific results. In castrated females with testicular implants, the oviducts were found to be decreasing in size and thus showing that the graft which had become established was exerting a slight influence on the host's body. This was verified by one case of partial sex reversal previously reported by Higbee (1934) and by data on supersexing appearing in the following paragraph.

In males which had been supersexed the writer found that the rudimentary oviducts became smaller and more rudimentary in appearance. This is probably due to the presence of a greater amount of testicular hormone and can be correlated with the observations previously made by the writer and others on the secondary sexual characters that supersexing causes them to appear oftener and remain visible for a longer time than they do in normal *Triturus* males.

In histological examinations made to date, it has been found in ovarian grafts ranging in age from eight days to 224 days that the oocytes had not degenerated and resembled those found in normal female *Triturus* animals. In castrated females with testicular implants and in the testicular grafts in supersexed animals, cysts were found filled with spermatogonia. Here again the cellular structure of the engrafted material was found to resemble normal tissue.

In summing up the results one may say that testicular implants in castrated female animals cause the oviducts to decrease in size.

That ovarian grafts in castrated male animals cause the rudimentary oviducts to become larger in size.

That supersexing males causes the rudimentary oviducts to become still more rudimentary in structure.

That under microscopical examination of engrafted material, the cellular structure of the implants resembled normal tissue as long as 224 days after implantation.

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A COMPARATIVE STUDY OF THE MESENTERIES OF THREE SPECIES OF THE GENUS *TRITURUS*

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In general a mesentery is a sheet or strand of connective tissue which supports an internal organ from the internal body wall, or which connects any two or more internal organs. In a specific sense, a mesentery is a connective tissue which suspends a digestive organ. A ligament is connective tissue which suspends organs other than a digestive organ, or it may connect two or more internal organs.

The first thing to be considered is the need of mesenteries in the body of any animal. Three reasons that immediately present themselves are: (1) support, (2) retention of organs in their position, (3) prevention of obstructions or knots in the intestine.

A brief history of the embryonic development of the mesenteries shows how they change from the simple to the more complex. At first there is a vertical mesentery extending the length of the body cavity and supporting the almost straight alimentary tract from the dorsal median line of the body cavity. This mesentery is really two, the dorsal mesentery and the ventral mesentery. As the embryo becomes older, the alimentary canal lengthens more rapidly than does the body. Thus the tract becomes bent upon itself and the dorsal mesentery continues to be attached to the alimentary canal throughout its length. The ventral mesentery does not follow the convolutions of the alimentary tract for it becomes comparatively narrower and drops its connection with the tract except in the caudal and the cranial portions.

While these changes are taking place two future organs are being formed, the pancreas within the dorsal mesentery and the liver within the ventral mesentery. But as embryonic growth continues the other organs develop and the mesenteries are not so simple. The liver no longer remains suspended by the ventral mesentery alone, but attachments with other organs are formed.

Different adult vertebrates represent different stages in the development of the mesenteries. In some of the most primitive forms the digestive tract is nearly straight and the dorsal and ventral mesenteries are

present but the folds and reduplications of the dorsal mesentery, which are characteristic of the higher forms are very simple, or are lacking. In general the embryonic development of the mesenteries of any form recapitulates the progress which has been made by that species and its ancestors. Thus in the late stages of the human embryo we find the mesenteries more highly developed than those of the adult salamander.

In the study of the mesenteries of the salamander three species of the genus Triturus were used: (1) *Triturus viridescens viridescens,* found in western Pennsylvania; (2) *Triturus torosus,* found in California; (3) *Triturus pyrrhogaster,* found in Japan.

The primary function of mesenteries is to support the various internal organs. These organs may be suspended from the body wall or one organ may be suspended from another organ. Thus, we find the intestine suspended by the dorsal mesentery, but the spleen is supported by the stomach and the lung, in the case of any species of the genus Triturus.

The mesenteries not only suspend the various organs within the body cavity, but suspend them in such a manner that each has its alloted position, and does not interfere with the other organs. The parts of the body could not function normally if the parts were so placed that they were crowding one another. Not only must crowding be avoided, but each organ must be attached so that it will not interfere with its neighbors. Interference not only prevents proper functioning, but in man represents discomfort as well. This discomfort and lack of normal functioning is experienced when a kidney becomes loosened from its mesenteric attachments. To enable the organs to be more firmly attached and to secure for them more stable positions, many organs have two or three mesenteries instead of one.

If the long sinuous length of the intestine were to lie free within the body cavity it would soon become full of knots and kinks which would be caused by the muscular movements of the intestine and the accompanying movements of the food mass within the intestine. No animal can continue to exist if the elimination of waste matter is prevented by obstructions within the intestine. The accumulation of toxic materials will soon bring about death. But the attachment of the intestine to the body wall by a mesentery prevents any great movement of the intestine.

In all forms of Triturus which we shall discuss the mesenteric plan is similar but specific differences are to be found. In general, the dorsal and ventral mesenteries are present. The dorsal mesenteries have numerous reduplications which suspend organs in the body cavity. The same organs are connected to each other but the extent of the connecting ligaments is not always the same.

In *Triturus viridescens viridescens, T. pyrrhogaster,* and *T. torosus,* the lung, testis, and fat body of each side are supported by a long fold of the dorsal mesentery. In these three forms the ligament supporting the lung and the fat body is continuous and the testis is in a small outpocketing of the ligament supporting the fat body.

In *Triturus viridescens viridescens* and in *T. pyrrhogaster* a very small ligament having the form of a fold extends from the cleft in the mid-anterior margin of the liver to the left lung near the base. But in *T. torosus* this ligament is seen quite plainly. It extends from the cleft of the liver along the anterior margin and around one-half of the left margin of the extreme left portion of the left lobe of the liver. It then connects the liver to the left lung near the base.

In *Triturus viridescens viridescens* the ligament connecting the liver and stomach is reduced to a narrow band or to two comparatively narrow bands of tissue. In the two other forms the ligament is continuous and extends from the pyloric region of the stomach to the cardiac region.

We notice that the differences between *Triturus viridescens viridescens, T. torosus,* and *T. pyrrhogaster* are very slight and are differences in the size and extent of two ligaments.

THE RATE OF REGENERATION IN RELATION TO THE DEGREE OF INJURY

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The phenomenon of regeneration or the replacement of lost parts has long been a fact of common experience. By means of this process plants and animals are able to restore tissues and even whole organs which have been mutilated or lost. Noble (1931) defines the process as a "type of developmental regulation which results in the replacement of parts lying peripherally to the cut surface." Przibram (1927) states that " 'Regeneration' may be regarded as an acceleration of the normal growth processes, restoring morphogenetic equilibrium in consequence of some disturbances, and one which is made possible by the fact that the remaining parts still retain the potentialities to form those which are lost." Dürkin maintains that it is a super-erogative developmental process.

Bonnet is accredited with the first reliable observations on regeneration reported in his work on the earthworm. Spallanzani confirmed the observations of Bonnet and contributed others on aquatic salamanders and frog tadpoles. Since that time volumes have been written on the

regenerative capacities observed throughout the phyla of the plant and animal kingdoms. Investigations have been directed toward the following phases of the problem:

Correlation of regeneration with the effects of light, heat and other physical factors.

Correlation of regeneration with the effects of physiological factors such as malnutrition, starvation, removal of the thyroid, pituitary, liver and other vital glands, and other induced metabolic disturbances. Correlation of regeneration with morphological influences such as the plane and method of injury, the level of injury in reference to the axial gradients, the rate and completeness of restoration, and the orientation of the regenerated portion. In the last relationship regeneration and transplantation have occupied the spotlight of interest and continue so even today.

These studies carried out upon all types of tissue, connective, supporting, epithelial, glandular, contractile, and nervous, though having failed to reveal the cause of regeneration, have evidenced some major conclusions, a few of which are:

1. Regeneration is a common faculty of the tissues of animals, but one which is reduced during phylogeny (Korschelt, 1927).

2. The power of regeneration diminishes with increasing organization usually during both ontogeny and phylogeny (Noble, 1931).

3. The regenerated tissues may be derived from already differentiated cells, but generally form from a group of undifferentiated cells termed the "blastema."

4. The blastema lying above the wound contains the determinants for the regenerated parts. There is no part-for-part influence (Weiss, 1926).

5. The determination of axes in the regenerating limbs follow the same course as in normal development (Swett, 1927).

6. Regeneration is closely related to development. The hormones that influence growth undoubtedly influence regeneration.

7. Regeneration is inhibited by rapid wound healing, and thyroidectomy, and even prevented by hypophysectomy.

8. Regeneration, though usually, is not always complete.

9. The rate of regeneration is increased with the degree of injury, or large losses are repaired more rapidly than small ones.

It is with this last conclusion that this paper is concerned. Zeleny (1916) reports that "the evidence in favor of a definite increase in rate with any certain increase in degree of injury is not so conclusive." Employing Ambystoma larvae from which a section of one fore-limb, a

section of both fore-limbs, and sections from both fore-limbs and the tail were removed, no significant increase in rate was recorded with the increased amount of injury.

Similar has been the author's experience, experimenting with adult forms of the red-spotted newt, *Triturus viridescens viridescens* Rafinesque. In the experiments, identical section-lengths were removed from one fore-limb, both fore-limbs, and both fore-limbs and the tail; in a second series of experiments, the same operations were repeated on the hind limbs; in a third series of experiments the fore-limbs were amputated below the elbow, these same operations being repeated on the hind limbs; in a fourth series the humeri and femurs were completely extirpated.

After operating, observations were made daily on the animals and the length of regeneration was recorded. The 'healing over' process was slightly more rapid in the fore-limbs than in the hind and slightly more rapid in the hind-limbs than in the tail. This held true for all levels of cut. Likewise the 'healing over' was slightly more rapid the more distal the cut. In most cases the wounds were completely healed at the end of two days, except in the case of the exarticulations wherein four to six days are required for complete healing. Since wounds are healed by spreading of epidermal cells over the denuded area (Eycleshymer, 1907; Dickerson, 1926; Cutuly, 1931), this variation may be explicable because of the increased diameter of the more proximal wounds. However it does not support the conclusion that more serious injury has a higher repair rate. The data on the regeneration after the wound is completely healed reveal that the shorter removed lengths are completely restored first, although not with the expected rapidity and with much individual variation as to time. However, the specific increase, *i.e.*, the ratio of restored length to the removed length, is higher where the removed length is shorter. It was noted that regeneration was extremely slow in the case of extirpations. In the case of the multiple injuries of the first and second series of experiments the variation rate falls within the variations observed in the third and fourth series, hence, indicate no significant acceleration. That this does not accord with Zeleny's results, which show a slight acceleration, may be due to the fact that the tissue of *Triturus* is inherently different from *Ambystoma*, or to the difference in stability of adult and larval tissue.

Further researches are proposed to investigate this stability factor, to correlate the rate of regeneration in various species of *Triturus*, and to supplement the above observations with cytological evidence. However, the collective gross observations do not support the generalization that the rate of regeneration is accelerated with increased degree or amount of injury.

The author wishes gratefully to acknowledge the advice and guidance of Dr. H. H. Collins during the course of this work.

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SOME ERRORS IN CURRENT TEXTBOOKS OF VERTEBRATE ZOOLOGY

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When one has become more or less familiar with certain vertebrate forms through teaching or research, it is a rather disconcerting experience to encounter errors regarding them in widely used and deservedly popular texts and reference books. One is led to wonder about the possible erroneous statements in such books concerning groups with which he is not especially well acquainted.

Some years ago, as an undergraduate student, the writer in studying a figure of a partially dissected shark in Hegner's *College Zoology* noted an error in the description of the reproductive system. The error in this figure, originally from Dean, has persisted in this and other texts to the present day. The figure in question depicts the specimen in lateral view, with a large portion of the lateral abdominal body wall displaying various internal organs, among them the ovary and oviduct which are specifically labelled as such. The pelvic fin, however, is shown bearing a clasper, a prominent secondary sexual structure present only in males. This is, of course, not a serious error, but it is interesting to note how it has persisted through a number of years.

The misstatements of fact which more seriously impressed the writer relate to Amphibians of the genus Triturus. For example, we read in Newman's *Vertebrate Zoology* the following: "Diemictylus viridescens is a good example of the 'efts,' sometimes also called 'Newts.' It is commonly called the 'vermilion spotted eft.' It has a prolonged life history, taking several years to reach full maturity. For the first three years it lives in the water, being green in color and having external gills. It then leaves the water and becomes yellow with vermilion spots. After some time it again returns to the water, becomes green, and lives an aquatic life during the breeding season, after which it once more takes on the terrestrial features and migrates to land."

While in different parts of its range, its life habits vary, the statement that they retain their gills throughout a three-year aquatic period is erroneous. In some regions, the species appears to remain permanently in the aquatic stage but not for a three-year period. In general, the premetamorphic aquatic period lasts from the spring season when the young are hatched to fall of the same year. The terrestrial stage continues for a period not definitely known but estimated at from two to four years. The coloration of the terrestrial form could scarcely be described as "yellow." The color is very variable, ranging from brick-red to the olive-green characteristic of the aquatic adult. In this same section on the family Salamandridae, following a reference to the "crested newt," *Triton cristatus*, we read: "Many other species of the genus Triton occur, two of which, *T. torosus* and *T. virescens*, occur in North America, the latter being common through the Eastern United States." Now as it happens, the genus name *Triton* has not been used for American forms for the last forty years. Furthermore there is no species "virescens," this term obviously being a mis-spelling of the species name viridescens. This name appears, correctly spelled, on the preceding page, but is here placed within the genus Diemyctylus. It may be added that this genus name has been replaced by the genus name Triturus, corresponding to the European genus Triton.

Another misstatement of fact with reference to Triturus which has come to the writer's attention occurs in that very excellent and most useful reference work, Pratt's *Manual of the Vertebrates of the United States*. In the description of *T. viridescens*, we read: "There are two larval stages, in the first of which the animal is aquatic, with gills and the color of the adult, and in the second it is terrestrial, without gills and bright red in color and smaller in size, but is spotted like the adult and without a keeled tail. The first stage lasts three or four months; the second lasts two or three years, and at the end of it the animal again

becomes aquatic." It might be added that in some parts of its range the terrestrial stage is omitted. With reference to the Pacific Coast species *torosus*, we read: "Body rather stout; tail long, with a wide keel above and below . . . in ponds and streams; no terrestrial forms present."

The writer has observed adult *torosus* on land at some distance from ponds and streams where they were observed in the water during the spring breeding season. Ritter (1897) studied the life history of this species in California, especially in the vicinity of San Francisco Bay. According to Ritter, following metamorphosis the animals are strictly terrestrial. They drown if prevented from leaving the water at that time. The same writer states that if adults are taken from land and placed in water they struggle frantically to get out.

An excellent summary of the observations of Ritter, Chandler, Storer, and others is given by Storer (1925) in his *Synopsis of the Amphibia of California*. It might be added that the wide keel or caudal fin is present only during the breeding season when the adults return to water.

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THE PROBLEM OF PATTERN REGULATION IN THE AMPHIBIAN SKIN

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In view of recent observations in the Zoological laboratory of the University of Pittsburgh tending to confirm the point of view of Collins and Adolph (1926) regarding melanophore migration in Amphibian skin, it seems worth while to summarize the evidence bearing upon the problem.

Rand and Pierce (1930) transplanted unpigmented ventral skin of frog tadpoles to the dark dorsal surface of the same individual or to

another of the same species. They found that the unpigmented graft did not acquire the characteristics of the surrounding dorsal skin. In a few cases, (autotransplants) the grafts remained for months unmodified. In most instances, however, the graft areas gradually assumed the appearance of the surrounding pigmented skin. According to the conclusions of these writers, the ventral skin graft, although "to superficial observation" appearing to undergo regulation and reorganization, is, on the contrary, actually slowly destroyed by phagocytic action and replaced by surrounding dorsal epithelium. They find further that: "There is no evidence that epidermal melanophores of the host advance independently of the epithelium in which they occur."

In contrast to the findings of Rand and Pierce, summarized above, the phenomena observed in wound healing and skin graft reorganization in adult *Triturus* do not appear to be explicable wholly in terms of passive movement of melanophores.

As observed by Collins and Adolph (1926) in the healing of wounds on the ventral surface of the body, following removal of areas of skin up to one square cm., melanophores were contributed to the wound from neighboring black spots. These large aggregations of melanophores so characteristic of *T. viridescens viridescens* never moved into a wound bed *in toto,* as would be anticipated if melanophores were passively dragged into the wound by inflowing dermal and epidermal cells. Melanophores passed into the wound from neighboring spots in somewhat straggling fashion, from wedge-shaped prolongations of the spots pointing toward the wound. Months after the removal of the skin the scattered melanophores in the former wound area were observed to aggregate slowly around several centers, thus forming isolated spots characteristic of normal ventral skin. Passive migration of melanophores would here presuppose active movements toward the centers of spot formation on the part of dermal and epidermal cells. So far as the writer is aware, such movements of dermal and epidermal tissues are not known to occur in wound healing.

A graft of ventral skin when placed in a wound bed from which skin had been removed on the dorsal surface, gradually assumes the appearance of the surrounding heavily pigmented dorsal surface. As observed by Collins and Adolph (1926) and later in a more extensive series of experiments by Miller (1931) the first indication of reorganization of the graft is seen in the initial stages of disintegration of the large spots. The constituent melanophores begin to move outward from the center. This movement is observed before any invasion of the graft by melanophores from the surrounding dorsal skin is evident. According to

Rand's theory of passive migration this would mean that, although the melanophores within the spots are moving outward from the centers of aggregation, the graft is, as yet, intact. It would seem that the passive migration theory breaks down at this juncture.

According to Miller (1931) "In the ventral half of the graft, (*i.e.,* a 90° rotation graft) it was not uncommon to see black spots within the graft and black spots lying just outside (in surrounding ventral skin) but close to the edge of the host integument send out melanophores toward each other. Several responses to this situation were seen. The melanophores from the spot within the graft might be entirely attracted to the spot outside. When this occurred, the melanophores might join the spot outside in the formation of an elongated aggregation. . . . Again, the two spots might elongate toward each other and join inside the graft or in the area between the graft and host skin." In these instances, we have melanophores moving in a direction opposite to that (*i.e.,* toward the graft) in which invading phagocytic host cells would be dragging melanophores, if the conditions obtain in Triturus, as described by Rand and Pierce (1930) for skin grafts in the frog tadpole.

Wolf (1934) in his studies of wound healing in the skin of the Japanese newt, *Triturus pyrrhogaster,* found that "the black pigment cells migrate actively into the wound area as melanophores from the surrounding melanophore plate."

In the writer's judgment, melanophore movement may well be passive in skin grafts of the frog tadpole, and at the same time, partially or wholly active in skin grafts in adult *Triturus.* Further work is necessary on both types of material before either hypothesis may be regarded as fully established.

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STUDIES OF LARVAL AND ADULT TISSUES WITHIN THE SAME BODY IN *TRITURUS*

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The successful implantation of larval fragments upon the bodies of adults of the same species suggests a number of interesting and significant problems for further research. Among these are the following:

1. The effect of the host's growth regulatory mechanism upon the post-operative growth of the graft.
2. Effects of the host upon form regulation of the growing larval fragment.
3. Effect of a maximum amount of larval tissue upon rate of regeneration in the adult. This is one way in which a possible effect of the larval tissue might be detected.
4. Histological changes in the tissues of the larval grafts—processes of de-differentiation and re-differentiation.
5. Regenerative powers possessed by larval grafts. Possible slowing up of rate of regeneration due to host influence.
6. Effect of adjacent larval implants upon regeneration of host appendages.
7. Interaction of circulatory systems of host and larva. Phagocytic reactions.
8. Establishment of nerve supply, from host to graft.

The above and related problems are now in process of investigation.

The experiments chiefly of the junior author have thus far shown that the host's growth regulatory mechanism which inhibits growth (except in the special case of regeneration, following injury) in the adult body, does not suppress growth and differentiation in the larval implants.

The host has been found to exert an influence upon the form of larval appendages developing from the larval fragment following implantation. Such appendages tend to develop adult proportions, though in miniature.

The larval heart has been found to persist for months following implantation of the cranial half or entire larva. The maximum time limit for the persistence of the functional heart has not as yet been determined. The larval heart beat does not become synchronous with that of the host.

A larval fragment implanted on the cut end of an amputated host limb has been found to suppress the regeneration of the limb. In one instance a larval limb developed from the anlagen invisible at the time of implantation. This limb displayed normal movements and was used by the host whose own limb had failed to regenerate.

Larval heads growing on the adult body as implants exhibited gulping reflexes, and side-to-side movements.

Larval implants on the trunk of the host developed limbs and tails which exhibited independent movements in response to local stimulation. The interesting problem of the innervation of these implants and many other problems, as well, await further investigation.

SOME RESULTS OF PARTIAL HEPATECTOMY IN THE RED SPOTTED NEWT

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Partial hepatectomy in *Triturus viridescens viridescens* is not an extremely serious operation. The mortality is low; under normal conditions, of thirty animals operated upon about three die. The loss of a portion of the liver seems to have no serious physiological effect on the normal functioning of the animal. If, however, total hepatectomy is performed the animal will die within ten to twenty days.

In the course of the operation if the left lobe which is to be removed is long and thin there is little chance of a hemorrhage. If, however, the lobe is short so that the removal of one centimeter causes the cut to extend up into the basal part of the liver, one of the hepatic arteries is likely to be severed which causes a rather severe hemorrhage. This excessive flow of blood is usually fatal to the animal. It is very seldom that the animal having this hemorrhage comes out of the anaesthetic. If either of the other two lobes is removed there is a much greater chance of death. The gall bladder is frequently destroyed, which often is fatal.

Another advantage of removing the left lobe is the small size of the incision which may be made in order to operate. The left lobe being long and thin can be pulled out of an opening in the body wall six to seven mm. long. The wound requires a very short time to heal and there is little chance of the stitches pulling out and the incision rupturing. The non-serious nature of the incision has an important effect upon the low death rate among the animals.

At the end of 24 hours after one centimeter has been removed from the left lobe of the liver, a blood clot is found to be covering the cut

surface. Immediately beneath the thrombus, hepatic cells appear in various stages of breaking down. Many have lost their cell walls. The entire region appears to be smaller. During the period of a week during which daily operations were made and the tissue preserved, a peritoneal membrane appears apparently growing in from the parenchyma. This membrane at the end of seven days had covered the cut end of the liver lobe and had begun to thicken. The cells of this new portion do not seem to have definite cell walls. The nuclei are numerous and are situated very close together. The new hepatic cells have large bright nuclei. The nuclei contain an excess of mitotic figures far above the normal number found in the rest of the tissue. These mitotic figures appear in the peripheral zones as early as the second day after part of the liver has been removed. Nuclear division precedes that of the cytoplasm which lags behind at a certain interval. By the end of the second week fibrous connective tissue has formed in the regenerating portion of the capsule, causing the capsule to become slightly thickened.

Construction of the tissue in the immediate vicinity of the cut portion, by the end of the first week, has taken on a primary developmental formation. Its similarity to the embryonic liver tissue is marked. The vascular system regenerates rapidly, but the arrangement of blood vessels takes on the cavernous system and does not assume the radial arrangements until a period of six weeks. This cavernous arrangement is very evident in the embryonic liver which does not take on a definite arrangement until the embryo is in the incipient metamorphic stage. In the embryonic liver the cell walls are missing and the nuclei are extremely close together. There is a comparable number of mitotic figures to that of the regenerating liver. The various daily and weekly stages of regeneration are directly comparable to those of the section made of the embryonic tissue, the age of which is determined by the Harrison Stages.

This process of regeneration is not, although it seems to be so at first, a true regeneration of the portion removed. The pedicle does not regenerate. The process, then, of restoration is not one of regeneration if the word is taken in the sense of restoring the lost part. There is a certain amount of actual regeneration which can be seen at the surface of the cut portion where new hepatic cells are being formed in one mass. There is also a proliferation of the hepatic tissue within the other portions of the liver. This is evident by the number of mitotic figures which are found throughout the remainder of the liver tissue. These mitotic figures are not so numerous in these remaining lobes as in the neighborhood of the cut portion, but they are, however, far in excess of those found in the normal tissue. The so-called regeneration then

is really compensatory hypertrophy of the remaining two lobes. The fact that the excised portion of the left lobe is not regenerated is shown by actual measurement. Ten of the animals operated upon were opened sufficiently at the time of the operation to measure the entire length of the liver. A total of the liver lengths was recorded and an average made. A centimeter was removed from each left lobe and the animals left for fourteen days. At the end of this time the animals were killed and the left lobe measured. This remaining portion measured no longer at the end of the two weeks it was left to regenerate than it did when it was excised.

In spite of this proof that there is no regeneration of the pedicle there is proof that there is restoration of the liver. Careful weighing of the animals and of their livers, both before and after removal of a portion of the liver, shows that there is a definite gain in weight of the hepatectomized liver at the end of 17 days over the weight following excision. This shows that there has been a restoration somewhere in the hepatic tissue. If, then, we are safe in saying that the pedicle does not regenerate, we are also safe in stating that the restorative process is one of compensatory hypertrophy.

OUR LEAST KNOWN STATES

By Lawrence Whitcome
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In the elementary courses in Physiography and Geology given at Lehigh University, Bethlehem, Penn., it has been found that the men have a very poor knowledge of the political geography of the United States.

At the first meeting of the class for the past several years, men taking the elementary course in Physiography have been given an outline map of the United States which showed the State boundaries and have been asked to fill in the names of the States. The results received have been so interesting that a study has been made during the last two years on one hundred men, in order to see which are the best and least known States. The tables below will show how lacking these men are in a general knowledge of the States of their own country.

The maps used were printed by the McKnight & McKnight Company, being their map number 1001 of the Ridgley series, and are $7\frac{1}{2} \times 5\frac{1}{2}$ inches in size. These maps are clear and distinct, and show not only the State boundaries but also the master streams of the country.

TABLE 1

Number of times State was misnamed by 100 college students

Alabama	25	Maine	8	Ohio	6
Arizona	55	Massachusetts	15	Oklahoma	51
Arkansas	64	Maryland	19	Oregon	24
California	0	Michigan	39	Pennsylvania	0
Colorado	55	Minnesota	51	Rhode Island	20
Connecticut	24	Mississippi	36	South Carolina	16
Delaware	28	Missouri	45	South Dakota	17
Florida	0	Montana	29	Tennessee	24
Georgia	19	Nebraska	63	Texas	0
Idaho	53	Nevada	32	Utah	56
Illinois	25	N. Carolina	15	Virginia	15
Indiana	33	N. Dakota	17	Vermont	39
Iowa	63	New Hampshire	40	Washington	20
Kansas	49	New Jersey	6	West Virginia	16
Kentucky	28	New Mexico	40	Wisconsin	53
Louisiana	30	New York	1	Wyoming	66

TABLE 2

Table 1 rearranged to show best and least known States

California	0	Maryland	19	Vermont	39
Florida	0	Rhode Island	20	New Hampshire	40
Pennsylvania	0	Washington	20	New Mexico	40
Texas	0	Connecticut	24	Missouri	45
New York	1	Oregon	24	Kansas	49
New Jersey	6	Tennessee	24	Minnesota	51
Ohio	6	Alabama	25	Oklahoma	51
Maine	8	Illinois	25	Idaho	53
Massachusetts	15	Delaware	28	Wisconsin	53
N. Carolina	15	Kentucky	28	Arizona	55
Virginia	15	Montana	29	Colorado	55
S. Carolina	16	Louisiana	30	Utah	56
West Virginia	16	Nevada	32	Iowa	63
North Dakota	17	Indiana	33	Nebraska	63
South Dakota	17	Mississippi	36	Arkansas	64
Georgia	19	Michigan	39	Wyoming	66

Fifteen minutes were allowed for the filling in of these maps and it has been found that the men who finish in the shortest length of time make the best grades.

Table 2 gives the States in order of their standing with the best known at the top and the least known at the bottom. Where more than one state has the same rating they are placed in alphabetical order.

The maps have shown that some States are known by everyone and that some States are missed by a large percentage of the men tested. Another interesting point that has been brought out in the common practice of mixing certain pairs of States. Most of the mistakes scored against New Hampshire and Vermont, Washington and Oregon, Minnesota and Wisconsin, and Arizona and New Mexico were caused by the student reversing the names in these pairs of States. No other adjoining States seem to cause such common confusion.

States on the South Atlantic seaboard are not well known. Virginia, North Carolina, South Carolina, and Georgia have been pitfalls. It is a common fault to place them one State too far south, thereby crowding out Georgia entirely or else forcing it around into Alabama. The perfect record made by California, Texas, and Florida is easily explained by their size or shape. Pennsylvania probably owes its perfect record to its being the State in which the men were residing at the time of the test. That New York should be missed by anyone and that New Jersey should have six mistakes marked up against it is rather surprising.

The small States do not have a bad record due to their being overlooked on the map, as Rhode Island has a better record than Connecticut, and Delaware and Kentucky are on equal footing.

It is, of course, realized that the States in the area from which Lehigh University draws the most of her students, that is, the North Atlantic States, should fare better than those at a distance, but this does not seem to hold true as distance alone does not explain the answers.

There have been many peculiar answers, as might be expected in any test of this kind. The absolute lack of idea of location is shown by such cases as Nevada being labeled Illinois, Ohio being labeled North Dakota, and Idaho being labeled Oklahoma. These illustrations are, of course, extremes, but any group of twenty maps will provide examples of a similar type.

Another mistake that has occurred frequently is the raising of Long Island to Statehood. The city of Omaha has also been flattered on numerous occasions by a similar promotion to the dignity of a sovereign State.

The purpose of this paper is to point out the conditions that exist and to raise the question of whether there is not some fundamental fallacy in the way political geography is taught now in our schools. It would seem that a knowledge of the geography of our own country is essential for an educated person, and that the present generation of college undergraduates is woefully wanting along this line. Similar tests given in other institutions throughout the country would be illuminating; probably the results would differ from those here recorded. The writer would be very glad to receive any data that may be obtained in tests at other colleges in order that he may compare the results.

A NEW XIPHOSURAN FROM THE ALLEGHENY OF PENNSYLVANIA[1]

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and
T. Husband Jones
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Introduction

In January 1935 the junior author brought to the senior author at the State Geological Survey at Harrisburg a remarkably fine example of a "Prestwichia." Careful study reveals that it is actually a new species of the xiphosuran genus *Euproöps*. The specimen was given the junior author by a donor who desires to remain anonymous; but we are able to report its rather remarkable history. Originally discovered about 1859 on a culm bank near Parsons, Pennsylvania, the fossil has since changed hands several times. The bank where it was collected contained débris from several coal beds, but a careful check by the junior author upon the local conditions and comparison of the shale in which the specimen is preserved with local material established beyond reasonable question that the fossil came from the "Baltimore seam" of Allegheny age. The culm pile is at the Baltimore Mines owned by the Hudson Coal Company.

Pennsylvanian Xiphorsura have been described from at least three localities in the United States, Vigo County, Indiana, Mazon Creek, Illinois, and the anthracite fields of Pennsylvania. Packard[2] described the occurrence of *Euproöps* (*Prestwichia*) in Pennsylvania. All of his material, a total of three specimens, came from higher beds than either those at Mazon Creek or the insect-bearing shale at Campbells Ledge near Pittston, Pennsylvania.[3] Packard's two best specimens were collected by R. D. Lacoe, one from the Butler mine near Pittston and the other at the Oakwood colliery at Wilkes-Barre. The first was collected in a shale just above the Mammoth bed, the other was found on the mine dump but probably came from the same zone. Packard's third specimen was found in the Scotch Hill railroad cut at Pittston, but he

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

[2] Packard, A. S., On the Carboniferous Xiphosurous fauna of North America, Nat. Acad. Sci., memoirs, vol. 3, part 2, pp. 143–165, 1887.

[3] White, I. C., The geology of the Susquehanna River region in the six counties of Wyoming, Lackawanna, Luzerne, Columbia, Montour and Northumberland: Penna. Second Geol. Surv., vol. G7, p. 41, etc., 1883.

failed to record its stratigraphic position or if found in place. Evidently, these finds correspond roughly with the probable stratigraphic occurrence of our specimen.

The present example differs sufficiently from previously described material to allow assignment to a new species. Were our material more abundant, a new genus might be erected, but at present it has seemed wiser to assign it to the existing genus *Euproöps*.

Description of Species

Order Ziphosura Gronovius

Family Belinuridea Packard

Genus Euproöps Meek

Meek and Worthan[4] described in 1866 Xiphosura from the Illinois Coal Measures and assigned them to known European genera without first having had access to the published figures of the types. A year later after Meek had seen Woodward's original type figures of the European genera,[5] he assigned the form which he had previously identified as *Prestwichia* to a new genus, *Euproöps*. This remains (despite Packard's objections) a valid genus and is the genotype.[6] Meek pointed out how *Euproöps* differs from *Belinurus* and *Prestwichia* (now *Prestwichianella*[7]). The chief differences are the smaller, more quadrangular "glabella," the more anterior position of the compound eyes and the more completely ankylosed abdominal segments. With all of these characters our specimen agrees and it is therefore here assigned to the genus *Euproöps*.

Euproöps packardi sp. nov.

Cephalothorax about three times as wide as long; anterior margin semicircular, bearing a concave border about 1 mm. wide extended into genal spines; posterior margin straight. Cephalothorax divided laterally

[4] Meek, F. B., and Worthan, A. H., Ill. Geol. Surv., vol. II, paleontology, pp. 393–398, 1866.

[5] Meek, F. B., Note on *Bellinurus danae* from the Illinois Coal Measures, Am. Jour. Sci., 2nd ser., vol. 43, pp. 257–258, 1867.

[6] Dr. E. W. Berry has kindly assisted the authors in furnishing the data for this last statement, letter of February 19, 1935. At the same time he wrote that "similar remains were discovered in western Maryland by Harvey Bassler about 20 years ago." Bassler's specimens appear to be lost.

[7] Woodward, Henry, Notes on some fossil arthropods from the Carboniferous rocks of Cape Breton, Nova Scotia, received from Dr. H. M. Ami, M.A., F.G.S., F.R.S. (Can.), Geol. Mag., vol. 5, page 462–471, 1918.

FIG. 1. *Euproöps packardi* Willard and Jones. Type specimen, natural size.

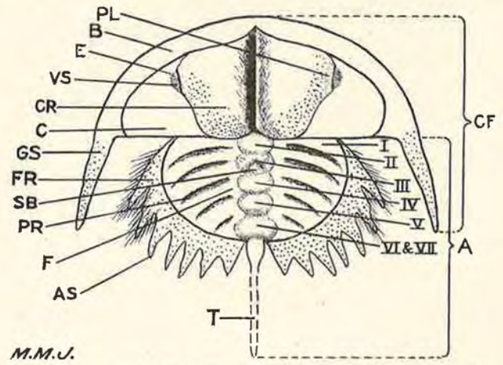

FIG. 2. *Euproöps packardi* Willard and Jones. Diagramatic drawing of type specimen showing anatomical details

A —abdomen (urosome)
AS—abdominal spine
B —border
C —cheek
CF—cephalothorax
CR—cranidium
E —compound eye
F —furrow
FR—frill
GS—genal spine
PL—palpebral lobe
PR—pleural rib
SB—spine base
T —telson
VS —visual surface
I–VII—abdominal segments

into three nearly equal areas; the lateral slopes or cheeks, triangular and produced at posterior, outer extremities into strong genal spines which arise at right angles to posterior margin of cephalothorax and

extend back approximately as far as base of telson. Median portion of cephalothorax, the cranidium ("glabella" of Packard) of trapezoidal outline, widest at front, the whole slightly convex or domed. Lateral margins sinuous, incurving. Apparent partings on these margins suggest sutures, a curious analogy to those of opisthoparian trilobites. Cranidium divided into right and left halves by strong, median ridge produced into small rostral point anteriorly and marked by notch in posterior margin. One pair of compound eyes but no ocelli present. Eyes reniform, fairly prominent, situated on cheeks and in contact with edges of cranidium at its widest portion. Visual surfaces directed laterally. Adjacent areas of cranidium next to eyes raised in palperbal lobes separated from visual surfaces by supposed facial sutures as in some trilobites.

Abdomen (urosome) semicircular in outline (disregarding the telson), width almost twice length; divided laterally by two shallow, broad, ill-defined furrows into a median and two lateral lobes. Median lobe narrow, about half as wide as either side lobe, and obscurely segmented. Segment I (Figure 2) concealed beneath posterior edge of cephalothorax. Numbers II, III and IV most clearly defined. Number III bears base of small, missing spine; V reduced and partly fused with VI; VI and VII completely ankylosed to form broad, swollen basal support for the telson which was articulated with the posterior end of this base by a ball-and-socket joint.[8] The telson is not here looked upon as a true segment but rather an appendage upon the seventh. It has been broken off about 2 mm. above the base, but slight indication of its extent remains in the enclosing shale for a distance of at least 10 mm. farther. The strong, proximal end and heavy support imply a well-developed, powerful organ. Pleural lobes consist each of seven segments separated by ill-defined transverse ridges which grow weaker posteriorly until none occurs between VI and VII. These ridges fail to meet the median lobe segments and are not prolonged into the fringe. First segment partly hidden beneath cephalothorax. Abdomen margined by flattened area, the fringe, 1.5 mm. wide and produced into seven pointed scallops or blunt spines, each of which terminates a segment. Their number furnishes evidence for total number of abdominal segments. First spine longest and sharpest, whence posteriorly they grow shorter and more obtuse, to seventh. First and second covered with fine setae. These scallops clearly differ from the more or less movable abdominal spines of *Limulus* with which they are not homologous. No ventral appendages known.

Surface characters are clearly preserved; abdomen smooth and polished, but fringe covered with numerous tiny pits; a like pitting on genal spines extends a little way onto outer margins of cheeks. Lateral portion of cranidium likewise pitted, but cephalothoracic shield otherwise smooth or slightly wrinkled. A few small knots occur irregularly over surface of entire animal, their significance not apparent. They may be foreign objects, as pyrite grains, embossed through the shell, and are surely not spine bases.

[8] Meek and Worthan figured but apparently failed to recognize the significance of this condition, *op cit.*, pl. 32, figs. 2 and 2a.

DIMENSIONS

	mm.
Total length without telson	17.5
Maximum breadth	26.0
Length of cephalothorax	9.5
Breadth of cephalothorax	26.0
Length of genal spines	8.0
Maximum breadth of genal spines	2.0
Length of abdomen	8.0
Breadth of abdomen	15.0
Length of 1st pair of abdominal spines	5.0
Minimum length of telson	12.0

PRESERVATION AND TAXONOMY

Euproöps packardi Willard and Jones is named in memory of Professor A. S. Packard, pioneer investigator of American Xiphosura. The type specimen, number x34, private collection of T. Husband Jones, is a mold of an external cast of the superior surface, none of the original animal substance remaining. The preserving medium is extremely fine, black, carbonaceous shale. Fragments of land plant stems are the only associated fossils. The shale is so fine that it has faithfully preserved details rarely seen, such as the setae on the abdominal spines, which appear to have escaped notice in previously figured material. Lateral distortion is absent, nor has the specimen been much crushed. The right half of the cranidium is broken and the eye on that side pushed out of place. The spine from the third abdominal segment and all but the base of the telson are all that appear to be lacking from the superior surface.

The species differs from previously described specimens of the genus in several ways. The outlines of respective parts of the cephalothorax are dissimilar. The "glabella" in specimens figured by Meek and Worthan or Packard is a depressed area, but domed in our example. This difference may be superficial. The fact that sutures appear to bound the sides of the cranidium and the little crushed condition of *E. packardi* suggest that in the related examples the glabella had been stove in. Such is also in agreement with the curved posterior cephalothoracic margin in other species compared to the straight margin in our specimen. The abdomen is distinctly different. The axal lobe is narrower than in *E. danae,* about the same proportional width as in *Belinurus lacoeï.* It differs further in the more complete fusion of the segments and the presence of a spinal base upon only the third. The partial concealment of the first segment may be due to a slight flexing of the body pushing the cephalothorax back upon the abdomen. The loss of segmentation in the lateral or pleural lobes is a distinctive feature with which is associated the fact that the intersegmental ridges fail to continue into the abdominal fringe to support the marginal spines or scallops as in the most nearly allied forms. These marginal scallops in our specimen seem to be unique in possessing setae on the first and second. The condition suggests the Jurassic *Limulus walchi.* Besides these differences, *E. packardi* is considerably smaller than all closely related genera and species. Although there is a possibility that we are dealing with an immature individual, this does not appear probable when its advanced anatomical development is considered.

FIELD AND SHORT LABORATORY SOIL TESTS

BY WALTER S. LAPP
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An accurate soil analysis requires many hours of work by a well-trained chemist. The data obtained are of great value to the research worker. Yet it is often helpful to know something about one's soil, to get an approximate picture of its nature and needs, without going to the expense of an accurate chemical analysis. To supply this need a number of short tests have been developed. These may be made in the field or in the laboratory. They never consume more than about 30 minutes and many of them not more than a few minutes. The apparatus used is of the simplest type.

In order to learn what tests of this kind are available a questionnaire was sent to all the agricultural experiment stations in the United States, asking: 1. To what extent do you use field and short laboratory tests? 2. What is your opinion of the value of such tests? 3. What is the cost of such tests to residents of your State? and 4. Give the names of manufacturers of equipment for such tests in your State. Replies were received from every State and from three of the Territories.

The replies indicate that short tests are available for pH, lime requirement, nitrate, ammonia, phosphorus, potassium, calcium, magnesium, aluminum, manganese, organic matter, and excess soil alkali. All but four stations report tests for pH, lime requirement (or excess soil alkali in the semi-arid regions). Thirty-three stations use some form of short test for available phosphorus, and 21 stations use at least two additional tests from the list enumerated.

Different opinions concerning the value of short soil tests were expressed. For instance, Collison of Geneva, N. Y. says "We would not

think of using such tests for serious soil research." Morgan of Connecticut says "Simple soil tests are a valuable aid as preliminary tests in our research work." The stations which have used short tests most widely consider them a valuable tool. On the other hand the stations which have used them least have a poorer opinion of them.

Here are a few representative opinions quoted from the replies received by the writer:

Merkle of Pennsylvania: A chemical test, however poor it may be, is better than a guess no matter how good the guess may be.

Sprague of New Jersey: I regard these tests as being a very valuable tool in determining the requirements of soils for growth of specific plants.

DeTurk of Illinois: We consider them an educational tool, motivating the farmer to study his own soil more intensely and intelligently.

Owens of Storrs, Conn.: The tests are probably worth as much as a teaching device as a guide for practice. We are sure that a number of the soil reaction and lime requirement tests have a close relationship to the need for lime.

Conner of Indiana: Over 10,000 soil samples have been tested. These rapid tests correlate very well with results obtained by the Neubauer method and also by the fifth normal nitric acid laboratory procedure. They should be classed as semi-quantitative and are not intended as the sole criterion for making fertilizer recommendations.

Truog of Wisconsin: We test thousands of samples yearly, and in recent years we have gone over almost entirely to the more rapid tests which determine the more readily available portion of the various constituents, rather than the total amount by means of elaborate laboratory methods.

As pH and phosphate tests are the ones most widely used these will be demonstrated. Many forms of each of these tests are used. One of the simplest pH field methods is used by Harper of Oklahoma. A pinch of soil is placed on a small piece of aluminum foil and the indicator solution dropped upon it. He considers brom cresol purple as the most suitable single indicator. Dr. Wherry suggested the use of this indicator more than ten years ago. In a subacid soil such as rhododendrons require the indicator is golden yellow, in a minimacid soil such as most common plants prefer it is red, and in a minimalkaline soil such as alfalfa prefers it is purple.

Seven distinct methods are reported for making the phosphate test. Seven stations use the Bray method, five the Truog, three the Morgan, two the Spurway, one the Dahlberg & Brown-Hellige, one the Emerson, and one the Harper. The remainder of the 33 stations using short phosphate tests employ an adaptation of one of more of these methods.

In the Bray method one part of soil is shaken with three parts of a standard solution of ammonium molybdate in dilute hydrochloric acid. In about five minutes the soil settles and the clear supernatant extract is stirred with a tin rod. Then as the blue color develops it is compared with a set of color standards; the darker the color the more phosphate is present.

The other phosphate methods involve filtering and more careful measuring of proportions. They all take considerably more time. Rost and Pinckney of Minnesota compared the Bray method with two forms of the Truog method on 116 control plots of which the response to phosphate fertilizing was already known. They report a "good agreement between the results secured by the three methods." Pohlman of West Virginia also reports that the Truog method and Bray method agree fairly well with crop responses in the greenhouse.

For details of the tests for other nutrients see the publications of California, Connecticut, Kentucky, Illinois, Indiana, Maryland, Michigan, and Wisconsin. These States have published more material on short soil tests than all the others combined.

Some new ideas concerning these tests seem worth passing on. Emmert of Kentucky finds that 1–2–4 amino naphthol sulfonic acid, as suggested by Fiske and Subarrow, is a better de-oxidizing agent than stannous chloride in the phosphate test.

Powers of Oregon has worked out extensive micro methods for estimating the nutrient requirement of soils.

DeTurk of Illinois reports that soil testing meetings are held in most of the townships of the State each year. Farmers bring their soil samples to these meetings and are taught how to make their own tests. In this way thousands of acres are tested at little expense to the experiment station.

Conner of Indiana states that 165 vocational teachers are cooperating by learning and applying short soil tests.

Emmert of Kentucky has developed a new short test for soluble nitrogen which he believes will be a very valuable trouble-shooter for growers of truck crops.

The Indiana and Kentucky stations have developed tests for detecting nutrients in plant tissues. These are more sensitive than soil tests and yet indirectly serve the same purpose.

Most States make simple soil tests for their own residents free of charge. When tests are made for commercial concerns, golf clubs, and

when extensive tests are made for individuals charges are made in proportion to the extent of the service.

The names of eleven manufacturers of soil testing equipment were reported by the agricultural experiment stations.

In conclusion it may be stated that there is still room for improvement in many of these tests. Ammonia interferes with the tests for potassium. Arsenic interferes with the test for phosphorus. The methods that work well in the humid regions do not always work in the semi-arid districts. Also methods suitable for northern soils do not work as well in the south according to reports from Alabama and Mississippi. On the whole the experiment stations agree that field and short laboratory soil tests should not be the sole consideration in making recommendations for fertilizer treatment. Yet they do consider such tests as very valuable indications when checked against field experiments and compared with the cropping history and other knowledge of the soil in question.

I thank Dr. M. W. Eddy of Dickinson College for permission to exhibit his soil testing equipment and Dr. Edgar T. Wherry of the University of Pennsylvania for the many valuable suggestions he has given me in this survey and for permission to apply many of the tests at The Morris Arboretum.

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DIFFERENCES BETWEEN MONTHS OF BIRTH OF PROMINENT MEN AND REGISTERED LIVE BIRTHS OF APPROXIMATELY THE SAME PERIOD

E. C. Herber and R. J. Finney

Dickinson College, Carlisle

Whenever we hear of someone's being raised to prominence, a certain amount of doubt is exhibited as to whether his success was entirely due to his own efforts. Among various reasons, month of birth has been suggested as a factor in one's chance for achieving prominence. The purpose of this paper is to present statistical evidence that there is some relationship between month of birth and achievement of prominence.

That there is a definite seasonal wave in the production of births and that the seasonal wave is similar for most of the civilized countries of the world has been noted by many writers. Using all the live birth data from the United States Birth Registration Area Reports since its inception until 1933, the authors have calculated the average daily births for each month. From these data we plotted the solid line of Figure I A which shows that there are two waves of high birth production, one with a peak in February and the other in August, with minimum points occurring in May and December. Similarly, we plotted the broken line of Figure I A made from 1892–96 State Registration Reports. The high and low points are the same with the exception of a slight shift of the late minimum point from December to November. Both of the curves suggest that there are two periods which show higher rate of conception—one in late spring and the other in late fall.

Table I presents live birth data from United States Birth Registration Area records (1915–33) and from Connecticut, Maine and Massachusetts Registration records (1892–97), the average for a day for each month, together with the percent of the total.

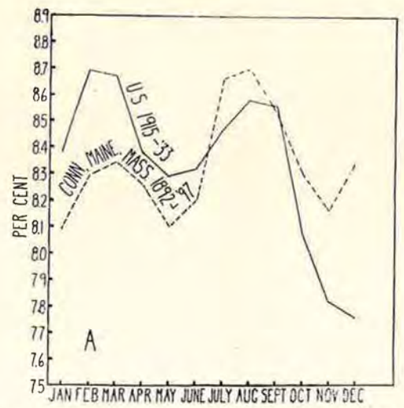


Fig. I. Curves of birth months plotted from percent of daily averages.

A. The solid line shows the percent of daily births for each month plotted from data taken from the United States Registration Area records, 1915–1932. The broken line shows similarly treated data for Maine, Connecticut and Massachusetts records, 1892–1896.

TABLE I

Daily Birth Averages for Each Month Taken from United States Registration Area Reports (1915–33) and from Connecticut, Maine, and Massachusetts Birth Registration Reports (1892–97)

	Month		Daily Average		Percent	
	U. S.	States	U. S.	States	U. S.	States
Jan.	2652834	42270	85575	1364	8.38	8.09
Feb.	2507407	39528	88759	1399	8.69	8.29
Mar.	2745654	43585	88569	1406	8.67	8.34
Apr.	2568205	41803	85607	1393	8.38	8.26
May	2625223	42353	84684	1366	8.29	8.10
June	2548312	41494	84943	1383	8.32	8.20
July	2680827	45289	86478	1461	8.47	8.66
Aug.	2715493	45486	87596	1467	8.58	8.70
Sept.	2619044	43208	87301	1440	8.56	8.54
Oct.	2559245	42467	82556	1402	8.08	8.31
Nov.	2395237	41343	79841	1378	7.82	8.17
Dec.	2456359	43618	79559	1407	7.76	8.34
Total	31073840	512444	85122	1405.5	100.00	100.00

The live birth data from United States Registration records of single years, 1917 and 1922, chosen at random were used to plot curves for those years but, since the lines were similar to the lines previously described, they were not included in this paper. Considering all these data, we conclude that any sizable quantity of live births taken from any year or number of years, gives curves which show similar seasonal waves.

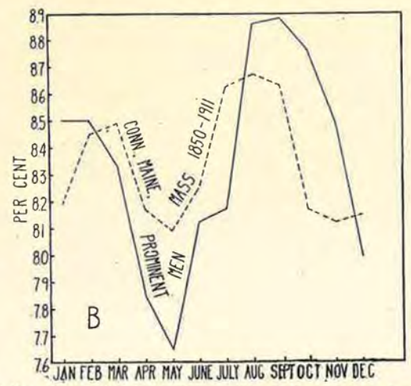
Table II shows data of prominent men recorded from American Men of Science (1933) and Who's Who in America (1934–35) and available live birth data from Connecticut, Maine and Massachusetts Registration reports (1850–1911).

TABLE II

DATA OF BIRTHS OF PROMINENT MEN AS RECORDED FROM AMERICAN MEN OF SCIENCE (1933) AND WHO'S WHO (1934–35) COMBINED, AND LIVE BIRTH DATA FROM CONNECTICUT, MAINE, AND MASSACHUSETTS REGISTRATION REPORTS (1850–1911)

	Month		Daily Average		Percent	
	Prominent Men	States	Prominent Men	States	Prominent Men	States
Jan.	3480	191382	112.3	6173.6	8.50	8.19
Feb.	3170	179796	112.3	6364.5	8.50	8.45
Mar.	3413	198328	110.1	6397.7	8.33	8.49
Apr.	3112	184832	103.7	6161.1	7.85	8.17
May	3133	188694	101.1	6086.9	7.65	8.09
June	3218	186580	107.3	6219.3	8.12	8.25
July	3338	201311	107.7	6493.9	8.15	8.62
Aug.	3627	202620	117.0	6536.1	8.86	8.67
Sept.	3519	195248	117.3	6508.3	8.88	8.63
Oct.	3556	190970	114.7	6160.3	8.68	8.17
Nov.	3366	183811	112.2	6127.0	8.49	8.12
Dec.	3273	190523	105.6	6145.9	7.99	8.15
Total	40205	2296117	110.2	6281.2	100.00	100.00

From these data Figure I B was plotted. The solid line shows the seasonal wave of the birthdays of prominent men while the broken line shows the same for all available live birth data of the period 1850–1911. In comparing these curves it is particularly noticeable that during the first half of the year starting with March and ending in July the curve for daily births of prominent men is considerably lower than the registered live birth curve, while in the last half of the year the opposite is true. From this graph it seems evident that a higher percentage of prominent men is born in the fall of the year than in the spring.



B. The solid line shows the same for combined data taken from American Men of Science (1933) and Who's Who in America (1934–35). The broken line shows, similarly, data of contemporaneous births from three State Birth Registration reports, 1850–1911.

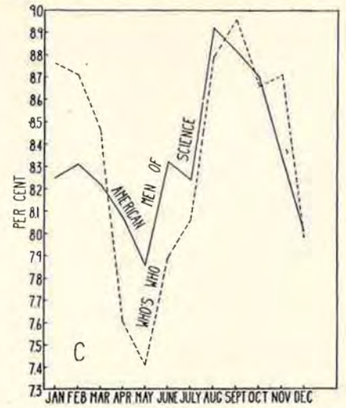
In order to determine whether the data are significant, the Chi square method was used. By this procedure it was found that differences in

TABLE III

STUDY OF BIRTHS RECORDED FROM AMERICAN MEN OF SCIENCE (1933) AND 18,817 LISTED CONSECUTIVELY FROM WHO'S WHO FOR (1934–35)

	American Men of Science			Who's Who		
Month	Total	Daily Average	Percent	Total	Average Daily	Percent
Jan.	1801	58.10	8.25	1679	54.16	8.76
Feb.	1649	58.37	8.31	1521	53.84	8.71
Mar.	1791	57.77	8.22	1622	52.32	8.46
Apr.	1700	56.57	8.07	1412	47.07	7.61
May	1712	55.23	7.86	1421	45.84	7.41
June	1754	58.47	8.32	1464	48.80	7.89
July	1794	57.87	8.24	1544	49.81	8.06
Aug.	1942	62.64	8.92	1685	54.36	8.79
Sept.	1856	61.87	8.81	1663	55.43	8.96
Oct.	1896	61.16	8.70	1660	53.55	8.66
Nov.	1747	58.23	8.29	1617	63.90	8.71
Dec.	1744	56.26	8.01	1529	49.32	7.98
Totals	21386	58.55	100.00	18817	51.55	100.00

curves such as occur in Figure I B could happen by chance once in many thousand trials. The possibility of choice birth grouping might arise when considering these results. For this reason we plotted American Men of Science and Who's Who birth data separately. The basic data necessary to show that the curves for American Men of Science and Who's Who are similar are contained in Table III and the graphic presentation is found in Figure I C. The single curves vary a good



C. Similarly treated data of births as obtained from American Men of Science (1933)—solid line, and Who's Who (1934–35)—broken line.

deal from each other when compared with the live births of the same period. Who's Who births, if plotted alone against ordinary births of the same period, show most strikingly the higher percentage of prominent individuals born in the fall months and the lower percentage in the spring months. Each curve alone, however, compared with the live births of the same period shows differences similar to the combined data curve for prominent men.

The data presented in this preliminary study are subject to certain defects. No complete study was made of the birth places of prominent men of certain periods and compared with the live births in the same locality during that same period. Information is scarce on live births for months of years before 1900. Since, however, the curve of live births from the three States appears typical for the years 1850 to 1911, it is interesting to note the marked difference between the results obtained from random samples of birth months of prominent men and live birth

statistics. Some reason should be suggested for the lower percentage of prominent men in the spring months and the higher percentage in the fall months. At this time, the causes of differential mortality are suggested as a reason. The season for epidemics is the winter and spring months. The child born in the spring months loses the vitamins and antitoxins received passively from the mother before winter begins. In the days before the newer knowledge of nutrition, the child was placed at a considerable hazard if he was born in the spring months and had to endure the winter without fresh vegetables, sufficient sunlight and the prophylactics against diseases. There is no doubt that those children were placed under a considerable physical handicap. Whether it affected their chances for prominency is not definitely proved. Fifty years hence, if United States Birth Registration records are continuous, there will be sufficient data to check the relationship of month of birth and prominence. Whatever the explanation may be, now or then, it is of interest to note that there is a significant difference between the birth months of present day prominent men and contemporaneous live births in the spring and fall months of the year.

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STRUCTURAL GEOLOGY OF THE NEW BLOOMFIELD QUADRANGLE, PENNSYLVANIA[1]

By Arthur B. Cleaves
Lafayette College, Easton

INTRODUCTION

The area covered by the New Bloomfield quadrangle, which is mostly in Perry County, just west of Harrisburg, includes strata from Ordovician through the Mississippian. It is characterized by easterly plunging anticlines and synclines, and thrust faults. The region may be divided into three structural units (Fig. 1, Sec. C–D) : a narrow northern syncline, a central anticlinal region in which steep dips, minor folds, and thrust faults are common, and a broad southern syncline.

The writer gratefully acknowledges the assistance rendered him in the field and laboratory by Dr. Bradford Willard of the Pennsylvania

[1] This paper is a part of a thesis submitted to the Division of Geological Sciences, Harvard University, in 1933, as partial fulfillment of the requirements for the Ph.D. degree.

Topographic and Geologic Survey, and Professor Marland Billings of Harvard University. He also appreciates the work of Professor Harry Itter of Lafayette College in drafting the block diagram of the New Bloomfield area.

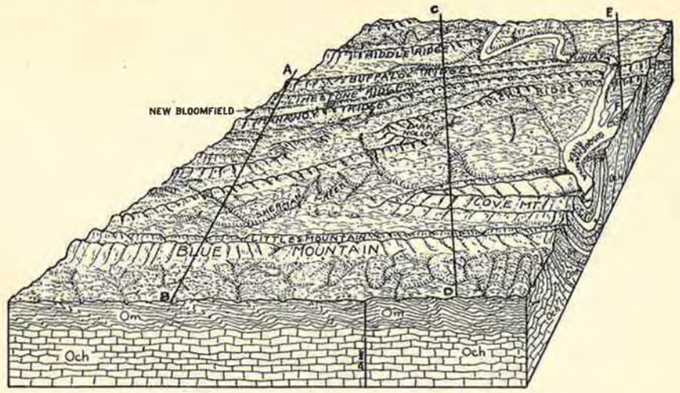


FIG. 1. Block Diagram of New Bloomfield Area, Pennsylvania.

NORTHERN SYNCLINE

The structure of the northern syncline is relatively simple. It is nearly symmetrical, the limbs dipping about 30°. It plunges gently northeast. The central part of the structure is occupied by red and green Chemung and Catskill shales and sandstones, whereas the northern and southern limbs are formed by Portage and Hamilton strata. The latter find topographic expression in the form of ridges. Some crumpling of the red beds is observed in the central part of the syncline and small drag folds have been seen on the limbs.

CENTRAL ANTICLINAL REGION

The central structural unit of the region is the most complex of the three. The special features within it to be discussed are: (1) a northern syncline, overturned toward the south in the western part of the area and broken by south-dipping thrust faults in the east (Fig. 2, Sec. A–B); (2) a southern anticline bounded on the north by a southerly-dipping thrust fault; and (3) two smaller anticlines in the west-central portion of the area. Minor folding and faulting are common on these more important structures.

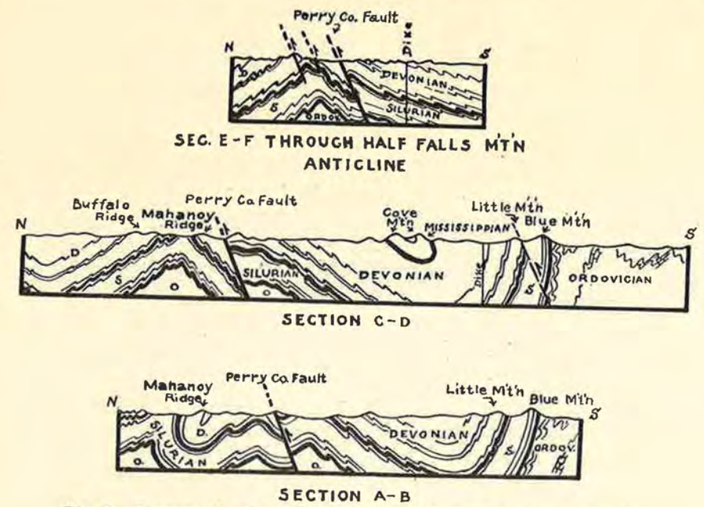


FIG. 2. Structure Sections, New Bloomfield Quadrangle, Pennsylvania.

The northern anticline strikes about northeast by east. The more resistant beds in the northern limb are Hamilton sandstones which hold up Buffalo and Hickory Ridges. In the western part of the area the strata of this limb dip about 30° north, but at the eastern end, just north of Half Falls Mountain (end of Dicks Ridge), the beds assume a high angle. The southern limb, in which the ridge-forming beds are also Hamilton sandstone (Mahanoy Ridge), is overturned just south and west of the town of New Bloomfield. The dip where measured is 80° north. This overturning of an anticline toward the south is not common in this part of the Appalachian province. This phenomenon is believed due to underthrusting from the southeast.

To the east, the southern limb of this anticline assumes a southerly dip which becomes less and less steep the farther east one goes until the nose of the anticline is reached where it is oversteepened.

The anticline, as a whole, suffered crumpling in the core and shows drag folds on the limbs. The crumpling is particularly obvious in the north limb where beds of the brittle Oriskany formation are caught and sharply bent into several small synclines. So strong was the buckling of beds in this region that even the massive sandstone layers of the Skaneateles formation in the Hamilton could not resist the pressure and

consequently were bent into a small syncline between Juniata Furnace and Buffalo Ridge.

Minor folding and faulting is frequently observed in the Helderberg and Tonoloway limestones in this anticline, and even the Bloomsburg red beds in the core of the structure show these features.

The same tendency of the beds to buckle and fold was observed on the eastern end of the anticline at Half Falls Mountain. Residual stress remaining after minor folding caused the steeply dipping beds in the nose of this large fold to break, developing two small thrusts which dip steeply to the south. These thrusts are local, and neither has a very great throw (see Fig. 2, Sec. E–F). The throw of the more northerly one is estimated to be about 500 feet and that on the south slightly less.

Two small anticlines were developed in the western part of the area between Mahanoy Ridge (the overturned limb of the northern anticline), and the Perry County fault,[2] which limits the southern anticline on the north. These two small anticlines plunge to the east and their north and south dips show them to be roughly symmetrical (see Fig. 2, sec. A–B).

The southern anticline is only partially represented, the Perry County fault limiting it on the north (figure 2, sec. A–B). In the central and eastern parts of the area the fault is at or very near the crest of the anticline, but in the western part it is developed on the north limb. Erosion of the anticline in the latter region has exposed older beds, which are rather strongly crumpled. As in the northern anticline at New Bloomfield, Tonoloway, Helderberg, and Oriskany beds are thrown into very sharp folds. Probably the compressive forces from the southeast were partially compensated for a time in this region by the crumpling of the beds, but finally the pressure became too great and a strong thrust fault was developed. In the western part of the area Helderberg beds were brought into contact with Upper Hamilton beds, the throw being about 1,700 feet. The greatest throw occurred in the central part of the area, near Roddy (at the foot of the north slope of Dicks Ridge), where Helderberg is brought into contact with Lower Chemung. Here the total throw is estimated to be about 3,500 feet. In the eastern part of the area the southern anticline has been thrust onto the northern one so that the Hamilton beds of the southern anticline are brought into contact with strata of similar age on the south limb of the northern anticline. The actual amount of the throw there is not known, but it is judged to be about 1,000 feet.

[2] Named by E. W. Claypole, Pa. Second Geol. Surv., Vol. F2, 1885.

The evidence in this area indicates that the fault dies out rapidly to the east and west. As a result of an examination of the structure in the regions immediately east and west of the New Bloomfield quadrangle, the total length of the Perry County fault is thought to be about 20 miles.

A rather sharp, deep fold was developed in this southern limb of the anticline at Dark Hollow, in Dicks Ridge. Apparently this secondary structure was local, because its presence does not affect the mapping of the Portage-Chemung contact to the south.

Southern Syncline

The chief characteristic of this great syncline is its asymmetry. The northern limb dips 45° south, although drag folds in the Portage and Chemung beds tend to obscure the general dip. Some crumpling of the Mauch Chunk red beds occurs in the central part of the syncline. In the southern limb the beds are almost vertical, dipping about 80° north at Sterrett Gap and overturned east of Lambs Gap. In the extreme western part of the area the syncline becomes almost symmetrical, both limbs dipping about 50°. The overturning of the southern limb on its eastern end is best shown at Susquehanna Gap where all the beds dip about 80° south.

An important thrust fault in the southern syncline occurs in the steeply dipping beds between Little and Blue Mountains. The fault dips steeply to the south. It begins just north of Sterrett Gap and the throw grows greater as the Tonoloway, Helderberg, Oriskany, and Onondaga formations are progessively cut out to the east. It may be that the Helderberg, Oriskany, and Onondaga formations were not faulted out, but were lost during a period of erosion when this part of the area was locally uplifted. This theory is noted by Willard.[3]

In the eastern part of the region the Bloomsburg red beds are in contact with the Hamilton group and the total throw is estimated to be about 1000 feet. It is believed that the faulting accompanied the folding and increased in magnitude with the degree of overturning.

Age of the Folding

The strata of the New Bloomfield area were folded in late Pennsylvanian time or at the end of the Paleozoic, for Mississippian (and Pennsylvanian beds just east of the area) are involved in the orogeny. On the other hand, the mountain-making movements must have begun

[3] Willard, Bradford; Hamilton Group of Central Pennsylvania: Geol. Society of Amer., Bull., vol. 46 (1935), pp. 217–218.

at least in Pennsylvanian time, for high relief was obligatory to form such coarse conglomerates as are found in the Pottsville formation in Dauphin County, a few miles east of the New Bloomfield quadrangle. The great thickness of Upper Devonian (continental) red beds is also indicative of uplift to the east and southeast. Although not a large amount of coarse material is contained in these red beds their great thickness indicates that the "pulse" of the ensuing orogeny was beginning to be felt. Perhaps the highlands from which this material was derived were a long distance away; at least it seems logical to assume that the compressive forces of the Appalachian Revolution had begun to exert themselves in the late Devonian. This is also indicated by the large amount of coarse material found in the Pocono formation, which is Mississippian, and immediately overlies the Upper Devonian red beds. With the continuance or renewal of the compressive forces, the strata of the New Bloomfield area became intensely folded. The faulting is believed to have accompanied the folding.

TRIPLE CHICK EMBRYO

By Jerome H. Kantor
Bucknell University

In opening 70 to 80 dozen incubated eggs annually at the zoölogical laboratory of Bucknell University, we find one or two cases of double chick embryos. In 1935 a triple chick embryo was found. This is the only record known to us.

The embryo consists essentially of two bodies, each with its own head, separate from each other in every detail. In addition, however, we have the added embryo, having its own head, with its anterior part of the body separate, but sharing the single posterior part with the left embryo.

The embryos together could be placed on a dime, with a little room to spare. They are calculated to be between 30 and 35 hours old, reckoned from beginning of incubation to the time when opened.

This case, then, may be characterized as a double embryonic invagination with a subsequent fission or splitting of one of the embryos, in the head region. To use the words of Dr. H. H. Newman, noted authority on twinning, who has examined the slide, it is a case of "double gastrulation followed by the anterior fission of one of the twin embryos."

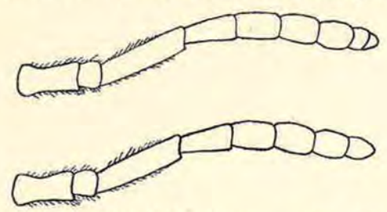
ANTENNAL SEGMENTS OF *TENTHREDO* (*LABIDIA*) *OPIMUS OPIMUS* (CRESSON) WITH A SYNOPSIS OF LABIDIA (TENTHREDINIDAE: HYMENOPTERA)

By Homer C. Will
Juniata College

The name Labidia was used by Provancher in 1886 for the western sawfly, *Tenthredo* (*Labidia*) *opimus opimus* (Cresson). Rohwer (1912) designated *Labidia* as a subgenus of *Tenthredo*. The structural characters responsible for this designation were the number of antennal segments and the petiolate anal cell of the hind wings. Segments of the antennae numbered seven or eight in *Labidia* and nine in *Tenthredo*.

I find difficulty in separating *Labidia* from *Tenthredo*. Antennae with eight or nine segments are more common than antennae with seven or eight segments. In August, 1932, the late Dr. William D. McIlroy, Jr., of the Carnegie Museum, Pittsburgh, and I collected a species of *Labidia* at Chinook Pass, Washington. These sawflies have antennae with eight or nine segments. The past summer Mr. Jack Myers of Montana State College, Bozeman, Montana, collected some sawflies in the Gallatin National Forest, located at the very northwest tip of Yellowstone Park, and sent them to me for identification. I found a species of *Labidia* in the group. This sawfly was *Tenthredo* (*Labidia*) *opimus opimus* (Cresson) according to present nomenclature.

The question of antennal segmentation occurred with *opimus*. Specimens with eight and nine antennal segments were about equal in number. Of all the *Labidia* which I have examined to the present, more than



Antenna of *Tenthredo* (*Lobidia*) *opimus opimus* (Cresson)

50 per cent had antennae similar to those of *Tenthredo*. These observations suggested the possibility of *Labidia* as a variant of *Tenthredo*. Certainly, antennal segmentation was not definite enough to permit the separation of the two groups.

Mr. Myers furnished me with the following data relating to *opimus:* The specimens were collected at Eldridge, Montana, on the route of the northwest entrance to Yellowstone Park. They were taken in the latter part of July in canyons called Specimen Creek and Buffalo Horn. The altitude was approximately 7,200 feet. The insects were found on plants belonging to the Umbelliferae.

SYNOPSIS OF *LABIDIA*

Genus TENTHREDO Linnaeus

Subgenus *Labidia* Provancher

Labidia Provancher, Addit. Faune Can. Hym., 1886, p. 21.
Tenthredo (*Labidia*) Rohwer, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 222.

Tenthredo (*Labidia*) *alienatus* Rohwer

Tenthredo (*Labidia*) *alienatus* Rohwer, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 224.

Tenthredo (*Labidia*) *anomocerus* Rohwer

Tenthredo (*Labidia*) *anomocerus* Rohwer, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 223.

Tenthredo (*Labidia*) *anomus* Rohwer

Tenthredo (*Labidia*) *anomus* Rohwer, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 225.

Tenthredo (*Labidia*) *opimus coloradensis* Rohwer

Tenthredo (*Labidia*) *opimus coloradensis* Rohwer, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 224.

Tenthredo (*Labidia*) *opimus opimus* (Cresson)

Allantus opimus Cresson, Trans. Amer. Ent. Soc., Vol. 8, 1880, p. 15.
Labidia columbiana Provancher, Addit. fauna Can. Hym., 1886, p. 21.
Labidia opimus (Cresson), Dalla Torre, Cat. Hym., Vol. 1, 1894, p. 83.
Allantus opimus Cresson, Konow, Genera Insectorum, Fascicule 29, 1905, p. 135.
Tenthredo (*Labidia*) *opimus opimus* (Cresson), Rohwer, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 224.

Tenthredo (*Labidia*) *originalis* (Norton)

Allantus originalis Norton, Trans. Amer. Ent. Soc., Vol. 1, 1867, p. 261.
Labidia originalis (Norton), Dalla Torre, Cat. Hym., Vol. 1, 1894, p. 83.
Allantus originalis Norton, Konow, Genera Insectorum, Fascicule 29, 1905, p. 135.
Tenthredo (*Labidia*) *originalis* (Norton), Rohwer, Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 224.
Labidia originalis (Norton), MacGillivray, Hym. Conn. Sur., Bull. No. 22, 1916, p. 92.

Tenthredo (*Labidia*) *subnigriceps* (Rohwer)

Allantus subnigriceps Rohwer, Can. Ent., Vol. 41, 1909, p. 148.
Tenthredo (*Labidia*) *subnigriceps* (Rohwer), Proc. U. S. Nat. Mus., Vol. 43, 1912, p. 224.

OCCURRENCE OF COLONIES OF THE GIANT SAND WASP *SPHECIUS SPECIOSUS* (DRURY) (SPECIDAE: HYMENOPTERA)

By Homer C. Will
Juniata College

There are few references in recent entomological literature which are concerned with the colonies of the Giant Sand Wasp. Records dealing with persistent colonies are still more difficult to find. The writer had the opportunity this past summer to study a colony which has continued in the same locality for five years. Observations and data relating to this colony are summarized in this paper.

On July 23, 1934, Mr. John C. Fox, an engineer at Narrows, Virginia, brought to the Mt. Lake Biological Station of the University of Virginia a box of insects for identification. The insects were collected in the yards of the electric substation of the Virginia Railway Co. at Narrows, Va. The writer identified the insects as specimens of the Giant Sand Wasp *Sphecius speciosus* (Drury).

Mr. Fox stated that the wasps were first noticed five years ago at the electric plant. Since that time the numbers have steadily increased each succeeding year until they have attained epidemic proportions. Although the activities of the wasps have caused no material loss as yet, the resident engineers fear that continued increase will lead to damage to the underground conduit ducts. In addition, the wasps were proving to be a source of much annoyance to the personnel of the station.

The writer visited the substation a week later and found the situation substantially as described by Mr. Fox. The electric plant is located on the banks of New River, about 100 yards from the water and at a slight elevation. The soil is loose and sandy and comparatively dry. The burrows were found scattered through the yards of the plant and in the adjacent fields. The wasps were flying back and forth in considerable numbers and reproductive activity was observable. There were few large trees nearby to aid the insect in bringing Cicadas to the burrows as has been described by Fuller and others.

An examination of the nests revealed a considerable mound of dirt, usually about a foot in diameter, placed loosely about the entrance. In many cases the mound was in front of the underground opening. In other cases there was a trail through the dump heap. An excavation of a number of the nests disclosed an underground passage about a foot long. This tunnel was enlarged at the terminus. In some of these cells a single Cicada was found, others were empty. Although there had been

an extremely heavy rain the night before, the burrows seemed comparatively dry.

The officials of the substation were quite anxious to know just how the wasp might be controlled. The otherwise immaculate yard around the building was marred by many mounds of fresh dirt. An effort was being made to flatten out these mounds but evidently it was not too successful. The writer noted that a collection of old tennis rackets was kept in the building and whenever an official emerged he was armed with a racket to strike the wasps.

The habits of the wasp and occurrence of colonies have been described by others. This occurrence seems worth reporting because of the long duration of the settlement at one place and the extremely large number of individuals composing the colony. An entomologist interested in the study of this species might easily have collected hundreds of specimens in a few hours this past summer within an area of a few hundred square feet.

THE POLEMONIACEAE OF PENNSYLVANIA[1]

By Edgar T. Wherry

Associate Professor of Botany, University of Pennsylvania

Ten members of the plant family *Polemoniaceae* are known to grow within the limits of this State. They may be differentiated by the following key:

Key to Polemoniaceae of Pennsylvania

Leaves pinnate; corolla campanulate; stamens declined or decumbent ..... Polemonium.
- Plant 75 to 125 cm. tall; inflorescence a thyrsoid panicle; blooming-period summer; corolla deep violet; stamens declined, subparallel, somewhat exceeding the petals; anthers deep yellow ..... *P. vanbruntiae.*
- Plant 25 to 75 cm. tall; inflorescence a lax panicle; blooming-period spring; corolla light violet; stamens irregularly decumbent, somewhat shorter than the petals; anthers cream-color ..... *P. reptans.*

Leaves simple and entire or essentially so; corolla salverform; stamens erect.
- Duration annual; flowers minute, whitish, in a dense cluster ..... Collomia.
  - – – A single species, *C. linearis*, introduced from the west. – – –
- Duration perennial; flowers large, purple or violet, white only in mutants, in a more or less open cyme or panicle ..... Phlox.
  - Stems woody, decumbent; leaves crowded, persistent; inflorescence a few-flowered cyme; pedicels elongate ..... *P. subulata.*
  - Stems herbaceous, decumbent or erect; leaves more or less remote, deciduous or sparingly persistent; inflorescence few or many-flowered; pedicels short.

[1] Contribution from the Botanical Laboratory and Morris Arboretum of the University of Pennsylvania.

Sepals mostly less than half united, conspicuously awn-tipped; stamens and style much shorter than the corolla-tube.
- Sterile shoots becoming decumbent, often rooting at nodes; leaves relatively broad; inflorescence lax; corolla-tube glabrous ..... *P. divaricata.*
- Sterile shoots erect, not rooting at nodes; leaves relatively narrow; inflorescence rather compact; corolla-tube pubescent ..... *P. pilosa.*

Sepals mostly more than half united, obscurely awn-tipped; stamens and style nearly or quite equalling the corolla-tube.
- Leaf-margins roughish or ciliate with soft hairs, the lateral veins obscure.
  - Prostrate stems well-developed, rooting at nodes; lower leaves spatulate, many of them persistent ..... *P. stolonifera.*
  - Prostrate stems poorly developed; lower leaves never typically spatulate, sparingly if at all persistent.
    - Flowering shoots mostly arising from the tip of a decumbent stem; nodes few; leaves elliptic to ovate; calyx averaging 10 mm. long ..... *P. ovata.*
    - Flowering shoots mostly arising from a rootstock; nodes numerous; leaves linear to ovate-lanceolate; calyx averaging 7 mm. long ..... *P. maculata.*
- Leaf-margins ciliate-serrulate with stiff bristles, the lateral veins prominent, acrolate ..... *P. paniculata.*

These species will now be discussed individually, with lists of counties from which specimens are preserved in the herbaria seen. Should any one know of additional occurrences of any of them, I will appreciate receiving data or specimens, in order to add to our information as to the range within the State.

Polemonium vanbruntiae Britton (spelling emended).—This north-Appalachian species grows in cool, swampy places, chiefly at high elevations. Its range in the State is peculiarly disrupted; it apparently survived glaciation in an area extending from Pocahontas County, West Virginia, across westernmost Maryland into Somerset County, Pa., two large colonies being known in the latter. Another extra-glacial occurrence lay 175 miles northeastward in a brook swamp near Lobachsville, Berks County, but was recently annihilated by changes in the stream course. When the Wisconsin ice sheet melted away about 25,000 years ago, swamps soon developed in the glaciated territory, and this *Polemonium* early invaded them. Colonies developed in Sullivan and Susquehanna counties in this State, and from there the species spread across eastern New York as far as the western border of New Hampshire.

Polemonium reptans Linné.—The distribution of this plant suggests that it survived Tertiary and Quaternary geological events in the Ozark and Interior Plateau regions, and migrated into Pennsylvania from the southwest. Being able to thrive under a great variety of environmental conditions—on moist circumneutral alluvial flats, in fertile loam over

limestone, in sterile, more or less acid clays, in acid litter of upland oak woods, and even around the margins of sphagnum bogs—it has spread nearly throughout the State, except on the higher plateaus and toward the northeast corner. Specimens are preserved in herbaria from the following counties: Allegheny, Butler, Lawrence, Crawford, Erie; Armstrong, Clarion, Elk, McKean, Potter; Somerset, Cambria, Bedford, Huntingdon; Franklin, Cumberland, Lycoming, Bradford; York, Lancaster, Berks, Luzerne; Chester, Delaware, Philadelphia, Montgomery, and Bucks. It also extends north into central New York.

As early as 1740 John Bartram sent roots of this plant to Peter Collinson in England, and he distributed it to other horticulturalists of the time. In the 1750's a painting of it was made for the series of illustrations of plants in Miller's Gardeners Dictionary, and when Linné founded the species in 1759 he cited this plate.

Collomia linearis Nuttall. (Mistakenly referred to the genus *Gilia* by Gray.)—A western mountain plant which has become a weed in fields and waste places over a wide area, and occasionally appears in the Eastern States. There are two records for Pennsylvania, Hartstown, Crawford Co., and Angora, Philadelphia Co.

Phlox subulata Linné.—Since three geographic varieties mingle and intergrade in the West Virginia mountains, that region is regarded as the refuge of the species during the geological changes of Tertiary time. Variety *ciliata* (Brand) Wherry has subsequently migrated northeastward across Pennsylvania, becoming locally abundant, especially on sand and serpentine barrens. It often escapes from cultivation, but is believed to be native at one or more stations in 35 counties: Beaver, Butler; Allegheny, Westmoreland, Indiana; Somerset, Huntingdon, Centre, Lycoming, Tioga, Bradford; Franklin, Adams, Cumberland, Perry, Juniata, Union, Northumberland, Montour, Columbia, Luzerne, Wyoming, Lackawanna; Lancaster, Lebanon, Berks, Lehigh, Northampton, Carbon, Monroe, Pike; Chester, Delaware, Montgomery, and Bucks. Continuing northeast, it extends to New Jersey and southern New York.

Although in describing this species Linné stated it to have come from "Virginia," the type specimen bears the letter K, signifying it to have been collected by Kalm, who would have obtained it in eastern Pennsylvania or adjacent New Jersey. Its type locality is accordingly to be ascribed to one of these States. A photograph showing its remarkable abundance on a Pennsylvania serpentine barren is reproduced in fig. 1.

Phlox divaricata Linné.—This Phlox centers in the Interior Plateau region, but has migrated eastward across Pennsylvania, having been observed in 31 counties: Beaver, Lawrence, Mercer, Crawford, Erie; Washington, Allegheny, Butler, Venango; Fayette, Westmoreland, Indiana, Jefferson, McKean; Cambria, Clearfield; Blair, Huntingdon, Mifflin,

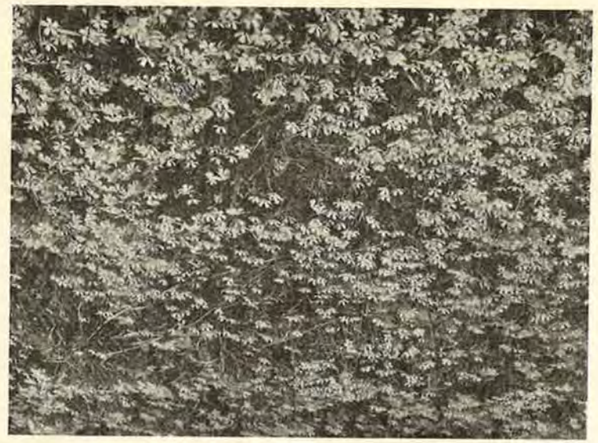


FIG. 1. *Phlox subulata ciliata* on serpentine barren northeast of Unionville, Chester County, possibly its type locality.

FIG. 2. *Phlox divaricata canadensis* along the Susquehanna River in Lancaster County, the region where first collected by Bartram.

Centre, Clinton, Lycoming, Bradford; Cumberland, Perry, Dauphin, Luzerne; York, Lancaster, Chester, and as an escape in Delaware. It also ranges northeastward along the Great Lakes and St. Lawrence valley to northwestern Vermont. The variety here is *Canadensis* (Sweet) Wherry.

The specimen on which this species was founded by Linné was growing in the garden at Upsala, Sweden, and its original source is uncertain; however, John Bartram had sent living material to Collinson in 1739, having obtained this along the Susquehanna River, presumably in Lancaster County. Since there is a strong probability that Collinson shared his plants with the other gardens of the time, the type locality may perhaps be taken as this county. Fig. 2 shows how it appears there at the present day.

Phlox pilosa Linné.—An Ozarkian species with many varieties, one of which, var. *virens* (Michaux) Wherry, pushes northeastward along narrow strips of territory and locally enters Pennsylvania. It follows the Ohio Valley, and has been once collected in Beaver Co., Pa., but is no longer known there. A second route of migration, along the flanks of the Blue Ridge, has brought it into Franklin and Adams counties. Conditions in the Piedmont and adjacent uplands seem to be somewhat more favorable to its growth, and it has developed colonies in Lancaster, Chester, Delaware, Montgomery, Bucks, Lehigh, and Northampton counties. Beyond this it occurs in a few New Jersey counties, and reaches its northeastern limit in western Connecticut.

Phlox stolonifera Sims.—This is a southern Appalachian plant attaining its maximum development in West Virginia. It follows the mountain valleys northeastward, reaching the northern and eastern limits of its range within Pennsylvania. One route takes it across Fayette, Westmoreland, Armstrong, Jefferson, and Elk to southern McKean; another, Somerset, Cambria, Blair, Huntingdon, Clearfield, and Centre. A single specimen is preserved from northern Lancaster County, a remarkable eastward range-extension, but the exact locality is lost.

Phlox ovata Linné.—The geographic relations of this Phlox are much like those of the next-preceding one, except that its maximum development occurs somewhat further south, and it does not range so far north or west in Pennsylvania. The seven county records comprise: Franklin, Huntingdon, Centre, Mifflin, Snyder, York, and Berks. The last represents a notable eastern extension into the Reading Hills prong of the New England Upland physiographic province.

Phlox maculata Linné.—Two varieties of this west-Appalachian species can be separated. The more northern of these, var. *odorata* (Sweet) Wherry, enters Pennsylvania from the west, and has spread

nearly throughout the State, while the more southern one, var. *pyramidalis* (Smith) Wherry, barely enters the southeast corner. At least 34 county records are at hand: Beaver, Lawrence, Mercer, Crawford; Allegheny, Butler; Fayette, Westmoreland, Clearfield, Cameron, McKean; Somerset, Bedford, Blair; Huntingdon, Centre, Bradford; Franklin, Cumberland, Perry, Montour, Columbia, Luzerne, Lackawanna; York, Lancaster, Berks, Lehigh, Northampton; Chester, Delaware, Philadelphia, Montgomery, and Bucks. Variety *odorata* blooms chiefly in May and June, variety *pyramidalis* a month or two later. The latter is thus far known only along the tributaries of Susquehanna River in Lancaster and rarely Chester counties. The northern variety is also abundant in New Jersey, where the type specimen was collected by Kalm, and ranges sparingly still farther northeast to Connecticut and southern Quebec.

Phlox paniculata Linné.—The native ancestor of our common perennial garden Phlox ranges widely over the Interior Plateaus, but has migrated northeastward along river valleys into Pennsylvania and locally western New York. In addition, it frequently escapes from cultivation, and is often found thus introduced in the eastern parts of these States. Presumably native occurrences have been observed in 20 counties: Beaver, Lawrence, Crawford; Greene, Washington, Allegheny, Butler; Fayette, Westmoreland, Armstrong; Somerset, Bedford, Huntingdon; Franklin; Dauphin, Schuylkill, Columbia, Luzerne; York and Lancaster.

Four of the species native to the State are to be classed geographically, then, as Appalachian plants, in that they seem to have survived the geological changes of Tertiary and Quaternary times in the Appalachians in what is now West Virginia, Virginia, or North Carolina. The other five are, correspondingly, Midland plants, their survival areas having apparently been in the Ozark or Interior Low Plateaus. In all cases they have entered Pennsylvania from the southwest, and migrated in a general northeastward direction. Two have not been able to invade the glaciated territory, and have not gone beyond our borders, but the remainder have pushed on into States lying farther north and east. It will be interesting to study other groups of plants in like manner, and see if their behaviors are similar.

SECOND ANNUAL MEETING
PENNSYLVANIA JUNIOR ACADEMY OF SCIENCE

Dickinson College, Carlisle, Pa.

April 19–20, 1935

PROGRAM

Saturday 9:00–11:30—Junior Section reading of papers

1. Electronic Discharges
   T. R. Witman & R. C. Fair, Reading Sr. H. S.
2. Microphotography
   George R. Rumor, Reading Sr. H. S.
3. A Rocket Trip to the Moon (Motion Pictures)
   Astronomy Club, Taylor Allderdice H. S.
4. Radio Transmitting Set
   Wm. Nagle and Thomas Luerssen, Muhlenberg Township High School.
5. Cutting and Polishing Stones from Natural Minerals
   Charles Hisler, Upper Darby Sr. H. S.
6. Chemistry in Photography
   Warren Slater, Reading H. S. Camera Club.
7. How to Take Pictures
   Ralph Angstadt, Reading H. S. Camera Club.
8. Works and Life of Madame Curie
   Dolores Boland, Altoona High School.
9. Experiments on Perpetual Motion
   Jack Garhardt, Altoona H. S.
10. Life in Fresh Water Pools
    Arthur Priestly, Altoona High School.
11. Florescence exhibit
    Steinmetz Scientific Society, Upper Darby H. S.
12. Photoelectric cell exhibit
    Steinmetz Scientific Society, Upper Darby H. S.
13. Micro-Projector
    Steinmetz Scientific Society, Upper Darby High School.

The second annual meeting of the Pennsylvania Junior Academy of Science was held in the Tome Science Building, Dickinson College, Carlisle, Pennsylvania, April 19–20, 1935.

The meeting was called to order by the president, Earl Thomas, of the Steinmetz Scientific Society, Upper Darby high school.

Dr. S. H. Derickson, President, Pennsylvania Academy of Science, extended a welcome to the Junior Section. Earl Thomas thanked him in behalf of the Junior Section.

The roll was then called and the following clubs were recorded present: Altoona High School Junior Academy of Science; Annville High School Science Club; Bellefonte High School Science Club; Collindale High School Science Club; Mount Union High School Biology Club; Muhlenberg Township High School Science Club; Astronomy Club, Taylor Allderdice High School, Pittsburgh; Punxsutawney High School Science Club; Camera Club, Reading Senior High School; Nature Club, Reading Senior High School; Reading High School Academy of Science; Steinmetz Scientific Society, Upper Darby High School. A total of 39 registered attendance.

President Thomas then appointed the following committees: *Financial,* H. C. Wimmer, Chairman; *Membership,* Mae W. Smith, Chairman; *Nominations,* Karl F. Oerlein, Chairman; *Publicity,* Walter E. Hess, Chairman; *Resolutions,* George Uibel, Chairman; *Charter and Pin,* R. C. Boyles, Chairman; Walter E. Hess, Karl F. Oerlein and the officers of the member clubs were included on a publicity and communications committee.

A plan for communication between the member clubs through the secretary and Publications Committee was adopted for next year.

The Charter and Pin Committee made its report and after a long discussion several designs were submitted for the approval of the members. Voting on the specific design was held over till the Saturday meeting.

The Nominations Committee suggested in the future the business be transacted during the last session of the program.

Several senior members presented papers. Mr. Charles E. Mohr, Reading Public Museum and Art Gallery, gave an interesting account of the Bats of Pennsylvania and his experience capturing them.

Dr. Edgar T. Wherry, University of Pennsylvania, spoke on the Phlox of Pennsylvania, tracing the history of all species known in Pennsylvania.

Dr. Arno Viehoever, Philadelphia College of Pharmacy and Science illustrated his work on the Toxic Effect of Strychnine on Daphnia, showing the possibilities for research with transparent animals.

The meeting was then recessed till 9:00 A. M. Saturday, April 20, so that the Junior Section might join the Senior Academy in the annual banquet and the lecture on Biological Studies of Human Parasites by Dr. William W. Cort, John Hopkins University.

The Saturday meeting was called to order and proceeded with the vote for the pin design. Pin No. 2 from the Arthur Schwemmer Co. with a retort as a guard was accepted, with a motion to let the Charter and Pin Committee determine the length of the contract.

The charter submitted by the committee was accepted with a few minor changes.

The Academy then accepted the following report of the Resolutions Committee:

1. That we extend our appreciation to Dickinson College and the Fraternities for their hospitality and kindness in furnishing room accommodations for the Junior Members of the Academy.

2. That we extend our appreciation and thanks to Dickinson College for the use of the science rooms and facilities.

3. That we thank the Senior Academy for its continued support and encouragement for the welfare of the Junior Academy of Science.

4. That we thank Mr. Charles E. Mohr for his discussion on the varieties of bats and their habits and especially for showing how to proceed with nature study.

5. That we thank Dr. Edgar T. Wherry for his interesting talk on Phlox, and for pointing out to us the importance of the study of the plant in relation to its environment.

6. That we thank Dr. Arno Viehoever for his interesting pictures on the Toxic Effects of Strychnine on Daphnia and for suggesting a new method of approach in scientific study.

7. That we thank all the Junior members of the Academy who have helped to make these meetings both interesting and profitable.

8. That the Junior members in attendance explain to their club members at home the value in attending and participating in the Academy programs.

The Financial Committee reported a total of twenty dollars paid in dues and bills of $5.55 leaving a balance of $14.45.

The Nominations Committee submitted the following ballot of officers for the coming year:

President: From Reading High School Academy of Science.

Vice-President: From Altoona High School Academy of Science.

Secretary: From Steinmetz Scientific Society, Upper Darby High School.

No other nominations were added so the secretary cast a ballot in the favor of the officers above.

The Publicity Committee suggested a more definite communication between clubs and working in local groups. Business connected with the report resulted in plans to notify the schools in the city in which the annual meeting is held. The Proceedings were also to be printed in the Senior Proceedings.

The Advisory Committee was increased to nine members. One of the four members to be Mr. Walter E. Hess.

Mr. H. C. Wimmer, President of the Pennsylvania State Teachers Association, invited the Junior Academy of Science to participate in the program of the Christmas meeting of the PSTA. Mr. Wimmer praised the demonstrations given at the 1935 meeting and asked if some of them might be repeated at the PSTA meeting.

Mr. Karl F. Oerlein reported the next annual meeting of the Pennsylvania Junior Academy of Science was tentatively planned to be held at Washington & Jefferson College.

Mr. Walter E. Hess then invited the Junior Academy members to attend geologic field trips to be held at Chambersburg, May 4, and at Stroudsburg, May 11, 1935.

There was no other business suggested and a regular adjournment closed the 1935 meeting of the Pennsylvania Junior Academy of Science.

Junior Academy of Science and officers of the Academy of Science at Dickinson College, Carlisle, April 19, 1935